October 30:

- In psychology, **learning** occurs when behaviour or knowledge changes as a result of experience.
- **Cognitive learning** is a type of learning that is active, constructive, and long-lasting. It engages students in the learning processes, teaching them to use their brains more effectively to make connections when learning new things.
- **Associative learning** is the process by which a person or animal learns an association between two stimuli or events.
- Through evolution, stimulus-response pairings have developed, wherein certain stimuli trigger specific involuntary responses.
- **Unconditioned stimuli (UCS)** elicit **unconditioned responses (UCR)**, and these pairings are innate and somehow serve towards survival.
- If UCS repeatedly occurs without any positive or negative consequences, UCR stops.
- **Classical conditioning** is an extension of stimulus-response mappings, wherein a neutral stimulus becomes associated with a pre-existing stimulus-response pair, resulting in a new conditioned stimulus-response pair.
- Classical conditioning was first discovered by Ivan Pavlov. He was a Russian physiologist who won a Nobel Prize in Physiology or Medicine in 1904 for his work on digestive processes.
- Pavlov noticed that his lab dogs would salivate when his lab assistants turned on the machine that distributed food. Importantly, the dogs salivated before the food was distributed.
- Pavlov's work in classical conditioning prompted a wave of **behaviourism** in the early 20th century, which rules psychology for many years.
- Conditioned stimulus-response pairings are not static and change with experience.
- For successful conditioning, the UCS must reliably follow the CS over multiple trials. One exception to this is **conditioned taste aversion**. Conditioned taste aversion is an acquired dislike for a food or drink because it was paired with an illness. It can happen just after one CS-UCS pairing.
- **Extinction** is when the association between CS-UCS ends, the CR will eventually not occur in response to the CS.
  I.e. The CS–CR pair fades.
- However, after a delay, the response returns. This is called **spontaneous recovery**. Spontaneous recovery occurs when an extinct CS–UCS association which elicits the CR may become active again after a delay.

November 4:

- Pavlov was about learning through association.
- **Classical conditioning:**
  - Learning by association
  - CS predicts UCS
  - Builds on existing SR Relations
- **Operant conditioning:**
  - Learning by consequence

    - E.g. Behaving in way X within context Y leads to Z
    - Can create complete new SR relations
- The term “operant” refers to the notion that humans learn from operating on their environment. We behave, then note the consequences and use them to modulate future behaviour.
- Edward Thorndike was one of the first to study operant conditioning. Early on, his research focused on “learning by trial and accidental success.” Through this, he formed the **Law of Effect** which states that a behaviour that is followed by a positive consequence will tend to be repeated. This is similar to evolution theory.
- B.F. Skinner strongly championed the experimental study of the Law of Effect, and he made strong claims to its application to human behavior.
- He invented a number of devices for studying operant conditioning, the most famous being the operant chamber or “Skinner Box”.
- Behaviour is often measured in terms of rate of responding.
- Skinner came up with a response recorder apparatus that allowed him to record each response over time. This device is called a cumulative recorder because it keeps track of the total number of responses over time. Thus, the effects of variables on the response rate could be measured allowing one to see if certain variables strengthen the response of interest, or weaken the response of interest.
- Skinner described any behavioural event in terms of three parts:
    1. The preceding event, which usually involves the presentation of a discriminative stimulus
    2. The behavioural response to the discriminative stimulus
    3. The following event, which represents the consequence of our behaviour
- **Shaping** is teaching an organism to learn a new behavior through successive approximation.

November 6:

- The pleasure centre in our brain is near the basal ganglia.
- Doing activities that are pleasurable for us will stimulate our dopamine production.
- In general, most addictive drugs impersonate some neurotransmitter that naturally occurs in the brain. With repeated use the brain begins to assume that external sources of the drug will exist so it produces less of the natural version. In addition, via classical condition, it also learns the contexts in which an external sources tends to occur, and it really reduces natural production when in those contexts.
- Gambling is very addictive because there’s a lot of randomness to it. The most powerful rewards, the ones that affect us the most and addict us the most, have a randomness about them.
- **Primary reinforcers** are innately satisfying stimuli or activities like eating food, having sex, feeling safe, being comfortable, drinking when thirsty, etc.
- **Secondary reinforcers** gained their reinforcement abilities through association with primary reinforcers … that is via classical conditioning. They include things like money, positive social gestures, grades, etc.

- **Characteristics of Addiction:**
    - The person becomes obsessed about the object, activity or substance.
    - Over time, a person needs more of the substance or activity to feel the same euphoric effects. As tolerance increases, so do consequences and negative effects that intensify the feeling of isolation and fear of discovery.
    - They will seek out and engage in the behaviour even though it is causing harm.
    - The person will engage in the activity over and over again.
    - Ceasing the substance or activities results in physical and emotional symptoms of withdrawal. These can include irritability, craving, restlessness or depression.
    - The person does not appear to have control as to when, how long, or how much he or she will continue the behaviour.

Textbook Notes:

- **Module 6.1 Classical Conditioning Learning by Association:**
- **Learning** is a process by which behaviour or knowledge changes as a result of experience.
- **Pavlov's Dogs Classical Conditioning of Salivation:**
- Research on associative learning has a long history in psychology, dating back to Ivan Pavlov (1849–1936), a Russian physiologist.
- Pavlov and his assistants noticed that as they prepared dogs for procedures, even before any meat powder was presented, the dogs would start salivating. This curious observation led Pavlov to consider the possibility that digestive responses were more than just simple reflexes elicited by food. If dogs salivate in anticipation of food, then perhaps the salivary response can also be learned. Pavlov began conducting experiments in which he first presented a sound from a metronome and then presented meat powder to the dogs. After pairing the sound with the food several times, Pavlov discovered that the metronome could elicit salivation by itself.
- Pavlov's discovery began a long tradition of inquiry into what is now called **classical conditioning**/**Pavlovian conditioning**, which is a form of associative learning in which an organism learns to associate a neutral stimulus with a biologically relevant stimulus, which results in a change in the response to the previously neutral stimulus.
- You can think about classical conditioning in mechanical terms—that is, one event causes another. A stimulus is an external event or cue that elicits a perceptual response; this occurs regardless of whether the event is important or not. Some stimuli, such as food, water, pain, or sexual contract, elicit responses instinctively.
- An **unconditioned stimulus (US)** is a stimulus that elicits a reflexive response without learning.
- An **unconditioned response (UR)** is a reflexive, unlearned reaction to an unconditioned stimulus.
- URs could include hunger, drooling, expressions of pain, and sexual responses.
- The link between the US and the UR is, by definition, unlearned.

- A defining characteristic of classical conditioning is that a neutral stimulus comes to elicit a response. It does so because the neutral stimulus is paired with, and therefore predicts, an unconditioned stimulus.
  E.g. In Pavlov's experiment, the sound of the metronome was originally a neutral stimulus because it did not elicit a response, least of all salivation. However, over time, it began to influence the dogs' responses because of its association with food.
- A **conditioned stimulus (CS)** is a once-neutral stimulus that later elicits a conditioned response because it has a history of being paired with an unconditioned stimulus.
- A **conditioned response (CR)** is the learned response that occurs to the conditioned stimulus.
- What distinguishes the UR from the CR is the stimulus that elicits them. A UR is a naturally occurring response whereas a CR must be learned.
  E.g. Salivation is a UR if it occurs in response to a US (food). Salivation is a CR if it occurs in response to a CS (the clicking of the metronome). A CS can have this effect only if it becomes associated with a US.
- **Evolutionary Function of the CR:**
- It is important to note that the UR and CR do not have to be identical.
- Many animals have an instinct to freeze when they are scared. You see this when deer are caught in headlights. They remain motionless. The reason is that many of their predators, such as the wolf, have perceptual systems that are quite sensitive to detecting movement; so remaining still has an evolutionary survival advantage. However, if the wolf were to begin to stalk the deer, it should immediately stop freezing and run. So, there are two different defensive responses associated with fear: freezing and fleeing.
- Psychologists have spent decades trying to study these defensive responses in the lab. For instance, many conditioning experiments have studied the ability of rats to associate a cue with a painful electric shock to their feet. Some of the URs to shock include flinching, jumping, and pain. However, once the rat has learned to associate the tone with the shock, the rat's primary learned response to the tone is to freeze. The freezing CR has served many species well for millions of years, so it is the natural response to a fear-inducing signal in the laboratory. The lesson from this experimental situation is that UR and the CR are often quite different responses. The CR has been selected by evolution to be a helpful response.
- Classical conditioning has a dramatic effect on an organism's survival.
- **Classical Conditioning and the Brain:**
- At its heart, classical conditioning is a simple biological process. The connections between specific groups of neurons or specific axon terminals and receptor sites on neurons become strengthened during each instance of classical conditioning.
- According to the Hebb Rule, when a weak connection between neurons is stimulated at the same time as a strong connection, the weak connection becomes strengthened.

- During conditioning, weak synapses fire at the same time as related strong synapses. The simultaneous activity strengthens the connections in the weaker synapse.
- **Processes of Classical Conditioning:**
- Although classically conditioned responses typically involve reflexive actions, there is still a great deal of flexibility in how long they will last and how specific they will be.
- Conditioned responses may be very strong and reliable, which is likely if the CS and the US have a long history of being paired together. Conditioned responding may diminish over time, or it may occur with new stimuli with which the response has never been paired.
- **Acquisition, Extinction, and Spontaneous Recovery:**
- Learning involves a change in behaviour due to experience, which can include acquiring a new response.
- **Acquisition** is the initial phase of learning in which a response is established.
- In classical conditioning, acquisition is the phase in which a neutral stimulus is repeatedly paired with the US.
- A critical part of acquisition is the predictability with which the CS and the US occur together.
- Of course, even if a conditioned response is fully acquired, there is no guarantee it will persist forever. **Extinction** is the loss or weakening of a conditioned response when a conditioned stimulus and unconditioned stimulus no longer occur together.
- A number of studies have shown that classically conditioned behaviours that had disappeared due to extinction could quickly reappear if the CS was paired with the US again. This tendency suggests that the networks of brain areas related to conditioning were preserved in some form. Additionally, some animals (and humans) show **spontaneous recovery**, or the reoccurrence of a previously extinguished conditioned response, typically after some time has passed since extinction.
- Acquisition of a conditioned response occurs over repeated pairings of the CS and the US. If the US no longer occurs, conditioned responding diminishes—a process called extinction. Often, following a time interval in which the CS does not occur, conditioned responding rebounds when the CS is presented again—a phenomenon called spontaneous recovery.
- Extinction and spontaneous recovery are evidence that classically conditioned responses can change once they are acquired. Further evidence of flexibility of conditioned responding can be seen in some other processes of classical conditioning, including generalization and discrimination.
- **Stimulus Generalization and Discrimination:**
- **Generalization** is a process in which a response that originally occurred for a specific stimulus also occurs for different, though similar, stimuli.
- At the cellular level, generalization may be explained, at least in part, by the Hebb rule. When we perceive a stimulus, it activates not only our brain's representation of that item, but also our representations of related items. Some of

these additional representations may become activated at the same time as the synapses involved in conditioned responses. If this did occur, according to the Hebb rule, the additional synapse would become strengthened and would therefore be more likely to fire along with the other cells in the future.

- Generalization allows for flexibility in learned behaviours, although it is certainly possible for behaviour to be too flexible.
- **Discrimination** occurs when an organism learns to respond to one original stimulus but not to new stimuli that may be similar to the original stimulus.
- This point is critical: If stimuli that are similar to the CS are presented without a US, then it becomes less likely that these stimuli will lead to stimulus generalization. Instead, these other tones would have their own memory representation in the brain.
- **Conditioned Classical Conditioning:**
- **Conditioned emotional responses** consist of emotional and physiological responses that develop to a specific object or situation.
- When an organism learns a fear-related association such as a tone predicting the onset of a startling noise, activity occurs in the amygdala, a brain area related to fear.
- If an organism learns to fear a particular location, such as learning that a certain cage is associated with an electrical shock, then context-related activity in the hippocampus will interact with fear-related activity in the amygdala to produce contextual fear conditioning.
- Importantly, the neural connections related to conditioned fear remain intact, even after extinction has occurred. Instead, other neurons suppress the activity of the brain areas related to the fear responses. If the CS is paired with the US again, this suppression will be removed and the fear-conditioned response will quickly reappear.
- During fear conditioning, a neutral stimulus (NS) such as a tone or a picture of a human face is briefly presented, followed by an unconditioned stimulus (US), such as a mild electric shock. The result is a conditioned fear response to the CS.
- **Evolutionary Role for Fear Conditioning:**
- A healthy fear response is important for survival, but not all situations or objects are equally dangerous.
- **Preparedness** is the biological predisposition to rapidly learn a response to a particular class of stimuli.
- **Conditioned Taste Aversions:**
- Another example of an evolutionarily useful conditioned fear response comes from food aversions. Chances are there is a food that you cannot stand to even look at because it once made you ill. This new aversion isn't due to chance; rather, your brain and body have linked the taste, sight, and smell of that food to the feeling of nausea.
- Aversion is not simply a case of feeling gross. Instead, it involves both a feeling of disgust and a withdrawal or avoidance response. When the CS and US are

linked, the taste of the food or fluid soon produces aversion responses (the CR), even in the absence of physical illness.

- This acquired dislike or disgust for a food or drink because it was paired with illness is known as **conditioned taste aversion**.
- Classical conditioning can account for the development of taste aversions. Falling ill after eating a particular food can result in conditioned feelings of disgust as well as withdrawal responses when you are later re-exposed to the taste, smell, or texture of the food. Conditioned taste aversions are another example of conditioning occurring even though the UR and the CR are not identical responses. Importantly, these conditioned aversions only occur for the flavour of a particular food rather than to other stimuli that may have been present when you became ill.
- Neurons in reward centres in the brain show altered patterns of activity to the food associated with illness. These different brain responses suggest that illness triggers a strong emotional response that causes the reward centres to update their representation of the illness-causing food, thus making that food less rewarding.
- Although these studies may explain how some aspects of conditioned taste aversions are maintained, there are still some riddles associated with this phenomenon. For instance, the onset of symptoms from food poisoning may not occur until several hours have passed after the tainted food or beverage was consumed. As a consequence, the interval between tasting the food (CS) and feeling sick (UR) may be a matter of hours, whereas most conditioning happens only if the CS, US, and the UR occur very closely to each other in time. Another peculiarity is that taste aversions are learned very quickly—a single CS–US pairing leading to illness is typically sufficient. These special characteristics of taste aversions are extremely important for survival. The flexibility offered by a long window of time separating food (CS) and the illness (UR), as well as the requirement for only a single exposure, raises the chances of acquiring an important aversion to the offending substance.
- One potential explanation for these characteristics involves the food stimuli themselves. Usually, a conditioned taste aversion develops to something we have ingested that has an unfamiliar flavour. Such flavours stick out when they are experienced for the first time and are therefore much easier to remember, even after considerable time has passed. In contrast, if you have eaten the same ham and Swiss cheese sandwich at lunch for years, and you become ill one afternoon after eating it, you will be less prone to develop a conditioned taste aversion.This scenario can be explained by **latent inhibition**, which occurs when frequent experience with a stimulus before it is paired with a US makes it less likely that conditioning will occur after a single episode of illness.
- **Working the Scientific Literacy Model Conditioning and Negative Political Advertising:**
- An attempt to use negative emotions to alter people's opinions of political candidates is similar to a psychology research technique known as **evaluative conditioning**. In an evaluative conditioning study, experimenters pair a stimulus

with either positive or negative stimuli. The repeated association of a stimulus with an emotion leads participants to develop a positive or negative feeling toward that stimulus.

- In the laboratory, evaluative conditioning works. This phenomenon has been found with visual, auditory, olfactory (smell), taste, and tactile (touch) stimuli. It has been used to alter feelings toward objects ranging from snack foods to consumer brands to novel shapes.
- **Drug Tolerance and Conditioning:**
- In addition to influencing overt behaviours such as salivating and emotional behaviours such as phobias, classical conditioning can influence how the body regulates its own responses to different stimuli. Cues that accompany drug use can become conditioned stimuli that elicit cravings. For example, classical conditioning can help explain some drug-related phenomena, such as cravings and tolerance.
- Conditioning can also influence drug tolerance, or a decreased reaction that occurs with repeated use of the drug. When a person takes a drug, his or her body attempts to metabolize that substance. Over time, the setting and paraphernalia associated with the drug-taking begin to serve as cues (a CS) that a drug (US) will soon be processed by the body (UR). As a result of this association, the physiological processes involved with metabolizing the drug will begin with the appearance of the CS rather than when the drug is actually consumed. In other words, because of conditioning, the body is already braced for the drug before the drug has been snorted, smoked, or injected. This response means that, over time, more of the drug will be needed to override these preparatory responses so that the desired effect can be obtained; this change is referred to as **conditioned drug tolerance**.
- This phenomenon can have fatal consequences for drug abusers.
- **Module 6.2 Operant Conditioning Learning through Consequences:**
- Very few of our behaviours are random. Instead, people tend to repeat actions that previously led to positive or rewarding outcomes. Conversely, if a behaviour previously led to a negative outcome, people are less likely to perform that action again. These types of stimulus-response relationships are known as **operant conditioning**, a type of learning in which behaviour is influenced by consequences.
- The term operant is used because the individual operates on the environment before consequences can occur. In contrast to classical conditioning, which typically affects reflexive responses, operant conditioning involves voluntary actions such as speaking or listening, starting and stopping an activity, and moving toward or away from something.
- In classical conditioning a response is not required for a reward or unconditioned stimulus to be presented.
- In classical conditioning, learning has taken place if a conditioned response develops following pairings of the conditioned stimulus and the unconditioned stimulus.

- In operant conditioning, a response and a consequence are required for learning to take place. Without a response of some kind, there can be no consequence.

	Classical Conditioning	**Operant Conditioning**
Target response is	Automatic	Voluntary
Reinforcement is	Present regardless of whether a response occurs	A consequence of the behaviour
Behaviour mostly depends on	Reflexive and physiological responses	Skeletal muscles

- **Basic Principles of Operant Conditioning:**
- The concept of **contingency** is important to understanding operant conditioning; it simply means that a consequence depends upon an action.
  E.g. Earning good grades is generally contingent upon studying effectively.
- The key distinction between reinforcement and punishment is that reinforcers, no matter what they are, increase behaviour. Punishment involves a decrease in behaviour, regardless of what the specific punisher may be. Thus both reinforcement and punishment are defined based on their effects on behaviour.
- **Reinforcement and Punishment:**
- **Reinforcement** is a process in which an event or reward that follows a response increases the likelihood of that response occurring again.
- The **law of effect** is the idea that responses followed by satisfaction will occur again in the same situation whereas those that are not followed by satisfaction become less likely.
- A **reinforcer** is a stimulus that is contingent upon a response and that increases the probability of that response occurring again.
- **Punishment** is a process that decreases the future probability of a response.
- A **punisher** is a stimulus that is contingent upon a response, and that results in a decrease in behaviour.
- Like reinforcers, punishers are defined not based on the stimuli themselves, but rather on their effects on behaviour.
- **Positive and Negative Reinforcement and Punishment:**
- Both reinforcement and punishment can be accomplished by removing a stimulus as well.
- Reinforcement: This increases the chances of a behaviour occurring again.
- Punishment: This decreases the chances of a behaviour occurring again.
- Positive: This means that a stimulus is added to a situation. Positive can refer to reinforcement or punishment.
- Negative: This means that a stimulus is removed from a situation. Negative can refer to reinforcement or punishment.

- These terms can be combined to produce four different subtypes of operant conditioning. **Positive reinforcement**, is the strengthening of behaviour after potential reinforcers such as praise, money, or nourishment follow that behaviour.
- Behaviour can also be reinforced by the removal of something that is unpleasant. This form of reinforcement, **negative reinforcement**, involves the strengthening of a behaviour because it removes or diminishes a stimulus. Negative reinforcement can be further classified into two subcategories:
    1. **Avoidance learning** is a specific type of negative reinforcement that removes the possibility that a stimulus will occur.
       Examples of avoidance learning include leaving a sporting event early to avoid crowds and traffic congestion, and paying bills on time to avoid late fees. In these cases, negative situations are avoided.
    2. **Escape learning** occurs if a response removes a stimulus that is already present.
       Covering your ears upon hearing overwhelmingly loud music is one example
- **Positive punishment** is a process in which a behaviour decreases in frequency because it was followed by a particular, usually unpleasant, stimulus.
- **Negative punishment** occurs when a behaviour decreases because it removes or diminishes a particular stimulus.

	Consequence	**Effect on Behaviour**	**Example**
Positive reinforcement	Stimulus is added or increased.	Increases the response	A child gets an allowance for making her bed, so she is likely to do it again in the future.
Negative reinforcement	Stimulus is removed or decreased.	Increases the response	The rain no longer falls on you after opening your umbrella, so you are likely to do it again in the future.
Positive punishment	Stimulus is added or increased.	Decreases the response	A pet owner scolds his dog for jumping up on a house guest, and now the dog is less likely to do it again.
Negative punishment	Stimulus is removed or	Decreases the response	A parent takes away TV privileges to stop the

	decreased.		children from fighting.

- **Shaping:**
- **Shaping** is the reinforcing successive approximations of a specific operant response.
- Shaping is done in a step-by-step fashion until the desired response.
- These techniques can also be used to help people develop specific skill sets.
- **Chaining** is a process that involves linking together two or more shaped behaviours into a more complex action or sequence of actions.
- **Applying Operant Conditioning:**
- **Applied behaviour analysis** (ABA) is a method which involves using close observation, prompting, and reinforcement to teach behaviours, often to people who experience difficulties and challenges owing to a developmental condition such as autism.
- People with autism are typically nonresponsive to normal social cues from a very early age. This impairment can lead to a deficit in developing many skills, ranging from basic, everyday ones to complex skills such as language. For example, explaining how to clear dishes from the dinner table to a child with autism could prove difficult. Psychologists who specialize in ABA often shape the desired behaviour using prompts (such as asking the child to stand up, gather silverware, stack plates, and so on) and verbal rewards as each step is completed. These and more elaborate ABA techniques can be used to shape a remarkable variety of behaviours to improve the independence and quality of life for people with autism.
- **Processes of Operant Conditioning:**
- Reinforcers can come in two main forms:
    1. **Primary reinforcers** consist of reinforcing stimuli that satisfy basic motivational needs—needs that affect an individual's ability to survive and reproduce.
       E.g. Food, water, shelter, and sexual contact
    2. **Secondary reinforcers** consist of stimuli that acquire their reinforcing effects only after we learn that they have value. They are more abstract and do not directly influence survival-related behaviours.
       E.g. Money
- Both primary and secondary reinforcers satisfy our drives.
- Research points to a specific brain circuit including a structure called the nucleus accumbens that underlies the motivation to seek out these reinforcers.
- The nucleus accumbens becomes activated during the processing of all kinds of rewards.
- Variations in this area might also account for why individuals differ so much in their drive for reinforcers. For example, scientists have discovered that people who are prone to risky behaviours such as gambling and alcohol abuse are more likely to have inherited particular copies of genes that code for dopamine and other reward-based chemicals in the brain.

- Researchers have also found that individuals who are impulsive, and therefore vulnerable to gambling and drug abuse, release more dopamine in brain areas related to reward, and have trouble removing dopamine from the synapses in these areas.
- The nucleus accumbens is one of the brain's primary reward centres.
- Secondary reinforcers also trigger the release of dopamine in reward areas of the brain.
- When a behaviour is rewarded for the first time, dopamine is released; this reinforces these new, reward-producing behaviours so that they will be performed again. These dopamine-releasing neurons in the nucleus accumbens and surrounding areas help maintain a record of which behaviours are, and are not, associated with a reward. Interestingly, these neurons alter their rate of firing when you have to update your understanding of which actions lead to rewards; so, they are involved with learning new behaviour–reward associations as well as with reinforcement itself.
- **Discrimination and Generalization:**
- Once a response has been learned, the individual may soon learn that reinforcement or punishment will occur under only certain conditions and circumstances.
- A **discriminative stimulus** is a cue or event that indicates that a response, if made, will be reinforced.
  I.e. A discriminative stimulus is a type of stimulus that is used consistently to gain a specific response and that increases the possibility that the desired response will occur.
  E.g. Before we pour a cup of coffee, we might check whether the light on the coffee maker is on—a discriminative stimulus that tells us the beverage will be hot and, presumably, reinforcing.
- Discriminative stimuli demonstrate that humans and animal subjects can use cues from our environment to help us decide whether to perform a conditioned behaviour.
- The idea of a discriminative stimulus should not be confused with the concept of discrimination. **Discrimination** occurs when an organism learns to respond to one original stimulus but not to new stimuli that may be similar to the original stimulus.
- In contrast to discrimination, **generalization** takes place when an operant response occurs in response to a new stimulus that is similar to the stimulus present during original learning.
- **Delayed Reinforcement and Extinction:**
- Reinforcement is more effective if there was very little time between the action and the consequence.
- Interestingly, neuroscientists have found that neural activity decreases during this time as well. In fact, delays of as little as half a second decrease the amount of neural activity in dopamine-releasing neurons.
- This effect of delayed reinforcement influences a number of human behaviours as well. For instance, drugs that have their effect soon after they are taken are

generally more addictive than drugs whose effects occur several minutes or hours after being taken. This difference is due, in part, to the ease with which one can mentally associate the action of taking the drug with reinforcement from the drug.

- Sometimes, however, a reinforcer is not just delayed; it doesn't occur at all.
- This change is known as **extinction**, the weakening of an operant response when reinforcement is no longer available.

Process	Classical Conditioning	Operant Conditioning
Discrimination	A CR does not occur in response to a different CS that resembles the original CS.	There is no response to a stimulus that resembles the original discriminative stimulus used during learning.
Generalization	A different CS that resembles the original CS used during acquisition elicits a CR.	Responding occurs to a stimulus that resembles the original discriminative stimulus used during learning.
Extinction	A CS is presented without a US until the CR no longer occurs.	Responding gradually ceases if reinforcement is no longer available.

- **Reward Devaluation:**
- Scientists have found that behaviours change when the reinforcer loses some of its appeal.
- Reward devaluation can also occur by making one of the rewards less appealing.
- **Schedules of Reinforcement:**
- The exact timing of the action and reinforcement or punishment differs across situations. Typically, a given behaviour is rewarded according to some kind of schedule. These **schedules of reinforcement**, rules that determine when reinforcement is available, can have a dramatic effect on both the learning and unlearning of responses.
- Reinforcement may be available at highly predictable or very irregular times. Also, reinforcement may be based on how often someone engages in a behaviour, or on the passage of time.
- During **continuous reinforcement**, every response made results in reinforcement. As a result, learning initially occurs rapidly.
- In other situations, not every action will lead to reinforcement. We also encounter situations where reinforcement is available only some of the time. In this kind of **partial (intermittent) reinforcement**, only a certain number of responses are

rewarded, or a certain amount of time must pass before reinforcement is available.

- Four types of partial reinforcement schedules are possible. These schedules have different effects on rates of responding. They are:
    1. Ratio schedule: This means that the reinforcements are based on the amount of responding.
    2. Interval schedule: This means that the reinforcements are based on the amount of time between reinforcements, not the number of responses an animal or human makes.
    3. Fixed schedule: This means that the schedule of reinforcement remains the same over time.
    4. Variable schedule: This means that the schedule of reinforcement, although linked to an average, varies from reinforcement to reinforcement.
- In a **fixed-ratio schedule**, reinforcement is delivered after a specific number of responses have been completed.
- In a **variable-ratio schedule**, the number of responses required to receive reinforcement varies according to an average.
- In contrast to ratio schedules, interval schedules are based on the passage of time, not the number of responses. A **fixed-interval schedule** reinforces the first response occurring after a set amount of time passes.
- The final reinforcement schedule is the **variable-interval schedule**, in which the first response is reinforced following a variable amount of time. The time interval varies around an average.
- One general characteristic of schedules of reinforcement is that partially reinforced responses tend to be very persistent. The effect of partial reinforcement on responding is especially evident during extinction. The **partial reinforcement effect** refers to a phenomenon in which organisms that have been conditioned under partial reinforcement resist extinction longer than those conditioned under continuous reinforcement. This effect is likely due to the fact that the individual is accustomed to not receiving reinforcement for every response; therefore, a lack of reinforcement is not surprising and does not alter the motivation to produce the response, even if reinforcement is no longer available.
- **Applying Punishment:**
- People tend to be more sensitive to the unpleasantness of punishment than they are to the pleasures of reward.
- It is also important to note that, while punishment may suppress an unwanted behaviour temporarily, by itself it does not teach which behaviours are appropriate. As a general rule, punishment of any kind is most effective when combined with reinforcement of an alternative, suitable response.

Principle	Description and Explanation
Severity	Should be proportional to the offence. A small fine is suitable for parking illegally or littering, but inappropriate for someone who commits assault.
Initial punishment level	The initial level of punishment needs to be sufficiently strong to reduce the likelihood of the offence occurring again.
Contiguity	Punishment is most effective when it occurs immediately after the behaviour. Long delays in punishment are known to reduce its effectiveness.
Consistency	Punishment should be administered consistently.
Show alternatives	Punishment is more successful, and side effects are reduced, if the individual is clear on how reinforcement can be obtained by engaging in appropriate behaviours.

- **Are Classical and Operant Learning Distinct Events:**
- It is tempting to think of behaviour as being due to either classical conditioning or operant conditioning. However, it is possible, even likely, that a complex behaviour is influenced by both types of learning, each influencing behaviour in slightly different ways.
- **Module 6.3 Cognitive and Observational Learning:**
- **Latent Learning:**
- **Latent learning** is learning that is not immediately expressed by a response until the organism is reinforced for doing so. Humans experience latent learning. I.e. Latent learning refers to knowledge that only becomes clear when a person has an incentive to display it.
- **S-O-R Theory of Learning:**
- Latent learning suggests that individuals engage in more thinking than is shown by operant conditioning studies. Instead, cognitive theories of learning suggest that an individual actively processes and analyzes information; this activity influences observable behaviours as well as our internal mental lives. Because of the essential role played by the individual, this early view of cognitive learning was referred to as the **S-O-R theory (stimulus-organism-response theory)**.
- Stimulus–response (S–R) and S–O–R theorists both agreed that thinking took place; however, they disagreed about the content and causes of the thoughts. S–R psychologists assumed that thoughts were based on the S–R contingencies

that an organism had learned throughout its life; in other words, thinking was a form of behaviour. Individual differences in responding would therefore be explained by the different learning histories of the individuals. S–O–R psychologists, on the other hand, assumed that individual differences were based on people's cognitive interpretation of that situation—in other words, what that stimulus meant to them. In this view, the same stimulus in the same situation could theoretically produce different responses based on a variety of factors including an individual's mood, fatigue, the presence of other organisms, and so on.

- **Observational Learning:**
- Not all learning requires direct experience.
- Many species, including humans, are able to learn new skills and new associations without directly experiencing them.
- **Observational learning** involves changes in behaviour and knowledge that result from watching others.
- For observational learning to occur, some key processes need to be in place if the behaviour is to be successfully transmitted from one person to the next.
- **Processes Supporting Observational Learning:**
- There are four processes involved in observational learning: attention to the act or behaviour, memory for it, the ability to reproduce it, and the motivation to do so. Without any one of these processes, observational learning would be unlikely—or at least would result in a poor rendition of the behaviour.
- For observational learning to occur, several processes are required: attention, memory, the ability to reproduce the behaviour, and the motivation to do so.
- First, consider the importance of attention. Observational learning can extend to operant conditioning as well. Observing someone being rewarded for certain behaviours facilitates imitation of the same behaviours that bring about rewards.
- Second, memory is an important facet of observational learning. When we learn a new behaviour, there is often a delay before the opportunity to perform it arises.Interestingly, memory for how to reproduce a behaviour or skill can be found at a very early age.
- Third, observational learning requires that the observer can actually reproduce the behaviour. This can be very challenging, depending on the task. Research indicates that observational learning is most effective when we first observe, practise immediately, and continue practising and observing soon after acquiring the response. For example, one study found that the optimal way to develop and maintain motor (movement) skills is by repeated observation before and during the initial stages of practising. It appears that watching someone else helps us practise effectively, and allows us to see how errors are made. When we see a model making a mistake, we know to examine our own behaviour for similar mistakes.
- Finally, motivation is clearly an important component of observational learning.
- Observational punishment is also possible, but appears to be less effective at changing behaviour than reinforcement. Witnessing others experience negative consequences may decrease your chances of copying someone else's

behaviour. Even so, we are sometimes surprisingly bad at learning from observational punishment.

- **Imitation and Mirror Neurons:**
- One of the primary mechanisms that allows observational learning to take place is **imitation**—recreating someone else's motor behaviour or expression, often to accomplish a specific goal.
- However, it is currently unclear what imitation actually is, although a number of theories exist. Some researchers suggest that children receive positive reinforcement when they properly imitate the behaviour of an adult and that imitation is a form of operant learning. Others suggest that imitation allows children to gain a better understanding of their own body parts versus the "observed" body parts of others. Finally, imitation might involve a more cognitive representation of one's own actions as well as the observed actions of someone else. It is likely that all three processes are involved with imitation at different points in human development.
- Italian researchers discovered that groups of neurons in parts of the frontal lobes associated with planning movements became active both when a monkey performed an action and when it observed another monkey performing an action. These cells, now known as **mirror neurons**, are also found in several areas in the human brain and have been linked to many different functions ranging from understanding other people's emotional states to observational learning.
- Additionally, groups of neurons appear to be sensitive to the context of an action.
- Research suggest that the mirror neuron system, a key part of our ability to imitate, is sensitive to the purpose or goal of the imitated action.

Definitions:

- **Acquisition:** The initial phase of learning in which a response is established.
- **Avoidance learning:** A specific type of negative reinforcement that removes the possibility that a stimulus will occur.
- **Classical conditioning/Pavlovian conditioning:** A form of associative learning in which an organism learns to associate a neutral stimulus with a biologically relevant stimulus which results in a change in the response to the previously neutral stimulus.
- **Conditioned emotional responses:** Consist of emotional and physiological responses that develop to a specific object or situation.
- **Conditioned response (CR):** The learned response that occurs to the conditioned stimulus.
- **Conditioned stimulus (CS):** A once-neutral stimulus that later elicits a conditioned response because it has a history of being paired with an unconditioned stimulus.
- **Conditioned taste aversion:** Acquired dislike or disgust for a food or drink because it was paired with illness.
- **Continuous reinforcement:** Every response made results in reinforcement.
- **Discrimination:** Occurs when an operant response is made to one stimulus but not to another, even if the stimuli are similar.

- **Discriminative stimulus:** A cue or event that indicates that a response, if made, will be reinforced.
- **Escape learning:** Occurs if a response removes a stimulus that is already present.
- **Extinction:** In classical conditioning, the loss or weakening of a conditioned response when a conditioned stimulus and unconditioned stimulus no longer occur together.
- **Extinction:** In operant conditioning, the weakening of an operant response when reinforcement is no longer available.
- **Fixed-interval schedule:** Reinforces the first response occurring after a set amount of time passes.
- **Fixed-ratio schedule:** A schedule in which reinforcement is delivered after a specific number of responses have been completed.
- **Generalization:** Takes place when an operant response occurs in response to a new stimulus that is similar to the stimulus present during original learning.
- **Imitation:** Recreating someone else's motor behaviour or expression, often to accomplish a specific goal.
- **Latent inhibition:** Occurs when conditioning a response can take longer if the subject experiences the conditioned stimulus repeatedly before it is actually paired with a US.
- **Latent learning:** Learning that is not immediately expressed by a response until the organism is reinforced for doing so.
- **Law of effect:** The idea that responses followed by satisfaction will occur again in the same situation whereas those that are not followed by satisfaction become less likely.
- **Learning:** A process by which behaviour or knowledge changes as a result of experience.
- **Negative punishment:** Occurs when a behaviour decreases because it removes or diminishes a particular stimulus.
- **Negative reinforcement:** Involves the strengthening of a behaviour because it removes or diminishes a stimulus.
- **Observational learning:** Involves changes in behaviour and knowledge that result from watching others.
- **Operant conditioning:** A type of learning in which behaviour is influenced by consequences.
- **Partial (intermittent) reinforcement:** A schedule in which only a certain number of responses are rewarded, or a certain amount of time must pass before reinforcement is available.
- **Partial reinforcement effect:** A phenomenon in which organisms that have been conditioned under partial reinforcement resist extinction longer than those conditioned under continuous reinforcement.
- **Positive punishment:** A process in which a behaviour decreases in frequency because it was followed by a particular, usually unpleasant, stimulus.
- **Positive reinforcement:** The strengthening of behaviour after potential reinforcers such as praise, money, or nourishment follow that behaviour.

- **Preparedness:** The biological predisposition to rapidly learn a response to a particular class of stimuli.
- **Primary reinforcers:** Reinforcing stimuli that satisfy basic motivational needs—needs that affect an individual's ability to survive (and, if possible, reproduce).
- **Punisher:** A stimulus that is contingent upon a response, and that results in a decrease in behaviour.
- **Punishment:** A process that decreases the future probability of a response.
- **Reinforcer:** A stimulus that is contingent upon a response, and that increases the probability of that response occurring again.
- **Reinforcement:** A process in which an event or reward that follows a response increases the likelihood of that response occurring again.
- **Schedules of reinforcement:** Rules that determine when reinforcement is available.
- **Secondary reinforcers:** Stimuli that acquire their reinforcing effects only after we learn that they have value.
- **Shaping:** Reinforcing successive approximations of a specific operant response.
- **Spontaneous recovery:** The reoccurrence of a previously extinguished conditioned response, typically after some time has passed since extinction.
- **Unconditioned response (UR):** A reflexive, unlearned reaction to an unconditioned stimulus.
- **Unconditioned stimulus (US):** A stimulus that elicits a reflexive response without learning.
- **Variable-interval schedule:** The first response is reinforced following a variable amount of time.
- **Variable-ratio schedule:** The number of responses required to receive reinforcement varies according to an average.