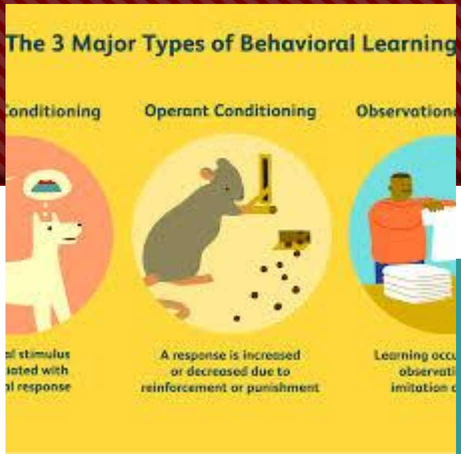
Learning and Behavior



Learning

Learning is a relatively permanent change in behavior that is brought about by experience.

it’s not always easy to identify whether a change in behavior is due to nature or nurture, because some changes in behavior or performance come about through maturation alone and don’t involve experience. For instance, children become better tennis players as they grow older partly because their strength increases with their size—a maturational phenomenon. To understand when learning has occurred, we must differentiate maturational changes from improvements resulting from practice, which indicate that learning actually has occurred.

Learning

We are primed for learning from the beginning of life. Infants exhibit a simple type of learning called habituation. **Habituation** is the decrease in response to a stimulus that occurs after repeated presentations of the same stimulus. For example, young infants may initially show interest in a novel stimulus, such as a brightly colored toy, but they will soon lose interest if they see the same toy over and over. Adults wearing watches get accustomed to it.

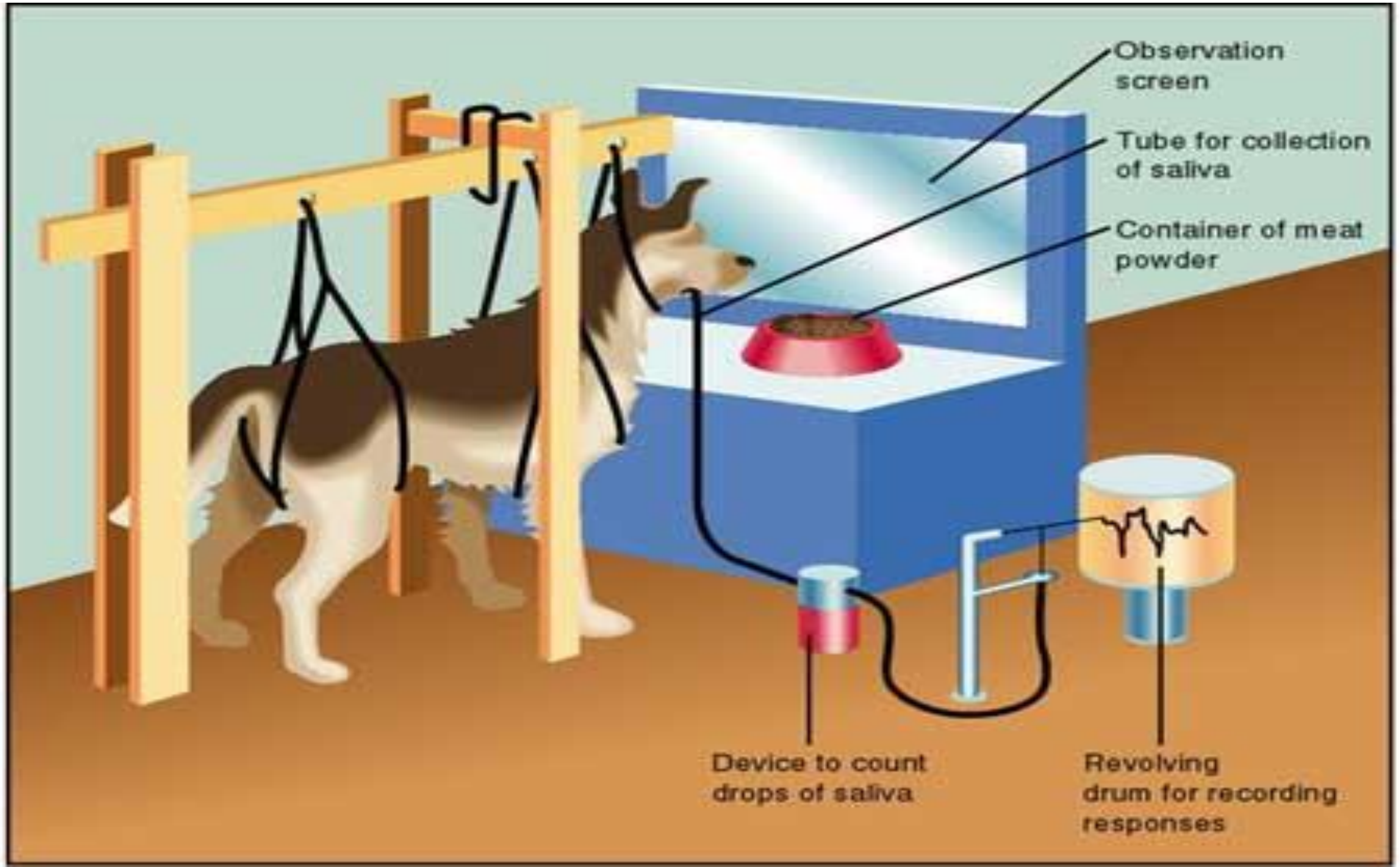
First systematic research on learning was done at the beginning of the 20th century, with Ivan Pavlov.

The Basics of Classical Conditioning

Ivan Pavlov, a Russian physiologist, never intended to do psychological research. Pavlov is remembered not for his physiological research but for his experiments on basic learning processes—work that he began quite accidentally.

Pavlov had been studying the secretion of stomach acids and salivation in dogs in response to eating varying amounts and kinds of food. While doing his research, he observed a curious phenomenon: Sometimes salivation would begin in the dogs when they had not yet eaten any food. Just the 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. 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.

Pavlov Experiment



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.

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.

Classical Conditioning

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 called 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. An **unconditioned response (UCR)** is a natural, innate response that occurs automatically and needs no training. Unconditioned responses are always brought about by the presence of unconditioned stimuli.

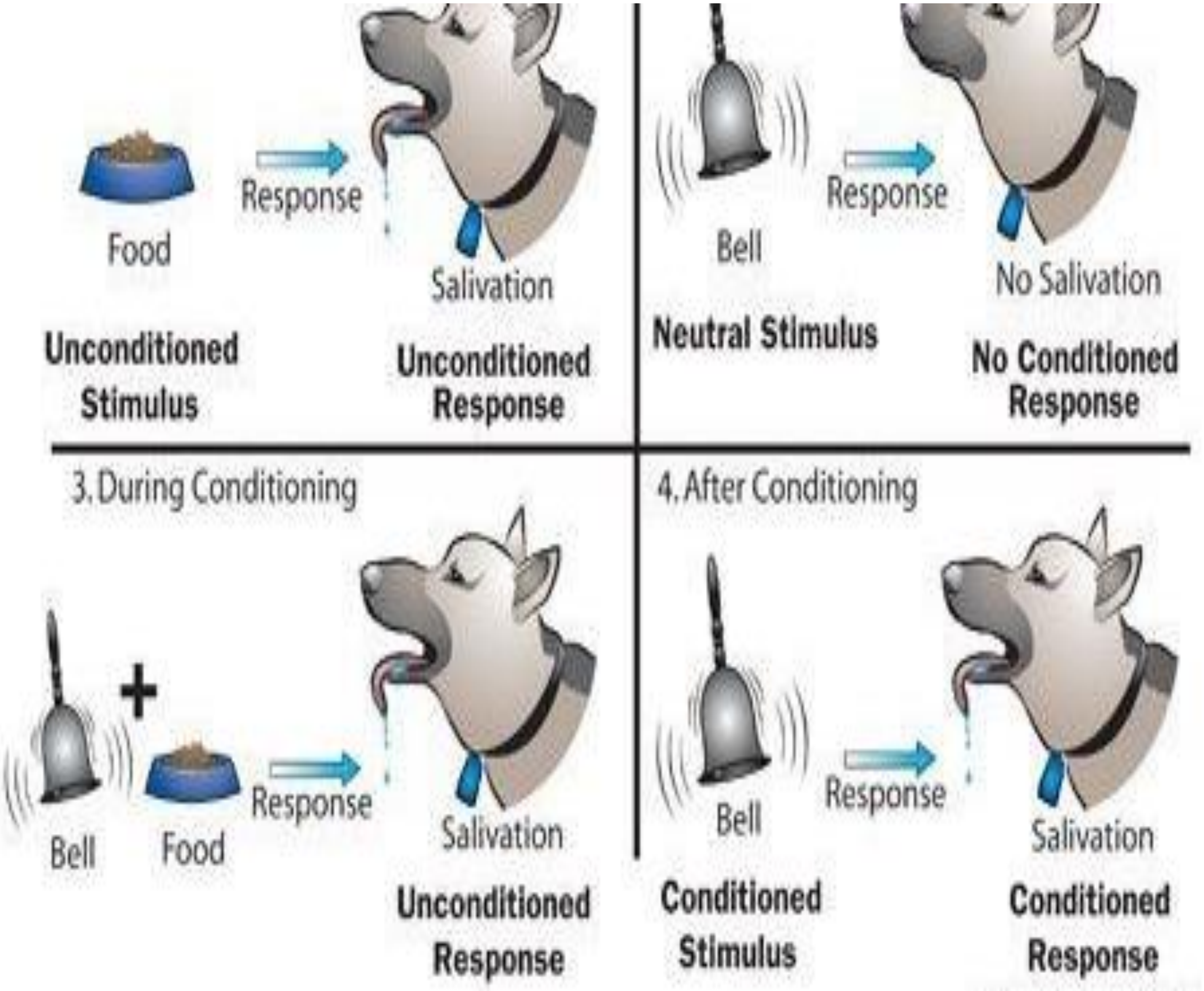
Classical Conditioning

During conditioning, 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 changed from a neutral stimulus to what is called a conditioned stimulus. A **conditioned stimulus (CS)** is a once-neutral stimulus that has been paired with an unconditioned stimulus to bring about a response formerly caused only by the unconditioned stimulus. This time, salivation that occurs as a response to the conditioned stimulus (bell) is called a **conditioned response (CR)**. After conditioning, then, the conditioned stimulus brings about the conditioned response.

Sequence and timing of presentation of the unconditioned stimulus and the conditioned stimulus are particularly important.

The basic process of classical conditioning. (a) Before conditioning, the ringing of a bell does not bring about salivation— making the bell a neutral stimulus. In contrast, meat naturally brings about salivation, making the meat an unconditioned stimulus (UCS) and salivation an unconditioned response (UCR). (b) During conditioning, the bell is rung just before the presentation of the meat. (c) Eventually, the ringing of the bell alone brings about salivation. We now can say that conditioning has been accomplished: The previously neutral stimulus of the bell is now considered a conditioned stimulus (CS) that brings about the conditioned response of salivation (CR).



Classical Conditioning

- Conditioned = learned.
- Unconditioned = not learned
- An unconditioned stimulus (UCS) leads to an unconditioned response (UCR).
- Unconditioned stimulus–unconditioned response pairings are not learned and not trained: They are naturally occurring.
- During conditioning, a previously neutral stimulus is transformed into the conditioned stimulus.
- A conditioned stimulus (CS) leads to a conditioned response (CR), and a conditioned stimulus–conditioned response pairing is a consequence of learning and training.
- An unconditioned response and a conditioned response are similar (such as salivation in Pavlov's experiment), but the unconditioned response occurs naturally, whereas the conditioned response is learned.

Applying Conditioning Principles to Human Behavior

Classical conditioning principles were found to explain many aspects of everyday human behavior. Recall, for instance, the earlier illustration of how people may experience hunger pangs at the sight of McDonald's golden arches. The cause of this reaction is classical conditioning: The previously neutral arches have become associated with the food inside the restaurant (the unconditioned stimulus), causing the arches to become a conditioned stimulus that brings about the conditioned response of hunger.

Emotional responses are especially likely to be learned through classical conditioning processes. For instance, how do some of us develop fears of darkness…. mice, spiders, and other creatures that are typically harmless?

Applying Conditioning Principles to Human Behavior

In a now infamous case study, psychologist John B. Watson (1920) showed that classical conditioning was at the root of such fears by conditioning an 11-month-old infant named Albert to be afraid of rats. “Little Albert,” like most infants, initially was frightened by loud noises but had no fear of rats.

In the study, the experimenters sounded a loud noise whenever Little Albert touched a white, furry rat. The noise (the unconditioned stimulus) evoked fear (the unconditioned response). After just a few pairings of noise and rat, Albert began to show fear of the rat by itself, bursting into tears when he saw it. The rat, then, had become a CS that brought about the CR, fear. Furthermore, the effects of the conditioning lingered: five days later, Albert reacted with some degree of fear not only when shown a rat, but when shown objects that looked similar to the white, furry rat, including a white rabbit, a white seal-skin coat, and even a white Santa Claus mask

Applying Conditioning Principles to Human Behavior

Learning by means of classical conditioning also occurs during adulthood. For example, you may not go to a dentist as often as you should because of previous associations of dentists with pain.

Classical conditioning also relates to pleasant experiences. For instance, hearing a certain song can bring back happy or bittersweet emotions due to associations that you have developed in the past.

Applying Conditioning Principles to Human Behavior

classical conditioning also relates to **pleasant experiences**. For instance, you may have a particular fondness for the smell of a certain perfume or aftershave lotion because thoughts of an early love come rushing back whenever you encounter it. Or hearing a certain song can bring back happy or bittersweet emotions due to associations that you have developed in the past.

Classical conditioning also explains why drug addictions are so difficult to treat. Drug addicts learn to associate certain stimuli—such as drug paraphernalia like a syringe or a room where they use drugs—with the pleasant feelings produced by the drugs. So simply seeing a syringe or entering a certain room can produce reactions associated with the drug and continued cravings for it.

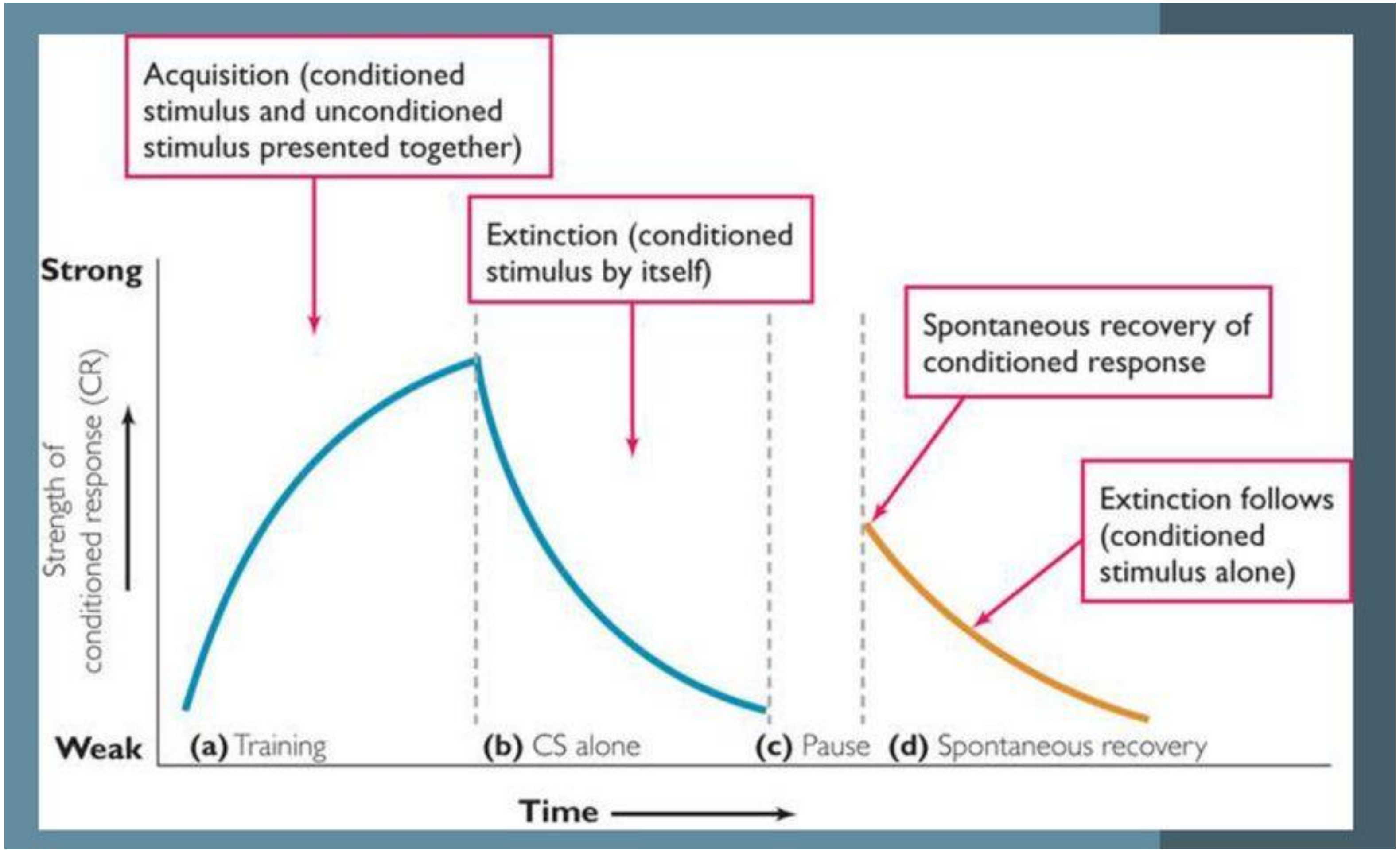
Extinction

Occurs when a previously conditioned response decreases in frequency and eventually disappears. To produce extinction, one needs to end association between conditioned stimuli and unconditioned stimuli. For instance, if we had trained a dog to salivate (the conditioned response) at the ringing of a bell (the conditioned stimulus), we could produce extinction by repeatedly ringing the bell but not providing meat (the unconditioned stimulus). At first dog would continue to salivate when it heard the bell, but after a few such instances, the amount of salivation would probably decline, and the dog would eventually stop responding to the bell altogether. At that point, we could say that the response had been extinguished. In sum, extinction occurs when the conditioned stimulus is presented repeatedly without the unconditioned stimulus.

Once a conditioned response has been extinguished, has it vanished forever? Not necessarily. Pavlov discovered this phenomenon when he returned to his dog a few days after the conditioned behavior had seemingly been extinguished. If he rang a bell, the dog once again salivated—an effect known as **spontaneous recovery**, or the reemergence of an extinguished conditioned response after a period of time and with no further conditioning.

Acquisition, Extinction & Spontaneous Recovery

Acquisition, extinction, and spontaneous recovery of a classically conditioned response. (a) A conditioned response (CR) gradually increases in strength during training. (b) However, if the conditioned stimulus (CS) is presented by itself enough times, the conditioned response gradually fades, and extinction occurs. (c) After a pause (d) in which the conditioned stimulus is not presented, spontaneous recovery can occur. However, extinction typically reoccurs soon after.



Generalization and Discrimination

Stimulus generalization is a process in which, after a stimulus has been conditioned to produce a particular response, stimuli that are similar to the original stimulus produce the same response. The greater the similarity between two stimuli, the greater the likelihood of stimulus generalization. Pavlov noticed his dogs often salivated not only at the ringing of the bell that was used during their original conditioning but at the sound of a buzzer as well.

Stimulus discrimination, in contrast, occurs if two stimuli are sufficiently distinct from each other that one evokes a conditioned response but the other does not. Stimulus discrimination provides the ability to differentiate between stimuli; our ability to discriminate between the behavior of a growling dog and that of one whose tail is wagging can lead to adaptive behavior—avoiding the growling dog and petting the friendly one.

Operant Conditioning

Very good . . . What a clever idea . . . Fantastic . . . I agree . . . Thank you . . . Excellent . . . Super . . . Right on . . . This is the best paper you've ever written; you get an A . . . You are really getting the hang of it . . . I'm impressed . . .

You're getting a raise . . . Have a cookie . . . You look great . . . I love you . .

Each of these simple statements can be used, through a process known as operant conditioning, to bring about powerful changes in behavior and to teach the most complex tasks.

Operant Conditioning

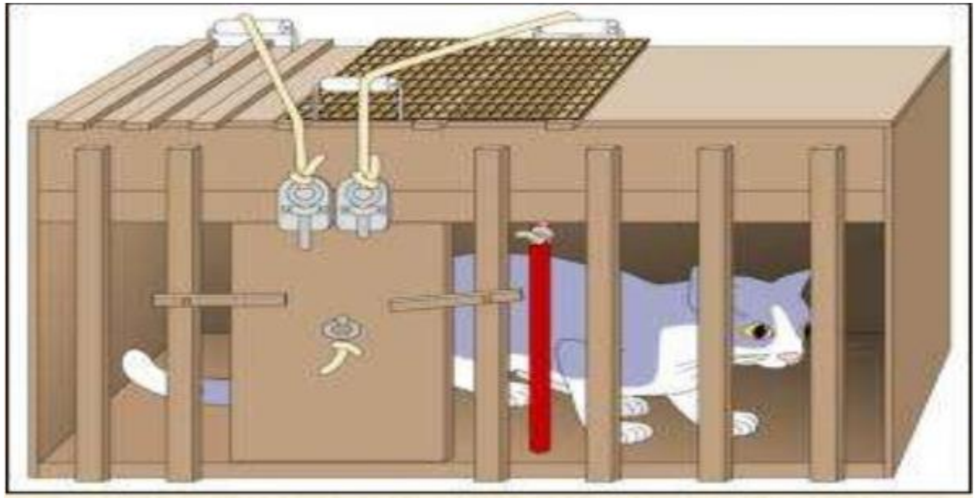
Operant conditioning is learning in which a voluntary response is strengthened or weakened, depending on its favorable or unfavorable consequences. When we say that a response has been strengthened or weakened, we mean that it has been made more or less likely to recur regularly. The term operant emphasizes this point: The organism operates on its environment to produce a desirable result. Operant conditioning is at work when we learn that studying hard results in good grades.

Thorndike's Law of Effect

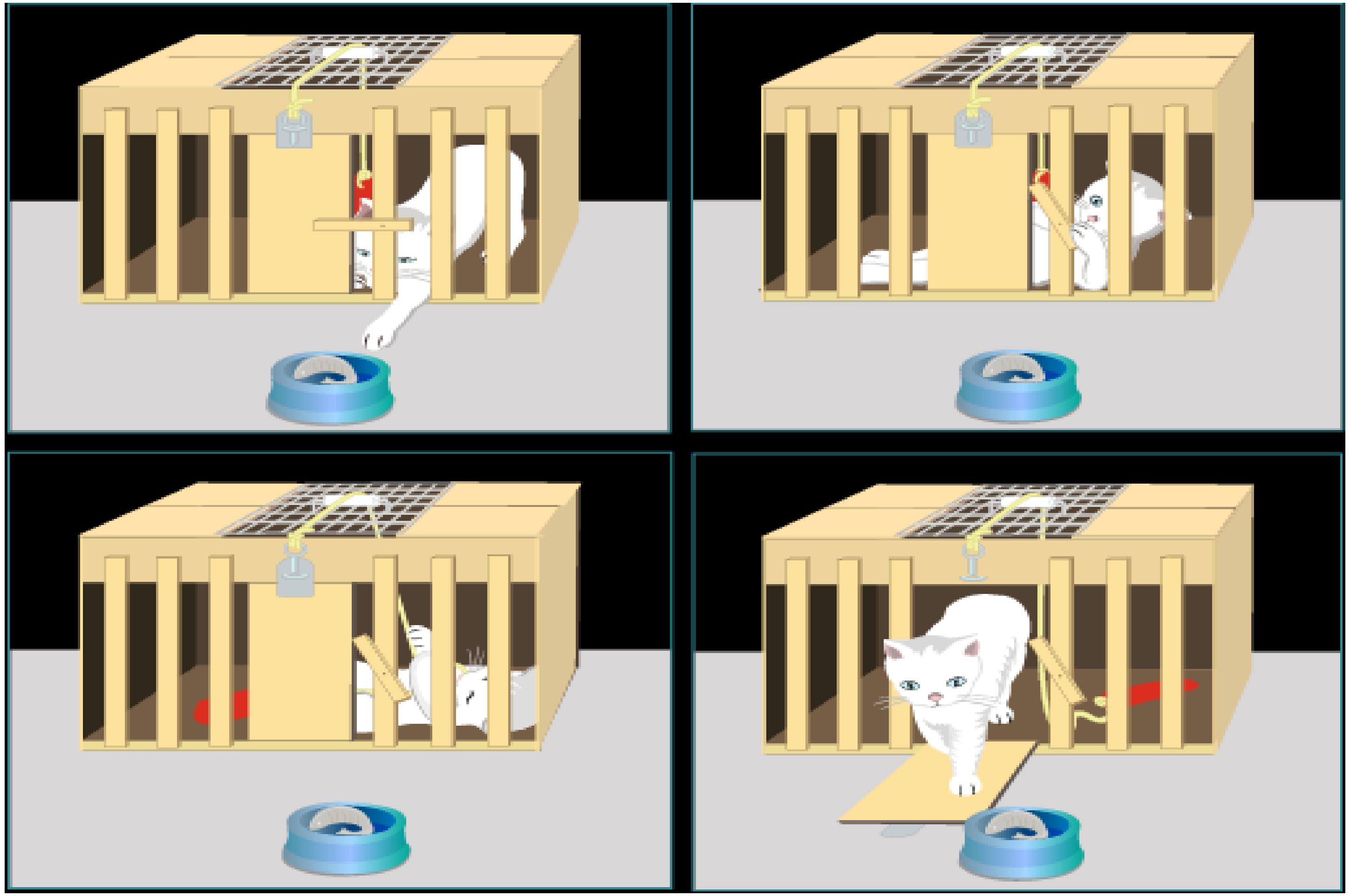
If you placed a hungry cat in a cage and then put a small piece of food outside the cage, just beyond the cat's reach, chances are that the cat would eagerly search for a way out of the cage. The cat might first claw at the sides or push against an opening. Suppose, though, you had rigged things so that the cat could escape by stepping on a small paddle that released the latch to the door of the cage. Eventually, as it moved around the cage, the cat would happen to step on the paddle, the door would open, and the cat would eat the food. What would happen if you then returned the cat to the box? The next time, it would probably take a little less time for the cat to step on the paddle and escape. After a few trials, the cat would deliberately step on the paddle as soon as it was placed in the cage.

Thorndike's Law of Effect

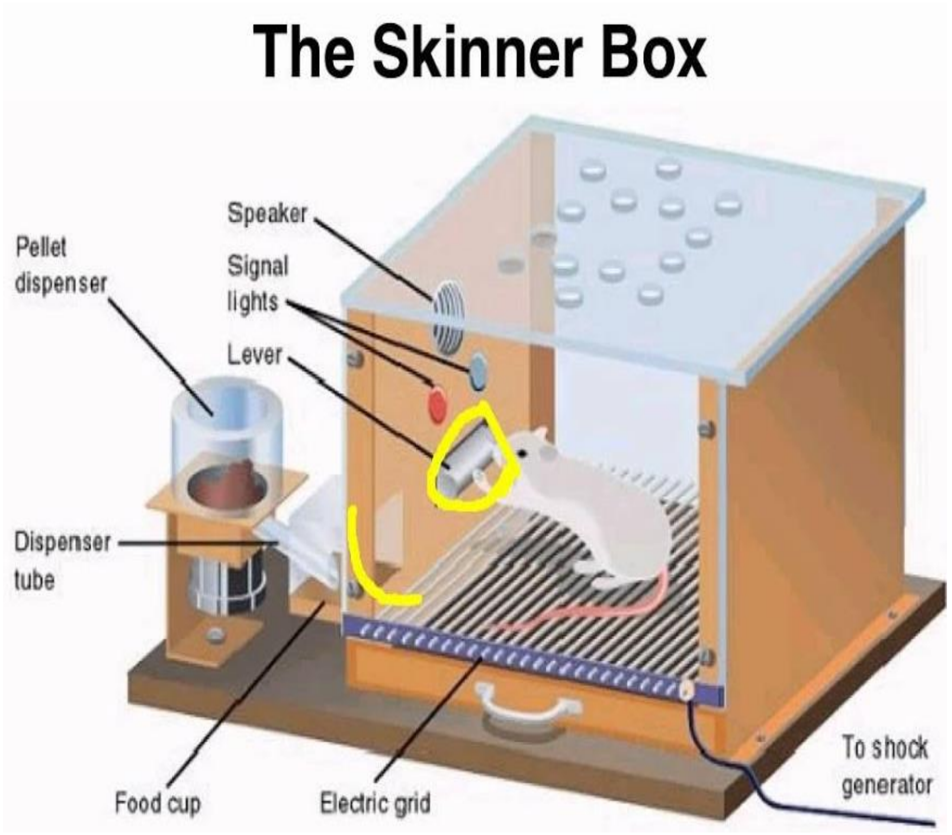
What would have occurred, according to Edward L. Thorndike (1932), was that the cat would have learned that pressing the paddle was associated with the desirable consequence of getting food. Thorndike summarized that relationship by formulating the **law of effect**: Responses that lead to satisfying consequences are more likely to be repeated. It was not necessary for an organism to understand that there was a link between a response and a reward. Instead, Thorndike believed, over time and through experience the organism would make a direct connection between the stimulus and the response without any awareness that the connection existed.



Thorndike's *Puzzle box*



The Basics of Operant Conditioning



Thorndike's early research served as foundation for the work of one of the 20th century's most influential psychologists, B. F. Skinner (1904–1990). **Skinner box**, a chamber with a highly controlled environment that was used to study operant conditioning processes with laboratory animals. In a Skinner box learn to obtain food by operating on their environment within the box.

Suppose you want to teach a hungry rat to press a lever that is in its box. At first the rat will wander around the box, exploring the environment in a relatively random fashion. At some point, however, it will probably press the lever by chance, and when it does, it will receive a food pellet. The first time this happens, the rat will not learn the connection between pressing a lever and receiving food and will continue to explore the box. Sooner or later the rat will press the lever again and receive a pellet, and in time the frequency of the pressing response will increase. Eventually, the rat will press the lever continually until it satisfies its hunger, thereby demonstrating that it has learned that the receipt of food is contingent on pressing the lever.

Reinforcement: the Central Concept of Operant Conditioning

Skinner called the process that leads the rat to continue pressing the key “reinforcement.” **Reinforcement**, process by which a stimulus increases the probability that a preceding behavior will be repeated. In other words, pressing the lever is more likely to occur again because of the stimulus of food.

In a situation such as this one, the food is called a **reinforcer**. A reinforcer is any stimulus that increases the probability that a preceding behavior will occur again. Hence, food is a reinforcer, because it increases the probability that the behavior of pressing (formally referred to as the response of pressing) will take place.

Reinforcement: the Central Concept of Operant Conditioning

Bonuses, toys, and good grades can serve as reinforcers—if they strengthen the probability of the response that occurred before their introduction. What makes something a reinforcer depends on individual preferences. Through experience we learn that money is a valuable commodity because of its association with stimuli, such as food and drink, that are naturally reinforcing. A **primary reinforcer** satisfies some biological need and works naturally, regardless of a person's previous experience. Food for a hungry person, warmth for a cold person, and relief for a person in pain all would be classified as primary reinforcers.

A **secondary reinforcer** is a stimulus that becomes reinforcing because of its association with a primary reinforcer. For instance, we know that money is valuable, because we have learned that it allows us to obtain other desirable objects, including primary reinforcers such as food and shelter. Money thus becomes a secondary reinforcer. Secondary reinforcers make up the heart of token systems sometimes used in the treatment of some psychological disorders for those who are in institutions. In a token system, a patient is rewarded for showing desired behavior with a token such as a poker chip. The token—an example of a secondary reinforcer—can then be redeemed for something desirable, such as snacks, games, or real money.

Positive Reinforcers, Negative Reinforcers, and Punishment

A **positive reinforcer** is a stimulus added to the environment that brings about an increase in a preceding response. If food, water, money, or praise is provided after a response, it is more likely that that response will occur again in the future. The paychecks that workers get at the end of the week, for example, increase the likelihood that they will return to their jobs the following week.

In contrast, a **negative reinforcer** refers to an unpleasant stimulus whose removal leads to an increase in the probability that a preceding response will be repeated in the future. For example, if you have an itchy rash (an unpleasant stimulus) that is relieved when you apply a certain brand of ointment, you are more likely to use that ointment the next time you have an itchy rash. Using the ointment, then, is negatively reinforcing, because it removes the unpleasant itch.

Negative reinforcement, teaches the individual that taking an action removes a negative condition that exists in the environment. Like positive reinforcers, negative reinforcers increase the likelihood that preceding behaviors will be repeated.

Positive Reinforcers, Negative Reinforcers, and Punishment

Negative reinforcement is not the same as punishment. **Punishment** refers to a stimulus that decreases the probability that a prior behavior will occur again. If we receive a shock that is meant to decrease a certain behavior, then we are receiving punishment, but if we are already receiving a shock and do something to stop that shock, the behavior that stops the shock is considered to be negatively reinforced. In the first case, the specific behavior is apt to decrease because of the punishment; in the second, it is likely to increase because of the negative reinforcement.

There are two types of punishment: **positive punishment and negative punishment**, just as there are positive reinforcement and negative reinforcement. In both cases, "positive" means adding something, and "negative" means removing something. **Positive punishment** weakens a response by applying an unpleasant stimulus. For instance, spanking a child for misbehaving or sending someone to jail for 10 years for committing a crime are examples of positive punishment. (In both cases, an unpleasant stimulus has been applied.)

Positive Reinforcers, Negative Reinforcers, and Punishment

In contrast, **negative punishment** consists of the removal of something pleasant. For instance, when a teenager is told she can no longer use her cell phone because she stayed out past her curfew, or when an employee is informed that he will have a cut in pay because of a poor job evaluation, negative punishment is being administered. (In both cases, something pleasant—cell phone use or more pay—is being removed.)

Both positive and negative punishment result in a decrease in the likelihood that a prior behavior will be repeated. So a jail term is meant to lead to a reduction in criminal behavior, and loss of a teenager's cell phone is meant to reduce the likelihood of staying out past curfew.

Positive Reinforcers, Negative Reinforcers, and Punishment

Intended Results

Increase in behavior
(reinforcement)

When stimulus is *added*, the result is . . .

Positive Reinforcement

Example: Giving a raise for good performance.

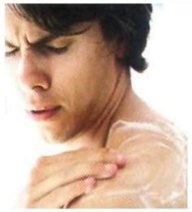
Results: INCREASE in response of good performance.

Intended Results

Increase in behavior
(reinforcement)

When stimulus is *removed*, the result is . . .

Negative Reinforcement



Example: Applying ointment to relieve itchy rash leads to higher future likelihood of applying ointment.

Results: INCREASE in response of using ointment

Intended Results

Decrease in behavior
(punishment)

When stimulus is *added*, the result is . . .

Positive Punishment

Example: Yelling at a teenager for stealing a bracelet.

Results: DECREASE in frequency of response of stealing.

Intended Results

Decrease in behavior
(punishment)

When stimulus is *removed*, the result is . . .

Negative Punishment

Example: Teenager's access to car restricted by parents due to teenager's breaking curfew.

Results: DECREASE in response of breaking curfew.

Positive Reinforcers, Negative Reinforcers, and Punishment

- Reinforcement increases the frequency of the behavior preceding it; punishment decreases the frequency of the behavior preceding it.
- The application of a positive stimulus brings about an increase in the frequency of behavior and is referred to as positive reinforcement; the application of a negative stimulus decreases or reduces the frequency of behavior and is called positive punishment.
- The removal of a negative stimulus that results in an increase in the frequency of behavior is negative reinforcement; the removal of a positive stimulus that decreases the frequency of behavior is negative punishm

Schedules of Reinforcement: Timing Life's Rewards

When we refer to the frequency and timing of reinforcement that follows desired behavior, we are talking about **schedules of reinforcement**. Behavior that is reinforced every time it occurs is said to be on a **continuous reinforcement schedule**; if it is reinforced some but not all of the time, it is on a **partial** (or **intermittent**) **reinforcement schedule**. Although learning occurs more rapidly under a continuous reinforcement schedule, behavior lasts longer after reinforcement stops when it is learned under a partial reinforcement schedule.

Example: candy vending machine and the slot machine

Partial reinforcement schedules (such as those provided by slot machines) maintain performance longer than do continuous reinforcement schedules (such as those established in candy vending machines) before extinction—the disappearance of the conditioned response—occurs.

Shaping: Reinforcing What Doesn't Come Naturally

Many complex behaviors, ranging from auto repair to zoo management does not occur naturally as part of anyone's spontaneous behavior. For such behaviors, a procedure known as shaping is used. **Shaping** is the process of teaching a complex behavior by rewarding closer and closer approximations of the desired behavior. In shaping, you start by reinforcing any behavior that is at all similar to the behavior you want the person to learn. Later, you reinforce only responses that are closer to the behavior you ultimately want to teach. Finally, you reinforce only the desired response. Each step in shaping, then, moves only slightly beyond the previously learned behavior, permitting the person to link the new step to the behavior learned earlier (Krueger & Dayan, 2009).

Shaping allows even lower animals to learn complex responses that would never occur naturally, ranging from lions jumping through hoops, dolphins rescuing divers lost at sea, or rodents finding hidden land mines. Shaping also underlies the learning of many complex human skills. For instance, the organization of most textbooks is based on the principles of shaping. Typically, information is presented so that new material builds on previously learned concepts or skills.

Cognitive Approaches to Learning

Consider what happens when people learn to drive a car. They don’t just get behind the wheel and stumble around until they randomly put the key into the ignition and, later, after many false starts, accidentally manage to get the car to move forward, thereby receiving positive reinforcement. Rather, they already know the basic elements of driving from previous experience as passengers, when they more than likely noticed how the key was inserted into the ignition, the car was put in drive, and the gas pedal was pressed to make the car go forward.

Some psychologists view learning in terms of the thought processes, or cognitions, that underlie it—an approach known as cognitive learning theory. People, and even lower animals, develop an expectation that they will receive a reinforcer after making a response.

Latent Learning

A new behavior is learned but not demonstrated until some incentive is provided for displaying it. In one experiment, a group of rats was allowed to wander around the maze once a day for 17 days without ever receiving a reward (called the unrewarded group). Understandably, those rats made many errors and spent a relatively long time reaching the end of the maze. A second group, however, was always given food at the end of the maze (the rewarded group).

Not surprisingly, those rats learned to run quickly and directly to the food box, making few errors. A third group of rats (the experimental group) started out in the same situation as the unrewarded rats, but only for the first 10 days. On the 11th day, a critical experimental manipulation was introduced: From that point on, the rats in this group were given food for completing the maze.

Latent Learning

The results of this manipulation were dramatic, the previously unrewarded rats, which had earlier seemed to wander about aimlessly, showed such reductions in running time and declines in error rates that their performance almost immediately matched that of the group that had received rewards from the start.

To cognitive theorists, it seemed clear that the unrewarded rats had learned the layout of the maze early in their explorations; they just never displayed their latent learning until the reinforcement was offered. Instead, those rats seemed to develop a cognitive map of the maze—a mental representation of spatial locations and directions.

Observational Learning: Learning Through Imitation

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. Bandura dramatically demonstrated the ability of models to stimulate learning in a classic experiment. In the study, young children saw a film of an adult wildly hitting a 5-foot-tall inflatable punching toy called a Bobo doll. Later the children were given the opportunity to play with the Bobo doll themselves, and, sure enough, most displayed the same kind of behavior, in some cases mimicking the aggressive behavior almost identically.

Piloting an airplane and performing brain surgery, for example, are behaviors that could hardly be learned by using trial-and-error methods without grave cost—literally—to those involved in the learning process. Observational learning may have a genetic basis. For example, we find observational learning at work with mother animals teaching their young such activities as hunting. In addition, the discovery of mirror neurons that fire when we observe another person carrying out a behavior suggests that the capacity to imitate others may be innate

Observational Learning: Learning Through Imitation

One crucial factor that determines whether we later imitate a model is whether the model is rewarded for his or her behavior. If we observe a friend being rewarded for putting more time into his studies by receiving higher grades, we are more likely to imitate his behavior than we would if his behavior resulted only in being stressed and tired.

Models who are rewarded for behaving in a particular way are more apt to be mimicked than are models who receive punishment. Observing the punishment of a model, however, does not necessarily stop observers from learning the behavior. Observers can still describe the model's behavior—they are just less apt to perform it