CHAPTER 5

Learning

CHAPTER OUTLINE

Adaptation is adjustment to changes in the environment. The process of development, from birth to death, involves adapting to increasingly complex, ever-changing environments, using continuously updated knowledge and skills gained through experience. Learning is a relatively permanent change in behavior or knowledge due to experience. People learn by observing relationships or associations between events in the world.

I. CLASSICAL CONDITIONING: LEARNING SIGNALS AND ASSOCIATIONS

How did Russian dogs teach psychologists about learning?

A. Pavlov’s Discovery

1. In his now-classic experiment, Ivan Pavlov taught a dog to salivate at the sound of a bell.
   a) First, he noted that a dog normally salivated when meat powder was put on its tongue (unlearned reflex), but not in response to a tone (neutral stimulus).
      (1) A reflex is a swift, unlearned automatic response to a stimulus.
      (2) A neutral stimulus is one that initially does not elicit the reflex being studied.
   b) Second, he repeatedly paired a tone and the meat. Each time the tone was sounded, he put some meat powder on the dog’s tongue.
   c) Eventually, the dog salivated at the tone alone, even if no meat powder was given. The tone had come to predict the presentation of the meat powder.

2. Pavlov’s experiment demonstrated classical conditioning, in which a neutral stimulus is repeatedly paired with a stimulus that already triggers a reflexive response until the previously neutral stimulus alone provokes a similar response.
   a) The stimulus that naturally elicits a response without learning is the unconditioned stimulus (UCS). The automatic, unlearned response to this stimulus is the unconditioned response (UCR).
   b) The learned or conditioned stimulus (CS) begins as a neutral stimulus, but after pairing with the UCS it acquires the capacity to elicit the learned or conditioned response (CR).

B. Conditioned Responses over Time: Extinction and Spontaneous Recovery

1. As a CS and a UCS are repeatedly paired, a CR is gradually learned, or acquired.

2. Extinction is the result of eliminating the UCS and repeatedly presenting the CS alone. Eventually, the CS will no longer elicit the CR.

3. Reconditioning is the quick relearning of a CR after extinction. Because reconditioning takes much less time than the original conditioning, extinction must not have completely erased the association between the conditioned stimulus and the conditioned response.

4. Spontaneous recovery is the temporary reappearance of the CR after extinction but without further CS-UCS pairings. In general, the longer the time between extinction and the reappearance of the CS, the stronger the recovered CR.

C. Stimulus Generalization and Discrimination
1. **Stimulus generalization** occurs when stimuli similar to the CS also elicit the CR. The strongest CRs are elicited by stimuli that are most similar to the “original” CS.

2. **Stimulus discrimination** complements generalization. Through stimulus discrimination you learn to differentiate between similar stimuli.

D. The Signaling of Significant Events

1. Organisms acquire conditioned responses when one event reliably signals the appearance of another. Such learned associations help organisms develop mental representations of the relationships between events in their environment.

2. **Timing.** Classical conditioning works best when the CS precedes (predicts) the UCS. There is no single “best” interval for every situation. Classical conditioning will always be weaker if the interval between the CS and the UCS is longer than what is ideal for the stimuli and responses in a given situation.

3. **Predictability.** It is insufficient for a CS to merely come before the UCS. Classical conditioning proceeds most rapidly when the CS always signals the UCS, and only the UCS, in other words, when the CS reliably predicts the UCS.

4. **Intensity.** A CR is learned faster when the UCS is strong.

5. **Attention.** The stimulus that is most closely attended to and perceived is most likely to become a CS that later triggers a CR.

6. Some stimuli are more easily associated with each other, perhaps because organisms are genetically “tuned” for certain kinds of learning that may be helpful for survival.
   a) An example of such biopreparedness may be conditioned taste aversion. If you become ill after tasting a certain food, you may later develop a learned nausea from that same taste. Taste aversions demonstrate that classical conditioning can occur even when there is a considerable delay between the CS (taste) and UCS (nauseous sensations).

7. **Second-order conditioning** occurs when a CS acts like a UCS, creating additional conditioned stimuli out of events associated with it.
   a) For example, white coat hypertensives show a rise in blood pressure when they see medical personnel (the original CS) who wear white coats. The white coats have become a second-order or piggyback CS for fear, and blood pressure rises as part of a CR fear response.

E. Some Applications of Classical Conditioning

1. Intense, irrational fears of objects or situations are called phobias. Some phobias (e.g., dog phobia) may be classically conditioned. Dangerous situations can produce long-lasting classically conditioning fears.
   a) Phobias are often treated with systematic desensitization, a procedure that associates a new response, such as relaxation, with a feared stimulus.

2. In drug addiction, when people repeatedly use an addictive drug, their responses become weaker. **Habituation** is a simple form of learning in which there is reduced responsiveness to a repeated stimulus.

3. According to Solomon’s opponent-process theory, habituation occurs because an automatic, involuntary response to a stimulus (UCR) is followed by an opponent response that counteracts the UCR. This second opponent response can be learned or conditioned; it becomes a CR. As the UCS is repeated, the CR occurs more quickly and with greater intensity. As the CR more strongly counteracts the UCR the UCR gets smaller, resulting in habituation. This could be the basis for the development of drug tolerance and addiction.

II. INSTRUMENTAL AND OPERANT CONDITIONING: LEARNING THE CONSEQUENCES OF BEHAVIOR

*How do reward and punishment work?*
People learn associations between responses and the stimuli that follow—between behavior and its consequences.

A. From the Puzzle Box to the Skinner Box
1. Edward Thorndike’s law of effect states that, if a response made to a stimulus is followed by satisfaction, that response is more likely to occur the next time the stimulus is present. In contrast, responses that produce discomfort are less likely to be performed again. In instrumental conditioning responses are strengthened when they are instrumental in producing rewards.
2. B. F. Skinner emphasized that an organism learns a response by trying actions that operate on the environment. Operant conditioning refers to learning in which behavior is changed by its consequences—by rewards and punishments.
   a) Skinner devised the Skinner box to study conditioning.

B. Basic Components of Operant Conditioning
1. Operants and reinforcers
   a) An operant is a behavior that affects the world; it is a response that “operates” on the environment.
   b) A reinforcer “strengthens” a behavior—it increases the chances that the operant will be repeated.
      (1) Positive reinforcers strengthen a response if they are presented after that response occurs. Positive reinforcement is the presentation of a positive reinforcer after a response. Example: After a child cleans his room, his parent may give him ice cream. If the child likes ice cream, he should be more likely to clean his room again.
      (2) Negative reinforcers are the removed of unpleasant stimuli after the response occurs. Negative reinforcement is the removal of a negative reinforcer after a response. Example: One learns to take aspirin for a headache because taking aspirin is followed by removal of the pain.
2. Escape and avoidance conditioning
   a) Escape conditioning is a response that ends an aversive stimulus and should be strengthened by negative reinforcement. Example: You may have learned to “terminate” intense cold by turning up the heat or putting on more clothing.
   b) Avoidance conditioning is a response to a signal in a way that avoids an aversive stimulus before it arrives.
      (1) Avoidance conditioning is often a combination of classical and operant conditioning.
      (2) Avoidance is a difficult habit to break, because reduced fear reinforces avoidance responses. This prevents learning that avoidance may no longer be necessary or learning more adaptive behaviors for the situation. Example: A person who avoids escalators out of fear never gets a chance to find out that they are safe.
3. Discriminative stimuli and stimulus control
   a) Discriminative stimuli signal that reinforcement is available if a certain response is made. Stimulus discrimination occurs when an organism learns to make a particular response in the presence of one stimulus but not another. Under such conditions, the learned response is under stimulus control. Example: You may joke with your friends because you have learned that they will reward you with social praise for this. But you would not joke with a police officer who has stopped you for speeding. The two situations present different signals as to which behaviors are likely to be reinforced and which are not.
b) **Stimulus generalization** occurs when an organism makes a response in the presence of a stimulus that is similar, but not identical, to the one that previously signaled the availability of reinforcement. *Example:* A person reinforced with a cold drink for putting money into a Coke machine will probably produce the same response in the presence of a Pepsi machine.

c) Stimulus generalization and stimulus discrimination complement each other.

C. Forming and Strengthening Operant Behavior

1. **Shaping**

   Shaping is the process of reinforcing *successive approximations* of the target behavior.

   a) *Example:* If you want a hyperactive child to sit in his seat for ten minutes, you might shape this behavior by rewarding the child first just for sitting. Then you gradually set longer and longer times the child must remain sitting before he gets a reward. Eventually, the child will sit in his seat for ten minutes.

2. Secondary reinforcement

   a) **Primary reinforcers** are events or stimuli that satisfy needs basic to survival.

   b) **Secondary reinforcers** are previously neutral stimuli that take on reinforcing properties if paired with already-reinforcing stimuli. Thus secondary reinforcers may be thought of as learned or *conditioned reinforcers*. The most obvious secondary reinforcer is money, which is associated with what it can buy.

3. Delay and size of reinforcement

   a) Consequences of behaviors have more impact when they occur immediately. *Example:* Right after you clean up the kitchen, your roommate compliments you and buys you a pizza. This will affect your cleaning behavior more strongly than would a pizza a week later.

   b) Conditioning is faster when reinforcers are larger. *Example:* If your grandmother gave you $20 every time you hugged her, the hugging would become an established behavior faster than if she gave you $1 per hug.

4. Schedules of Reinforcement

   a) In a *continuous reinforcement schedule*, reinforcers follow every time the response occurs.

   b) In a *partial, or intermittent, reinforcement schedule*, reinforcement occurs only part of the time.

      (1) *Fixed-ratio (FR)* schedules provide reinforcement only after a fixed number of responses or behaviors. *Example:* In a factory, workers may be paid $1 for every five items produced.

      (2) *Variable-ratio (VR)* schedules give reinforcers after a certain number of responses, but number varies. *Example:* If you keep putting quarters into a slot machine until you win, sometimes it takes twenty quarters before a payoff, sometimes sixty, sometimes ten.

      (3) *Fixed-interval (FI)* schedules give reinforcement for the first response after a fixed time has elapsed since the last reinforcer. *Example:* Coming to work on Friday results in receiving a paycheck for work completed during the interval of a week.

      (4) *Variable-interval (VI)* schedules reinforce the first response after some period of time, but the amount of time varies unpredictably. *Example:* If a friend wants to reinforce your studying behavior on a VI schedule, she may come to your room and give you a chocolate if you are studying, after ten minutes, then after thirty minutes, then after eighteen minutes, and so on.

   c) Ratio-partial reinforcement schedules give the highest response rates, since reinforcement is still based on the number of responses. *Example:* Paying factory
workers on a piecework basis, tied to the number of items they produce, should yield a high rate of worker productivity.

d) In fixed-interval schedules, responding falls off just after a reinforcer, followed by ever-increasing responding as the predictable time for the next reinforcer nears.

5. Schedules and Extinction

a) Failure to reinforce a behavior should reduce its frequency and eventually extinguish it. Example: When a child throws temper tantrums she may be rewarded with parental attention. But when her parents stop paying attention to the tantrums, the tantrums may first intensify but will eventually stop.

b) The partial-reinforcement extinction effect describes the fact that behaviors learned under partial reinforcement are harder to extinguish than those learned with continuous reinforcement.

(1) In accidental reinforcement, a reinforcer following a behavior by chance may strengthen the behavior. This may explain learned superstitious behavior.

D. Why Reinforcers Work

1. Reinforcers may work by exerting particular effects on the brain. Particularly important are brain regions whose neurons use the neurotransmitter dopamine.

E. Punishment

1. **Punishment** decreases the frequency of a behavior by presenting an unpleasant stimulus or removing a pleasant stimulus (called a penalty) afterward. Note: Students often confuse negative reinforcement with punishment. Emphasize that the chances of a behavior are strengthened by negative reinforcement but are weakened by punishment.

2. Using punishment has many drawbacks.

   a) Punishment doesn’t “erase” an undesirable behavior; it merely suppresses it.

   b) Punishment can have unwanted side effects. The person may come to associate the punisher with the punishment and come to simply fear the punisher.

   c) Effective punishment must be given right after a response and must follow every response.

   d) Physical punishment can become aggression when given in anger, and people may imitate the aggressiveness of some forms of punishment.

   e) Punishment signals that inappropriate behavior has occurred but does not specify a correct alternative behavior.

3. Punishment works best under certain conditions.

   a) The punisher explains why punishment is being given.

   b) The punisher emphasizes that the behavior is being punished, not the person.

   c) Punishment should be rapid and severe enough to eliminate the response without being abusive.

   d) More appropriate responses are identified and reinforced.

F. Some Applications of Operant Conditioning

1. Basic ideas of operant conditioning have endless examples in everyday life. Learning how to be “civilized” and cultural gender roles are just two examples.

2. Principles of operant conditioning have led to treatment programs for altering problematic behavior.

   a) Behavior modification programs combine the use of rewards and extinction.

   b) Using discriminative stimuli can help change behavior. Stimulus control therapy encourages insomniacs to use their bed only for sleeping, making it more likely they will sleep better when in bed.

III. LINKAGES: NETWORKS OF LEARNING
A. Associations we form among stimuli and events are represented in complex networks of connections among neurons.
   1. In parallel distributed processing models, knowledge of something does not lie in a single spot or node in the brain but is distributed throughout a network of associated, connected nodes.

B. Neural network or connectionist models of learning focus on how these connections develop through experience.
   1. The weaker the connection between two items, the greater the increase in connection strength when they are experienced together.

IV. COGNITIVE PROCESSES IN LEARNING

Can people learn to be helpless?

Cognitive psychologists argue that both classical and operant of conditioning may result not only from automatic associations, but also from more complex mental processes that underlie adaptation to and understanding of the world around us. Learning is affected not only by the nature of the stimuli we experience, but also by our expectations about and interpretations of them.

A. Learned Helplessness
   1. Learned helplessness is a tendency to give up on efforts to control the environment because of the perception that actions will have no effect on events.

B. Focus on Research: The “I Can’t Do It” Attitude
   1. What was the researcher’s question?
      Can lack of control over the environment lead to learned helplessness in humans?
   2. How did the researcher answer the question?
      Subjects first heard a series of thirty bursts of loud, obnoxious noises. Some subjects had no control over these noises, others could push a button to turn off the noise, and others heard no noises at all. Then all subjects were given a series of eighteen noise bursts. Before each noise, a red warning light appeared. All subjects could move a lever either left or right to terminate the noise (varied for each noise burst) or even prevent it if they moved fast enough. Just before these eighteen trials, half of the subjects were told that avoiding or escaping noises depended on their lever-moving skill. The other half were told that success would be a matter of chance.
   3. What did the researcher find?
      People who had earlier experienced noises with no control failed to terminate the now-controllable noises four times as often as the other subjects. Also, no matter what the subjects had experienced before, those who expected that control depended on skill terminated more controllable noises than those who thought that control depended on chance.
   4. What do the results mean?
      It appears that the belief of learned helplessness—either through direct experience or through expectation—makes people less likely to use available control.
   5. What do we still need to know?
      Further research is needed on when and how learned helplessness affects people’s thoughts, feelings, and actions. People with pessimistic explanatory styles see good things that happen to them as temporary and due to chance, whereas the bad things are seen as permanent and due to internal factors. Research is needed to understand the connection between pessimism and negative consequences, and to determine how to minimize learned helplessness and maximize learned optimism.
C. Latent Learning and Cognitive Maps

1. **Latent learning** is learning that is not evident when it first occurs. Learning does not always result from reinforcing overt responses. It can sometimes result from cognitive processes like understanding and making inferences.
   a) Tolman took three groups of rats. Group A had food placed in the goal box of the maze on each trial, and they gradually improved their maze-running performance. Group B never had food placed in the goal box and continued to make many errors. Group C had no food in the goal box for the first ten days and made many mistakes. On the eleventh day, food was placed in the box and the rats made almost no mistakes after receiving reinforcement. Tolman argued that the reinforcement did not affect learning, but only the rats’ performance.
   b) **Cognitive maps** are mental representations of physical arrangements. Cognitive maps develop as you explore your surroundings, although you may not show an overt response or receive explicit reinforcement.

D. Insight and Learning

1. Kohler studied **insight**, a sudden understanding of a problem as a whole. He argued that it was different from trial and error, because once the problem was solved, because it was now understood, a similar situation would evoke a similar response. Also, solutions that did not work were rarely tried. Other psychologists argue that insight is the result of a trial-and-error process.

E. Observational Learning: Learning by Imitation

1. **Observational learning**, also known as *social learning*, is learning that occurs by watching others.
   a) **Vicarious conditioning** is a kind of observational learning through which a person is influenced by watching or hearing about the consequences of others’ behavior.
   b) Children are particularly influenced by the adults and peers who act as models for appropriate behavior. Observational learning is important in *socialization*, the process through which children learn about which behaviors are proper or improper in their culture.

F. Thinking Critically: Does Watching Violence on Television Make People More Violent?
The average child in the United States spends about two and one-half hours each day watching television, and much of what he or she sees is violent programming. The average child will see 8,000 murders and 100,000 other acts of televised violence before finishing elementary school and twice that number by age eighteen.

1. *What am I being asked to believe or accept?*
   Exposure to television violence results in increased aggressive behavior, both contemporaneously and over time.

2. *Is there evidence available to support the claim?*
   Some evidence comes from anecdotes and case studies. In correlational studies, children who watch more violence on television are more aggressive, even twenty years later. Experiments show that children shown violent television shows display more violent behavior than children shown nonviolent shows.

3. *Can that evidence be interpreted another way?*
   Anecdotes and case studies are open to many interpretations. Correlations do not imply causation—it may be that watching television violence and behaving violently are both caused by third factors, such as personality or poverty, the effects of drugs and alcohol, or other stressors. Some experiments may also not be applicable beyond the experimental setting.
4. **What evidence would help to evaluate the alternatives?**
   Further evidence from controlled experiments and a better understanding of how observed violence relates to other causes of aggressive behavior would be helpful.

5. **What conclusions are most reasonable?**
   Based on current evidence, it is reasonable to conclude that watching television violence is one cause of violent behavior, especially in some children.

V. USING RESEARCH ON LEARNING TO HELP PEOPLE LEARN

What should teachers learn about learning?

A. **Classrooms Across Cultures**
   1. In a typical U.S. classroom session, teachers address students as a group, students work independently at their desks, and feedback and reinforcement is delayed a day or two or not given at all. In Japanese classrooms, teachers work with students on a one-to-one basis with immediate feedback, and students are encouraged to form teams that include people of varying skills and abilities and to work together cooperatively.
   2. The Japanese children practiced more, spent more days in school during the year, and spent more hours doing homework.
   3. Research suggests that application of basic principles of operant conditioning can improve education.
   4. Research in cognitive psychology suggests that students will retain more of what they learn if they study in several sessions “distributed” over time, rather than in single “cramming” sessions.

B. **Active Learning**
   1. **Active learning**, in which the student must do something other than simply sit and listen, is generally more interesting and enjoyable for students, and is associated with greater in-depth understanding of material.

C. **Skill Learning**
   1. **Skills** are complex action sequences that require both physical and mental practice. Practice should continue past the point of correct performance, until the skill can be performed automatically, with little or no attention.
   2. Feedback about the correctness of the response is necessary. Large amounts of guidance may produce very good performance during practice, but too much of it may impair later performance. Independent practice is critical for skill development.
   3. There is little or no evidence to support “sleep learning” or similar schemes designed to make learning effortless.