LEARNING

mendura
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MODULE 4

LEARNING

Learning is a relatively permanent change in behavior due to experience (Domjan, 2006). This definition excludes both temporary changes and more permanent changes caused by motivation, fatigue, maturation, disease, injury, or drugs. Each of these can alter behavior, but none qualifies as learning.

4.1: CLASSICAL CONDITIONING

Classical conditioning can be defined as basic form of learning in which one stimulus comes to serve as a signal for the occurrence of a second stimulus. During classical conditioning, organisms acquire information about the relations between various stimuli, not simple associations between them.

4.1.1: Pavlov's Experiment

Ivan Pavlov, a Russian physiologist, never intended to do psychological research. In 1904 he won the Nobel Prize for his work on digestion, testimony to his contribution to that field. Yet Pavlov is remembered not for his physiological research but for his experiments on basic learning processes - work that he began quite accidentally (Marks, 2004; Samoilov & Zayas, 2007).

Pavlov had been studying the secretion of stomach acids and salivation in dogs in response to the ingestion of varying amounts and kinds of food. While doing that, he observed a curious phenomenon: Sometimes stomach secretions and salivation would begin in the dogs when they had not yet eaten any food. The mere sight of the experimenter who normally brought the food, or even the sound of the experimenter's footsteps, was enough to produce salivation in the dogs. Pavlov's genius lay in his ability to recognize the implications of this discovery. He saw that the dogs were responding not only on the basis of a biological need (hunger) but also as a result of learning— or, as it came to be called, classical conditioning. Classical conditioning is a type of learning in which a neutral stimulus (such as the experimenter's footsteps) comes to elicit a response after being paired with a stimulus (such as food) that naturally brings about that response. To demonstrate classical conditioning, Pavlov (1927) attached a tube to the salivary gland of a dog, allowing him to measure precisely the dog's salivation. He then rang a bell and, just a few seconds later, presented the dog with meat. This pairing occurred repeatedly and was carefully planned so that, each time, exactly the same amount of time elapsed between the presentation of the bell and the meat. At first the dog would salivate only when the meat was presented, but soon it began to salivate at the sound of the bell. In fact, even when Pavlov stopped presenting the meat, the dog still salivated after hearing the sound. The dog had been classically conditioned to salivate to the bell.

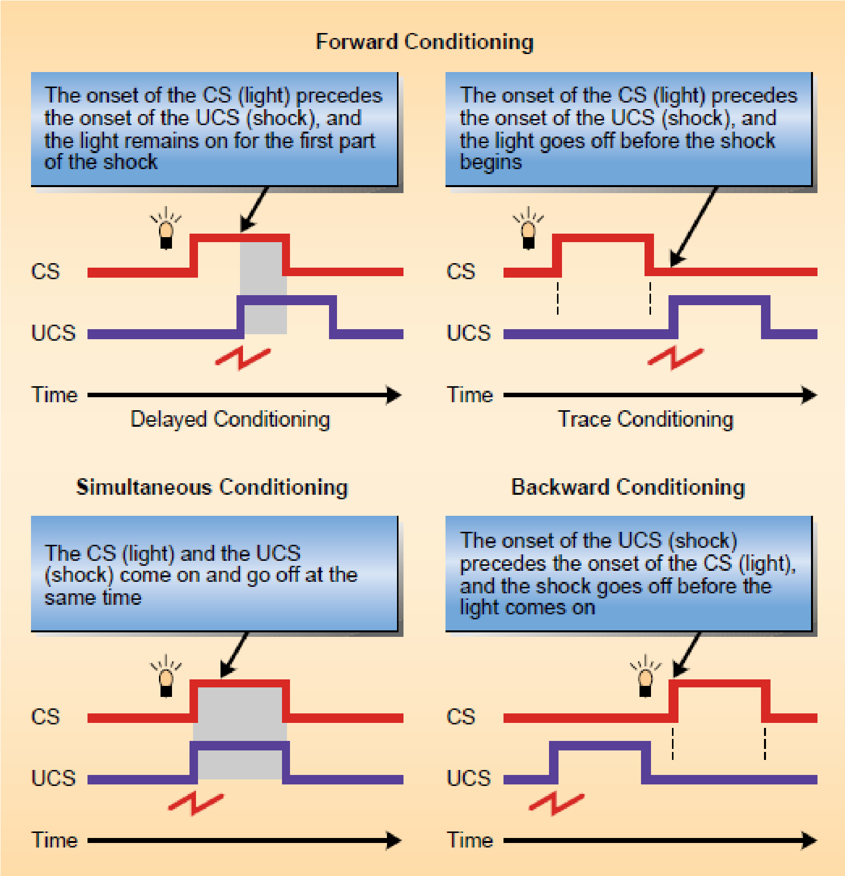
4.1.2: The Basics of Classical Conditioning

Element	Symbol	Description	Example
Unconditioned stimulus	US	A stimulus innately capable of eliciting a response	Meat powder
Unconditioned response	UR	An innate reflex response elicited by an unconditioned stimulus	Reflex salivation *to the US*
Neutral stimulus	NS	A stimulus that does not evoke the unconditioned response	Bell *before conditioning*
Conditioned stimulus	CS	A stimulus that evokes a response because it has been repeatedly paired with an unconditioned stimulus	Bell *after conditioning*
Conditioned response	CR	A learned response elicited by a conditioned stimulus	Salivation *to the CS*

Before conditioning, there are two unrelated stimuli: the ringing of a bell and meat. We know that normally the ringing of a bell does not lead to salivation but to some irrelevant response, such as pricking up the ears or perhaps a startle reaction. The bell is therefore called the **neutral stimulus**, because it is a stimulus that, before conditioning, does not naturally bring about the response in which we are interested. We also have meat, which naturally causes a dog to salivate - the response we are interested in conditioning. The meat is considered an **unconditioned stimulus** (UCS) because food placed in a dog's mouth automatically causes salivation to occur. The response that the meat elicits (salivation) is called an **unconditioned response** (UCR) - a natural, innate, reflexive response that is not associated with previous learning. Unconditioned responses are always brought about by the presence of unconditioned stimuli.

The bell is rung just before each presentation of the meat. The goal of conditioning is for the dog to associate the bell with the unconditioned stimulus (meat) and therefore to bring about the same sort of response as the unconditioned stimulus. After a number of pairings of the bell and meat, the bell alone causes the dog to salivate.

When conditioning is complete, the bell has evolved from a neutral stimulus to a conditioned stimulus (CS). At this time, salivation that occurs as a response to the conditioned stimulus (bell) is considered a conditioned response (CR). After conditioning, then, the conditioned stimulus evokes the conditioned response.



The sequence and timing of the presentation of the unconditioned stimulus and the conditioned stimulus are particularly important. Like a malfunctioning warning light at a railroad crossing that goes on after the train has passed by, a neutral stimulus that follows an unconditioned stimulus has little chance of becoming a conditioned stimulus. However, just as a warning light works best if it goes on right before a train passes, a neutral stimulus that is presented just before the unconditioned stimulus is most apt to result in successful conditioning. **Research has shown that conditioning is most effective if the neutral stimulus (which will become a conditioned stimulus) precedes the unconditioned stimulus by between a half second and several seconds, depending on what kind of response is being conditioned** (Bitterman, 2006; Wasserman & Miller, 1997).

4.1.2: Principles of Classical Conditioning

4.1.2.1: Acquisition

The process by which a conditioned stimulus acquires the ability to elicit a conditioned response through repeated pairings of an unconditioned stimulus with the conditioned stimulus.

In most instances, classical conditioning is a gradual process in which a conditioned stimulus gradually acquires the capacity to elicit a conditioned response as a result of repeated pairing with an unconditioned stimulus. This process— termed acquisition—proceeds quite rapidly at first, increasing as the number of pairings between conditioned and unconditioned stimulus increases. However, there is a limit to this effect; after a number of pairings of CS and UCS, acquisition slows down and finally levels off.

4.1.2.2: Extinction

The process through which a conditioned stimulus gradually loses the ability to evoke conditioned responses when it is no longer followed by the unconditioned stimulus.

The course of extinction, however, is not always entirely smooth. Let's consider the behavior of one of Pavlov's dogs to see why this is true. After many presentations of a bell (conditioned stimulus) in the absence of meat powder (unconditioned stimulus), the dog no longer salivates in response to the bell. In other words, extinction has occurred.

4.1.2.3: Spontaneous Recovery

Reappearance of a weakened conditioned response to a conditioned stimulus after an interval of time following extinction.

4.1.2.4: Stimulus Generalization

The tendency of stimuli similar to a conditioned stimulus to evoke conditioned responses.

4.1.2.5: Stimulus Discrimination

The process by which organisms learn to respond to certain stimuli but not to others.

4.1.2.6: Higher Order Conditioning

Classical conditioning in which a conditioned stimulus is used to reinforce further learning; that is, a CS is used as if it were a US.

Once a response is learned, it can bring about higher order conditioning. In this case, a well-learned CS is used to reinforce further learning (Lefrançois, 2006). That is, the CS has become strong enough to be used like an unconditioned stimulus.

4.1.3: Classical Conditioning: The Neural Basis of Learning

Several converging lines of evidence seem to indicate that the cerebellum and related brain circuitry play a significant role in learning. The cerebellum is a structure in the brain well known for its role in helping us to maintain our sense of balance and coordinate movements.

Several evidences are available for the cerebellum's role in the acquisition of conditioned responses.

First, electrical recordings of the brains of laboratory animals show that the rate of neural firing of cells in the cerebellum predicts the onset of a conditioned response. Second, researchers have shown that electrical stimulation of specific pathways into the cerebellum can elicit the occurrence of both conditioned and unconditioned responses. Finally, when structures in the cerebellum of animals are surgically destroyed, previously learned associations can be severely disrupted, and the ability to learn new associations eliminated altogether (Thompson & Krupa, 1994).

Studies of humans who have sustained damage to their cerebellum reveal a similar pattern of results. For example, careful research indicates that it is extremely difficult to establish conditioned responses with these persons. They blink normally (UCR) in response to a puff of air to the eye (UCS), indicating that their motor functions and ability to respond to external stimulation remain intact. However, efforts to establish a conditioned response to, say, a light or a tone are usually unsuccessful (Daum & Schugens, 1996; Topka et al., 1993). Related research has also revealed that the ability to acquire conditioned eye-blink responses seems to fade with age. Researchers believe that age-related declines in the number and efficiency of certain cells in the cerebellum may be the cause (Woodruff-Pak & Thompson, 1988).

In short, these findings provide strong evidence that the cerebellum plays a significant role in classical conditioning—at least for the relatively simple stimulus relationships just described.

4.1.4: Applications of Classical Conditioning

4.1.4.1: Classical Conditioning and Phobias

One of the earliest applications was reported in a study, now a classic in psychology, conducted by John B. Watson and his assistant, Rosalie Raynor, in 1920. Watson and Raynor (1920) demonstrated through their work with "little Albert" that human beings can sometimes acquire strong fears—termed phobias—through classical conditioning. In this study, an eleven-month-old child named Albert was shown a white laboratory rat. Albert's initial reactions to the rat were positive: He smiled and attempted to play with it. Just as he reached out for the rat, though, an iron bar was struck to make a loud noise right behind his ear. Albert jumped, obviously very upset by the startling noise. After several more pairings of the rat (conditioned stimulus) and the loud noise (unconditioned stimulus), Albert cried hysterically and tried to crawl away whenever he saw the rat—or any other small, furry object—even when there was no loud noise.

Fortunately, knowledge of how phobias like little Albert's occur has led to the development of several effective procedures for reducing these reactions (Davey, 1992). In one procedure, termed **flooding**, a person suffering from a specific fear may be forced to confront the fear-eliciting stimulus without an avenue of escape (Gordon, 1989; Morganstern, 1973).

In cases where fear-provoking thoughts are too painful to deal with directly, **systematic desensitization**—a progressive technique designed to replace anxiety with a relaxation response—has proved effective (Wolpe, 1958, 1969). A person undergoing this procedure is asked to describe fearful situations. Then, starting with the least anxiety-producing situation, the person alternately visualizes situations and relaxes. Gradually, the individual learns to relax while imagining situations that are increasingly more threatening. Please see the Beyond the Headlines section for more information on the use of classical conditioning to treat phobias.

4.1.4.2: Classical Conditioning and Drug Overdose

Knowledge of conditioning processes has also helped explain some instances of drug overdose. For example, it is well known that certain drugs become less effective over time. But why does this occur? One possibility is that when a person uses drugs repeatedly in a particular context, the stimuli in that environment become conditioned stimuli and come to elicit a conditioned response (Siegel, 1983, 1984). For certain addictive drugs, this conditioned response can be just the opposite of the unconditioned response (Siegel, 1975; Siegel et al., 1982). Knowledge of classical conditioning processes may help health professionals arrange environments that minimize relapse among former drug users—by eliminating the cues that trigger conditioned responses.

4.1.4.3: Classical Conditioning and the Immune System

Research evidence suggests that it may be possible to affect aspects of the immune system through classical conditioning (Ader et al., 1993; Husband et al., 1993). In one recent study, Alvarez-Borda and her colleagues (1995) used classical conditioning to enhance specific immune functions in a group of rats. The researchers first divided the rats into two groups. On conditioning day, one group of rats was allowed to drink a distinctive beverage—saccharin-flavored water (the CS)—before receiving an injection of a substance (the UCS) known to raise the level of certain antibodies in their systems. A second group of rats received only water before receiving the same injection. As predicted, both groups showed an enhanced immune response (UCR) to the injection. Then, after the effects of the injection had faded (more than a month later), the researchers tested to see if conditioning had taken place. Half of the rats that had been exposed to saccharin-flavored water during conditioning were again exposed to saccharin-flavored water, while the other half received only water. The group that had received only water during conditioning also received water during the test trial. The researchers' predictions were supported: Re-exposure to the saccharin-flavored water (the CS) resulted in a significant elevation of antibodies in these rats, despite the fact that no further injections (the UCS) were given. In contrast, there was no enhanced immune response in the other groups; measurements indicated that antibody levels in these rats were not significantly different from levels assessed prior to conditioning.

4.2: OPERANT CONDITIONING

A process through which organisms learn to repeat behaviors that yield positive outcomes or permit them to avoid or escape from negative outcomes.

Operant conditioning is learning in which a voluntary response is strengthened or weakened, depending on its favorable or unfavorable consequences. When we say that a response has been strengthened or weakened, we mean that it has been made more or less likely to recur regularly.

Unlike classical conditioning, in which the original behaviors are the natural, biological responses to the presence of a stimulus such as food, water, or pain, operant conditioning applies to voluntary responses, which an organism performs deliberately to produce a desirable outcome. The term operant emphasizes this point: The organism operates on its environment to produce a desirable result.

4.2.1: The Nature of Operant Conditioning

In situations involving operant conditioning, the probability that a given response will occur changes depending on the consequences that follow it. **Psychologists generally agree that these probabilities are determined through four basic procedures, two of which strengthen or increase the rate of behavior and two of which weaken or decrease the rate of behavior. Procedures that strengthen behavior are termed reinforcement, whereas those that suppress behavior are termed punishment.**

4.2.1.1: Reinforcement

Reinforcement: The application or removal of a stimulus to increase the strength of a specific behavior.

Negative reinforcement: Stimuli that strengthen responses that permit an organism to avoid or escape from their presence.

There are two types of reinforcements: positive reinforcement and negative reinforcement. **Positive reinforcement involves the impact of positive reinforcers—stimulus events or consequences that strengthen responses that precede them**. In other words, if a consequence of some action increases the probability that the action will occur again in the future, that consequence is functioning as a positive reinforcer.

Some positive reinforcers seem to exert these effects because they are related to basic biological needs. Such **primary reinforcers** include food when we are hungry, water when we are thirsty, and sexual pleasure. Humans also respond to a much broader range of rewards and reinforcers. Money, praise, attention, approval, success, affection, grades, and the like, all serve as **learned or secondary reinforcers.** A **token reinforcer** is a tangible secondary reinforcer, such as money, gold stars, poker chips, and the like, that can be exchanged for primary reinforcers gain their value more directly (Mazur, 2006). Learned desires for attention and approval, which are called **social reinforcers**, often influence human behavior.

Preferred activities can also be used to reinforce behavior, a principle referred to as the **Premack principle**. **This principle states that a more preferred activity can be used to reinforce a less preferred activity.** Eg: Parents may instruct their children that; “You must clean your room before you can watch TV” or “You must eat your vegetables before you get dessert” etc. Premack principle is a powerful tool for changing behavior.

Negative reinforcement involves the impact of negative reinforcers—**stimuli that strengthen responses that permit an organism to avoid or escape from their presence.** Thus, when we perform an action that allows us to escape from a negative reinforcer that is already present or to avoid the threatened application of one, our tendency to perform this action in the future increases. Some negative reinforcers, such as intense heat, extreme cold, or electric shock, exert their effects the first time they are encountered, whereas others acquire their impact through repeated association.

Say briefly, both positive and negative reinforcement are procedures that strengthen or increase behavior. Positive reinforcers are stimulus events that strengthen responses that precede them, whereas negative reinforcers are aversive stimulus events that strengthen responses that lead to their termination or avoidance.

4.2.1.2: Punishment

Punishment aims to weaken or decrease the rate of a behavior. As with reinforcement, there are two types of punishments: positive punishment and negative punishment. **In positive punishment, behaviors are followed by aversive stimulus events termed punishers. In such instances, we learn not to perform these actions because aversive consequences—punishers—will follow.**

In negative punishment, the rate of a behavior is weakened or decreased by the aversiveness of loss of potential reinforcements (Catania, 1992; Millenson & Leslie, 1979). For example, parents frequently attempt to decrease the frequency of certain behaviors of their teenagers (e.g., hitting younger siblings or talking back to parents) by temporarily denying them access to positive reinforcers—such as driving the family car on weekend dates. A common form of negative punishment is "time-out".

4.2.2: Principles of Operant Conditioning

In operant conditioning, organisms learn associations between particular behaviors and the consequences that follow them. Additionally, the responses involved in operant conditioning are more voluntary and are emitted by organisms in a given environment. In order to understand the nature of this form of conditioning, then, we must address two basic questions: (1) Why are certain behaviors emitted in the first place? (2) Once behaviors occur, what factors determine the frequency with which they are repeated?

4.2.2.1: Shaping

Shaping can be defined as a technique in which closer and closer approximations of desired behavior are required for the delivery of positive reinforcement.

Shaping is based on the principle that a little can eventually go a long way. Participants receive a reward for each small step toward a final goal—the target response—rather than only for the final response. At first, actions even remotely resembling the target behavior—termed successive approximations—are followed by a reward. Gradually, closer and closer approximations of the final target behavior are required before the reward is given. Shaping, then, helps organisms acquire, or construct, new and more complex forms of behavior from simpler behavior.

4.2.2.2: Chaining

Chaining can be defined as a procedure that establishes a sequence of responses, which lead to a reward following the final response in the chain.

In chaining, the trainers establish a sequence, or chain, of responses, the last of which leads to a reward. Trainers usually begin chaining by first shaping the final response. When this response is well established, the trainer shapes responses earlier in the chain, then reinforces them by giving the animal the opportunity to perform responses later in the chain, the last of which produces the reinforcer.

4.2.2.3: The Role of Reward Delay

Operant conditioning usually proceeds faster as the magnitude of the reward that follows each response increases. But the effectiveness of rewards can be dramatically affected by **reward delay—the amount of time that elapses before the reward is delivered.** In general, longer delays produce poorer levels of performance.

4.2.2.4: Schedules of Reinforcement

Schedules of reinforcement are the rules determining when and how reinforcements will be delivered.

The simplest is called the **continuous reinforcement (CRF) schedule, in which every occurrence of a particular behavior is reinforced.** For example, if a rat receives a food pellet each time it presses a lever, or a small child receives twenty-five cents each time he ties his shoes correctly, both are on a continuous reinforcement schedule. Continuous reinforcement is useful for establishing or strengthening new behaviors.

Other types of schedules, however, termed **partial or intermittent reinforcement**, are often more powerful in maintaining behavior.

- **Fixed Interval Schedule**

  A schedule of reinforcement in which a specific interval of time must elapse before a response will yield reinforcement.

  In this type of reinforcement, the occurrence of reinforcement depends on the passage of time; the first response made after a specific period has elapsed brings the reward. When placed on schedules of this type, people generally show a pattern in which they respond at low rates immediately after delivery of a reinforcement, but then gradually respond more and more as the time when the next reward can be obtained approaches. A good example of behavior on a fixed-interval schedule is provided by students studying. After a big exam, little if any studying takes place. As the time for the next test approaches, the rate of such behavior increases dramatically.

- **Variable Interval Schedule**

  A schedule of reinforcement in which a variable amount of time must elapse before a response will yield reinforcement.

  Here, the period that must elapse before a response will again yield reinforcement **varies** around some average value. An example of behavior on a variable-interval schedule of reinforcement is provided by employees whose supervisor checks their work at irregular intervals. Since the employees never know when such checks will occur, they must perform in a consistent manner in order to obtain positive outcomes, such as praise, or avoid negative ones, such as criticism. This is precisely what happens on variable-interval schedules: Organisms respond at a steady rate, without the kind of pauses observed on fixed-interval schedules.

- **Fixed Ratio Schedule**

  A schedule of reinforcement in which reinforcement occurs only after a fixed number of responses have been emitted.

  Reinforcement is determined in a very different manner on a fixed-ratio schedule. Here, reinforcement occurs only after a fixed number of responses. Individuals who are paid on a piecework basis, in which a fixed amount is paid for each item produced, are operating according to a fixed-ratio schedule. Generally, such schedules yield a high rate of response, though with a tendency toward a brief pause immediately after each reinforcement. The pauses occur because individuals take a slight breather after earning each unit of reinforcement.

- **Variable Ratio Schedule**

  A schedule of reinforcement in which reinforcement is delivered after a variable number of responses have been emitted.

  On a variable-ratio schedule, reinforcement occurs after completion of a variable number of responses. Since organisms confronted with a variable-ratio schedule cannot predict how many responses are required before reinforcement will occur, they usually respond at high and steady rates.

4.2.3: Application of Operant Conditioning

Because positive and negative reinforcement exerts powerful effects on behavior, procedures based on operant conditioning have been applied in many practical settings.

First, principles of operant conditioning have been applied to the field of education. One of the most impressive operant-based teaching techniques involves the use of computers in the classroom—often termed **computer-assisted instruction**, or CAI. In CAI students interact with sophisticated computer programs that provide immediate reinforcement of correct responses. With certain restrictions, these programs are paced according to each student's progress (Ross & McBean, 1995). The effectiveness of CAI as an instructional tool is even more impressive when students are exposed to an instructor who models the use of these programs in advance. Some evidence suggests that students may learn to take greater responsibility for their own performance under CAI than under teacher-led instruction, because they view computers as impersonal and therefore fairer. With the color graphics, synthesized speech, and other effects available on videodisc, CAI instruction may add excitement and enhance motivation for learning (e.g., Kritch, Bostow, & Dedrick, 1995).

A second intriguing area of application of operant conditioning is **biofeedback—a technique in which sophisticated equipment allows people to monitor and then alter bodily responses not usually susceptible to voluntary control, such as skin temperature, muscle tension, blood pressure, and electrical activity of the brain**. For example, with biofeedback equipment ongoing increases or decreases in muscle tension are reflected by concomitant changes in a light or tone. A patient undergoing biofeedback then monitors this information and uses it to alter muscular tension. Biofeedback has been used successfully to treat a broad range of ailments, including headaches, high blood pressure, muscle tics and chronic lower back pain, depression in alcoholics and even sexual dysfunction (Palace, 1995).

Third, principles of operant conditioning have been applied in interventions for solving socially significant issues in our communities, such as crime, energy conservation and recycling, health care issues, consumer affairs, and safety promotion.

Finally, techniques of operant conditioning have been applied to many issues and problems in work settings, for example, to improve the performance of and in the development of flexible work schedules. In one study, Petty and his colleagues (1992) demonstrated that a group incentive program improved the productivity of employees in a division of an electric utility company, thereby reducing the cost of electricity to the customers. Moreover, employees perceived that the incentive plan increased teamwork and encouraged greater employee involvement in decision making. Clearly, both organizations and their workers can profit greatly from closer attention to basic principles of operant conditioning.

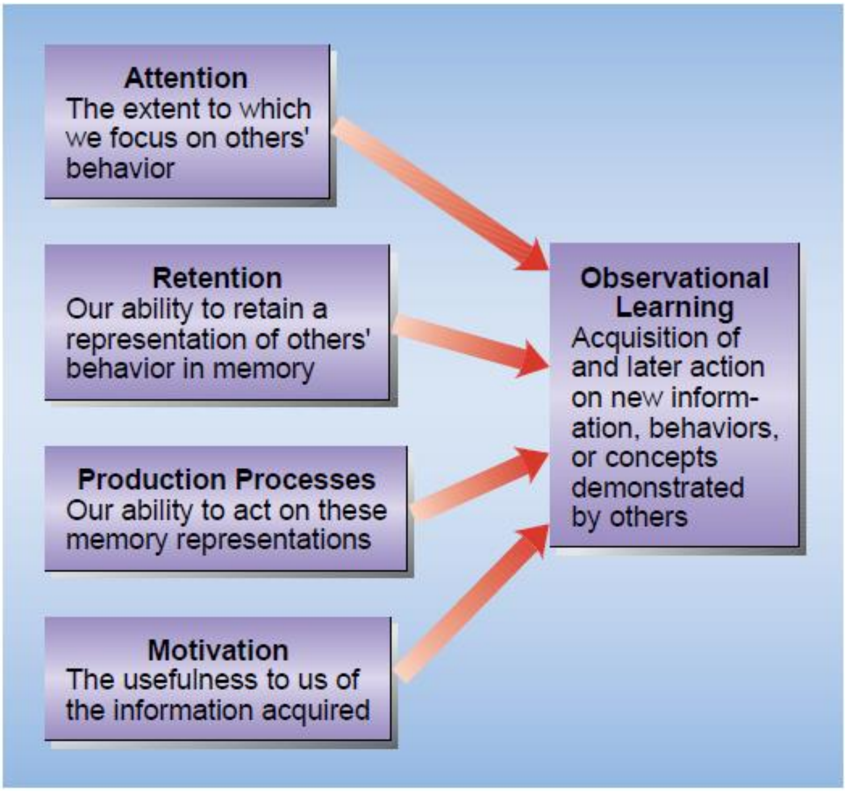
4.3: SOCIAL LEARNING

Social learning or observational learning can be defined as the acquisition of new forms of behavior, information, or concepts through exposure to others and the consequences they experience.

According to psychologist Albert Bandura and colleagues, a major part of human learning consists of observational learning, which is learning by watching the behavior of another person, or model. Because of its reliance on observation of others—a social phenomenon—the perspective taken by Bandura is often referred to as a social cognitive approach to learning (Bandura, 1999, 2004).

4.3.1: Basic Principles of Observational Learning

- First, in order to learn through observation we must direct our attention to appropriate models—that is, to other persons performing an activity. And, as we might expect, we don't choose such models at random but focus most attention on people who are attractive to us; on people who possess signs of knowing what they're doing, such as



status or success; and on people whose behavior seems relevant to your own needs and goals (Baron, 1970).

- The second essential factor is **retention**, or memory, of what the persons have said or done. Only if we can retain some representation of their actions in memory, we can perform similar actions at later times or acquire useful information from our models.
- Third, we need to be able to convert these memory representations into appropriate actions. Bandura terms this aspect of observational learning **production processes.** Production processes depend on (1) our own physical abilities— if we can't perform the behavior in question, having a clear representation of it in memory is of little use; and (2) our capacity to monitor our own performance and adjust it until it matches that of the model.
- Finally, **motivation** plays a role. We often acquire information through observational learning but do not put it into immediate use in our own behavior. We may have no need for the information, as when we watch someone tie a bow tie but have no plans to wear one our self. Only if the information or behaviors acquired are useful will observers put them to actual use.

4.4: LATENT LEARNING

A form of learning in which a new behavior is acquired but is not demonstrated until some incentive is provided for displaying it.

In latent learning, a new behavior is learned but not demonstrated until some incentive is provided for displaying it (Tolman & Honzik, 1930). In short, latent learning occurs without reinforcement.

Individuals develop cognitive maps of their surroundings. For example, latent learning may permit you to know the location of a kitchenware store at a local mall you've frequently visited, even though you've never entered the store and don't even like to cook. The possibility that we develop our cognitive maps through latent learning presents something of a problem for strict operant conditioning theorists.

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