



PSY1101 Final Exam - Test review sheet

Introduction to Psychology: Foundations (University of Ottawa)

Module 2 Notes

Methods

Rationalism: The view that reason and logical argument, but not experience, is most important for how we acquire knowledge. (Hermann Ebbinghaus answered questions about how the mind worked through this)

- Aristotle used rationalism to reason that human thoughts, perceptions and emotions were part of the heart rather than the brain
- He recognized the heart as the centre of our being: the heart is the seat of our senses and emotions

The flaw in rationalism is that what we ‘think’ is true about behaviour is often different from how we actually behave. The differences between how we think we might act and how we behave highlight the limits of rationalism to explain behaviour.

Scientific Method:

- Identify the problem
 - Based on observation, previous research established theory or intuition
- Gather information
 - Once topic of interest is identified, review scientific literature to examine existing theories of behaviour
- Generate a hypothesis
 - Researchers develop a hypothesis, educated prediction, about the outcome
- Design and conduct experiments
 - Develop an experiment to test the hypothesis and collect data
 - There are two different groups under study and the only difference is that one section gets credit, the other doesn’t
- Analyze data and formulate conclusions
 - Determining whether the findings support the hypothesis
 - New data/evidence may come along that could refute the hypothesis
- Restart the process
 - Process starts over again – researcher reconsiders the original question/problem and may choose to either replicate the same experiment, conduct another one with modifications or move onto a new topic

Descriptive Methods: Any means to capture, report, record or describe a group – interested in identifying ‘what is’ without necessarily understanding ‘why it is’. Four popular methods:

- Naturalistic observation
 - Observation of behaviour as it happens in a natural environment, without an attempt to manipulate or control the conditions of the observation
 - Ex: Observing the behaviour of animals in a zoo compared to animals in their natural habitat
 - Lack of manipulation is key
 - *Field experiment:* researcher manipulates and controls the conditions of the behaviour under observation – observations can be captured quantitatively or qualitatively
 - It helps generate new ideas about an observed phenomenon
 - Helps us understand behaviour as it happens in the real world – this behaviour is ecologically valid as the observations are a product of genuine reactions (it is important to stay unobtrusive as possible so people don’t realize they are being watched)
 - Disadvantages of natural observations:
 - Researchers lack control over the environment and the many different factors that can affect behaviour – weakens the conclusions, makes it difficult for it to be repeated
 - Researchers’ perspectives and bias may influence the interpretation of behaviours – two observers may make two varying observations – it is important for researchers to share results and ensure interrater reliability
- Participant observation
- Case studies
 - An in-depth analysis of a unique circumstance or individual; popular in medicine where an unusual patient is observed and attempt to investigate the condition to explain a broader phenomenon

- Psychologists should engage in accurate, honest, and non-biased practices in the science, teaching and practice of psychology
- Justice
 - Establish equality in the research process
 - People who participate in the research process should also be the same people who stand to benefit from the research outcomes; Justice is stated to prevent exclusion of populations from research – researchers should include or exclude any group for reasons unrelated to the study
 - There can be *inclusion criterion* (a participant attribute that is essential to answer the question) and *exclusion criteria* (attributes that would prevent participation because they cannot address the question) – *eligibility criteria*: set of characteristics shared by all participants that ensure those participating will help support question
- Respect for people's rights and dignity
 - Each person is valued, and researchers take measures to respect and protect participants' rights, privacy and welfare – must communicate openly and honestly about the details of the study before asking for participants' consent to participate, and respect privacy and confidentiality of all participants (data cannot be traced back to person)
 - Respect for dignity means understanding vulnerabilities of the participant populations – not coerced into anything they're not comfortable with

Practice of Ethical Research: Study will be reviewed by the Institutional Review Board

- The proposed study will use sound research design.
- Risks associated with participation in the study are minimized and reasonable.
- The benefits of the research outweigh any potential risks.
- All participants can make an informed decision to participate in the study, and that decision may be withdrawn at any time without consequence to the participant.
- Safeguards are in place to protect the well-being of participants.
- All data collected will be kept private and confidential.

Once this is approved, informed consent must be received by all participants: the process where researchers work with participants to describe essential details of the study. (There was no presence of this in the Facebook Emotional Contagion Experiment – conducted in the ethical gray areas due to users unknowingly participating)

Ethical Considerations

- *Vulnerable populations:* Include any individual or group with any of the following criteria
 - *Decisional impairment:* refers to any instance when a potential participant has diminished capacity to provide informed consent
 - *Situational vulnerability:* when the freedom of choice to participate in research is compromised as a result of undue influence from another source
- They should not participate and researchers should consider:
 - No study should ever be conducted on vulnerable populations if the research question could be reasonably carried out using participants without these vulnerabilities.
 - When research is carried out with vulnerable populations, researchers should be responsive to the needs, conditions, and priorities of these individuals. IRB committees should include members with expertise on these populations.
 - In instances of decisional impairment, consent to participate in the research process requires that two types of consent are acquired: Parents and guardians must provide informed consent on behalf of the participant *and* the participant must provide assent (affirmative permission to take part in the study). In this case, both parties are needed to give the okay to participate before their participation can begin.
 - In cases of situational vulnerability, additional safeguards should be put in place to prevent exploitation. For instance, a study may include an impartial third party to advocate on behalf of individuals who might not otherwise feel comfortable doing so.
- *Deception* – researchers may feel that informing participants of the real intent of their research may change the way participants react during the experiment – may seek to engage in *participant deception*: the act of withholding information about the purpose/procedure in the informed consent process
- In order for this to be valid it must meet the criteria:

- The research poses no more than a minimal risk to participants. This means that the research is unlikely to cause emotional or physical discomfort to participants.
- The deception does not affect the well-being and the rights of the participants throughout the study.
- Researchers must provide justification that using deception is the only way to conduct the study. There should be no other reasonable alternative approach to addressing the research questions.
- After the participant's role in the study is finished, participants should be *debriefed* by researchers and provided with information about what the researcher was investigating and how their participation will contribute to the research question. On the rare occasions when deception is used in a study, participants must be told about the deception and given reasons why this was necessary to answer the research question. Participants should also be allowed to ask questions and seek clarification about any part of the study. The goal of this process is not only to provide information to participants, but also to help them leave the study in a similar mental state as to when they entered the study.

Correlation: Researchers must decide how they want to analyze and explore this information, often looking to identify relationships that exist between two or more variables – we can quantify this relationship through correlation;

- This can be done through representation on a scatterplot where there is a visual representation of the relationship
- Correlations have positive, negative or zero directionality – positive does not imply goodness and negative does not denote badness; when there is a positive correlations variables change in the same direction, when there is a negative correlation – the increase in one variable leads to a decrease in the other, a zero correlation indicated that there is no apparent relationship between variables
- The strength of a correlation is determined by the correlation coefficient – the value ranges from -1 to +1, the (+/-) indicate direction and the number is the strength of the correlation – as the coefficient gets stronger, the value approaches (-/+1); directionality is unrelated to strength, where there is no relationship, $r=0$
- Correlations are not causation, simply a relationship between two variables
- Confounding variable: another variable that may influence one or both variables, and thus influence coefficient

Experimental Methods

A *hypothesis* is a prediction about what will happen in research. The aim of conducting experimental research is to explain cause-and-effect relationships. It should follow the criteria:

- It should be consistent with prior observations or an existing theory
- It should be as simple as possible
- It should be testable
- The hypothesis should be falsifiable

Experimental and Control Groups: Researchers need to select groups that are fair and representative of the bigger population.

- *Simple random sampling:* every individual in the population has an equal chance of participating
- *Stratified random sampling:* divides the population by subgroups, then randomly takes samples in proportion to population of interest
- The group that receives the treatment of interest is the *experimental group*
- The *control group* is nearly identical to the experimental group but does not receive the treatment
- Power of mind can influence our feelings and behaviour; placebo effect

Describing data

- *Deceptive statistics* are a collection of ways to describe data in the simplest way possible through quantitative values
- *Central tendency* is the score that best represents the others; *mean*, *median* and *mode* – allows a researcher to summarize large sets of data in an objective way (Mean can be affected by extreme values)
- *Variability* describes the spread/ distribution of the data (basically, how variable the data is!). So in the example on Table 2.3., you can see that the range in Class A is much bigger than Class B. In class B, everyone got around the same grade. In Class A, people got very different grades (anywhere from 100 to 60). Variability can be measured by multiple measures, but SD is one of these measures. SD is calculated by:
 - Calculate the squared deviation of each score (i.e. $(\text{score} - \text{mean})^2$)
 - Calculate the variance, which is the average of the squared deviations (i.e. sum of the squared

deviations / number of scores)

- The square root of the variance.
- When you're calculating for population, the denominator in the variance is the number of scores (n). But for samples, the denominator is number of scores minus 1 ($n-1$) in order to account for some error in measurement.
- The average of the squared deviation scores is called variance

Module 3

Can you answer these questions?

Label the neuron, describe its functions and tell me how they communicate

Why's the language of the brain electrochemical?

What are the subsystems of the nervous system?

Label major parts of the brain and explain the functions

What are the methods of neuroscientific research?

An Intro to the nervous system

The nervous system is the interpreter of the events in your body and in the outer world.

Our brain and spinal cords are the problem solvers that mail messages and receive them.

When they get signals, they send them to the nervous system that processes this information.

It's overall purpose is to create behaviour.

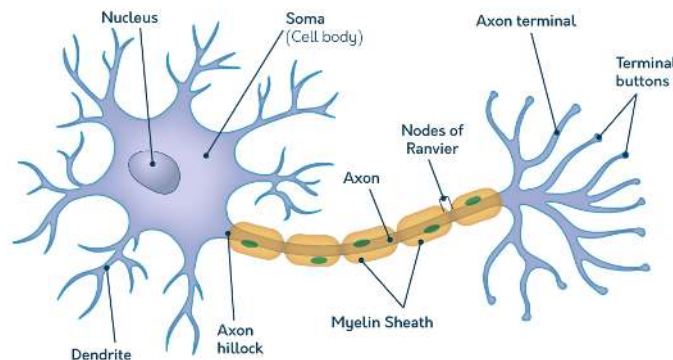
What are the parts of the nervous system?- (Gray matter)

1. Neurons – transmit electrical impulses
2. Glial cells – provide support function

Neurons: the building blocks of the nervous system

Neurons have a cell body, nucleus and organelles like other cells. How are they different then?

They communicate with each other through chemical messages that alter electrical activity.



A breakdown of neurons

Dendrites are extensions of the membrane and receive chemical messages. With age dendrites spread and form new and more complex connections.

- More dendrites = more contacts
- Receptor proteins are embedded into dendrite membranes. Receptors bind with neurotransmitters.

Soma: The dendrites attach to the soma (body).

- Location of metabolic processing in the cell. Holds organelles.

Axon Hillock : stick out from the membrane and is the start of the axon.

Axon: It's the wire that passes the signal from the soma to the end axon ONLY 1.

Axon Terminals & Terminal Buttons: Crucial for neural communication.

- Houses vesicles (bubbles with neurotransmitters)
- At this site, the neuron will release neurotransmitter that send signals to dendrites.
- Also call presynaptic neuron
- Vesicles \square into the synapse room and neurotransmitters just float there until someone cuts like \square

postsynaptic receptors □ call them.

Myelin: a fatty protein that's like an insulator. Keeps the electrical impulse flowing down the axon.

Nodes of Ranvier: Breaks in the myelin and allow ions to enter the cell allowing more efficient signal transmission.

How do we even create electrical energy?

Action potential: Electrical activity in our body exists because ions run around.

Negative ions inside a cell creates a negative charge. (-70mV) and is called polarized.

- When it is polarized it will not release neurotransmitters.

Positive ions = positive charge. Called depolarization.

- The more depolarized, the more likely it is to react

How do ions even run around?

Through channels that go through the membrane. Channels can be locked and need someone to open her up like neurotransmitters OR some wait for a stimulus like charge to change.

- Action potential is created by Na⁺ moving into the neuron.

What's action potential? – Something you gotta review bimbo****

Because there's many Na channels along the axon, it causes the electrical impulse to continue.

When the channels sense positive shift, they open, and the cycle continues. This cycle is **propagation**.

We can't be open all the time... we're Na Channellssssssss

To catch a break the opening of K channels. Allows the neuron to return and maintain resting potential.

K channels also react to depolarization but only after Na.

Na coming in triggers K to leave.

Another way of controlling when to turn neurons on or off is through chemical interactions released from axons to dendrites.

How do Neurotransmitters work?

Some neurotransmitters are excitatory: increase the chance of a neuron becoming active

Some are inhibitory and decrease the chance of a neuron becoming activates.

Channels also have locks because they don't always want to be open.

Imagine you have something that opens many doors on one floor, but each room has a different purpose.

When neurotransmitters enter the synaptic space they are attracted to the □postsynaptic □ neurons and alter cell activity. If enough neurotransmitters activate their receptors, we get an action potential.

What kinds of Neurotransmitters are there?

Each neurotransmitter is specific to a receptor protein. And the interaction creates different responses within the neuron. Ex: inhibitory or excitatory

GABA binds to open a Cl channel and inactivates the cell.

Don't do Drugs

The interaction between neurotransmitters can be artificially manipulated through chemicals.

Agonists (mimic) the action of an **endogenous** (OG)

Agnostics prevent the action of the original and compete to get to the binding site. Some can be non-competitive but they're passive aggressive and will interfere from some hidden location.

Drugs are partial agonists a bind with less power than the OG. It'll bond to the same receptor but for a shorter time.

Neurotransmitter	Excitatory/ Inhibitory	Function	Associated Drugs
Glutamate	Excitatory	Learning and movement	PCP (causes hallucinations), Ketamine (anesthetic)
GABA	Inhibitory	Learning, anxiety regulation through inhibition of neurons	Valium (used to treat anxiety), Flumazenil (used to reverse anesthesia)
Acetylcholine	Excitatory	Learning, muscle action	Botox (Botulinum toxin, inhibits release of Acetylcholine)
Dopamine	Excitatory/ Inhibitory	Learning, Reward/Pleasure	Cocaine (prevents reuptake of dopamine, produces euphoria)
Serotonin	Excitatory/ Inhibitory	Elevation / depression of mood	Prozac (prevents reuptake of serotonin, used to treat depression)
Norepinephrine	Excitatory/ Inhibitory	Elevation / depression of mood	Doxepin (used for treating anxiety and depression)
Enkephalins/ Endorphins	Excitatory/ Inhibitory	Regulation of pain responses	Opiates (Morphine, Heroin)

Glial Cells

Glial cells support neurons and outnumber them. They're like the caretakers providing

- Structural support
- Nutrients
- Remove waste
- Speeding up electrical impulses

Myelin wraps around axons by glial cells called: **oligodendrocytes**

They also do the same thing for nerves outside the brain and are called: **Schwann cells**.

Astrocytes and **microglia** help form the immune system of the brain.

- Fight infections
- Clean up debris

If they don't function properly it can lead to neurodegenerative diseases.

Building the Network

So, we know that electrical impulses signal the release of neurotransmitters but how do we get that to organs or muscles?

Through neural Networks.

- Complex connections between dendrites and axons of many neurons.

A nerve is just a bundle of axons from many neurons bundled into a tube.

Specific axons, **efferents** carry impulses away from CNS to trigger neurotransmitter or hormone release in an organ or muscle

Others called **afferents** carry impulses to the CNS from muscles.

Changing the system

Because the system responds to outside stimuli it should be able to change itself!

This is done through the process of **neuroplasticity**

At birth we have an excess of neurons and we lose them as we grow. We need to get rid of them if they are inefficient, damaged or unnecessary.

- The system can grow new branches on dendrite and change the amount of receptors/neurotransmitters. (mirror therapy after a stroke)
- Many processes our automatic and subconscious. They have specific networks dedicated to them.

The part that does conscious decision making is the **neocortex**- outer layer of brain

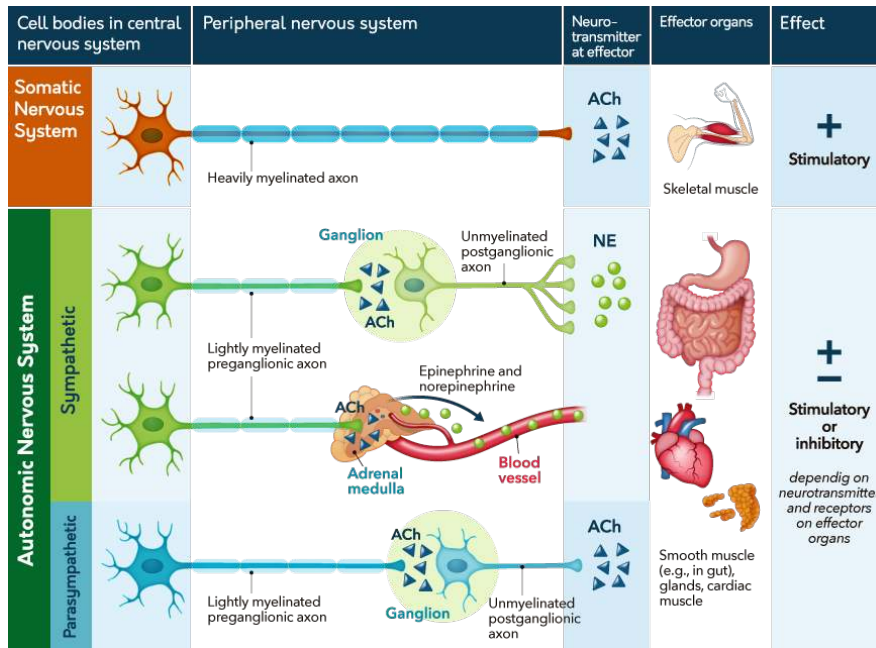
The part that does basic life functions is the **medulla**.

Stressful situations can give us some control over basic life functions like thinking of something that calms you down.

Types of Systems

1. Central – brain and spinal cord
2. Peripheral - nerves outside skull, vertebral column, special sensory ending

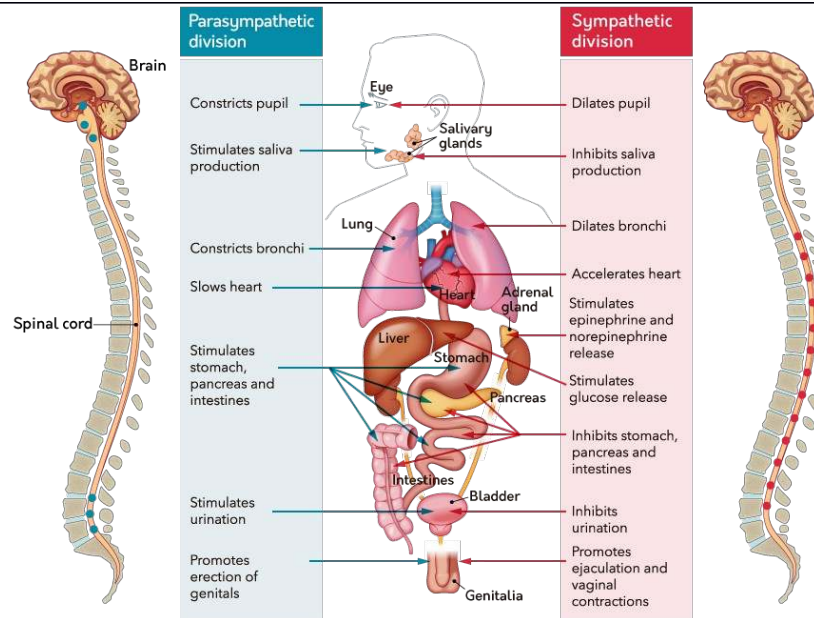
Peripheral System



Somatic (voluntary)- contain neurons that control muscles for voluntary movement and bring sensory information from the body → brain.

Ex: throwing a ball sends commands activating somatic neurons creating action potential in nerves.

Autonomic- is divided into sympathetic(go) and parasympathetic(relax)



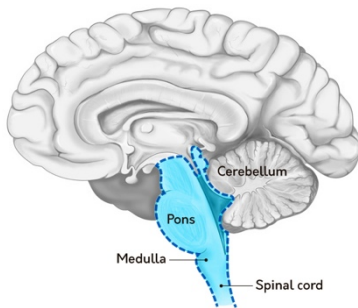
Parasympathetic- nerve and neurons originate in the lower brain and sacral spinal cord. They transmit commands to your organs that help you recover, digest, and become sexually aroused.

Sympathetic-neurons and supporting cells in the spinal cord. When you're scared your heart beats a lot to pump blood into muscles and field of vision is narrowed.

When one is activated the other is deactivated

Parts of the brain- from a functional view

The medulla and pons (network of cells for alertness) sustain basic life functions and are found in all animals. They also connect the peripheral and CNS



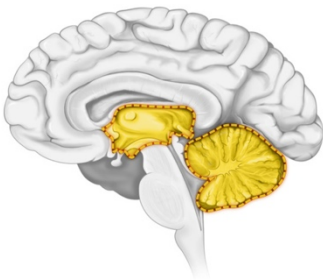
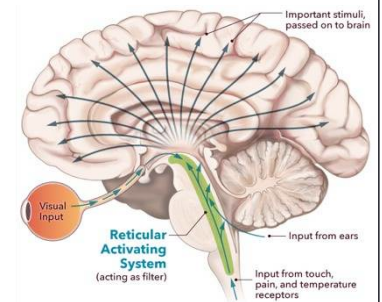
Medulla- without it you could not breathe, heart could not beat, and you could not swallow. Being an alcoholic like me depresses medulla activity

Pons- info goes from spine c. → medulla → pons so that info can be useful at each step. Helps regulate excitement, coordinate senses with cerebellum and

a bridge for tracts from upper to lower brain. Controls facial expressions & eye movement.

Reticular activating system- network of neurons spanning the center of the medulla and pons. Bridges the function of body + brain through spinal connections and the thalamus.

- Controls the level of arousal
- Control our attention on tasks
- Filter out unnecessary stimuli



Network of neurons and glia in the **limbic system**, **basal ganglia** and cerebellum are modifiers of action and thought
Collect info from impulses and help cortical circuits modify high-level commands

Areas that help us adjust on the fly after the prefrontal cortex makes decisions. Feel emotions + Remember

Limbic system- composed of circuits in the cortex (telencephalon) and the midbrain. Helps regulate endocrine system and emotions + emotion



memory. Contains prefrontal cortex, olfactory cortex amygdala, hippocampus, cingulate gyrus and hippocampus. Integrates primitive functions with complex high order thoughts.

Amygdala – increases e activity under threat.

Aggressive under threat. Responsible for norepinephrine during fight and flight and strong bitch memories. Integral to fear.

- Receives sensory input from everyone and calculates emotional value + intensity

Hippocampus – a loop of neurons that are activated when forming memories. Hippocampal synapses strengthen making more receptors and transmitters over time.

Cingulate gyrus - set of neurons that have increased activity after physical pain and social exclusion. Helps us focus on thoughts that are unpleasant. Sounds really rude. We should cut her off.

Hypothalamus – helps control many functions is the autonomic and endocrine system. Responsible for hunger responses, sexual behavior, temperature and aggression

Basal Ganglia- interconnected groups of neurons that modulate movement in the brain before they get to the spinal cord. Helps make complex moves more automatic

Cerebellum- a rhythm and timing machine. Neuronal circuits are connected with other parts of the brain to modify what they do. The circuits are set up to simultaneously receive and organize info from multiple networks.

1. Spinocerebellar – match sensory input to motor plans to fine-tune movement
2. Vestibulocerebellar – process info from inner ear to help adjust posture + balance
3. Cerebrocerebellar – manages connections with the pons and thalamus to adjust timing and planning of movements.

Thalamus – arranges connection between senses ex: the sight of some cookies can make you think of how they smell.

Each cluster of neurons in the thalamus responds to a particular function and location.

The RAS determines arousal the thalamus uses to choose which thing we pay attention to

Should we know the different parts of the thalamus and their function?

Neocortex- governs personality, context and decision making. Classic picture when you think of a brain. □

Gyri (ridges) sulci (valley) and fissures (space between lobes) Its structure allows us to fit more brain into a small space like the skull and has 6 layers.

Each lobe gets sensory info in primary areas adjacent to these are the association cortex that further process info.

1. **Frontal lobe**- decision making and movement. At the very end of this lobe is the motor cortex that houses neurons that initiate voluntary movement. *Homunculus* A representation of the number of neurons dedicated to a specific body part.
 2. **Prefrontal Cortex**- Receives input from all parts of the cerebral cortex. Helps decide when why and how we do things. Has inhibitory and excitatory connections. Helps us formulate decisions that are “if then”. More complex than just “go or stop”. Dysfunction in the prefrontal cortex correlate's with negative symptoms such as *social withdrawal*.
- **Ventromedial P.C**- helps modulate behaviour based on fear
 - **Dorsolateral P.C**- helps maintain info in our memory and change how we do things depending on the task.

Prefrontal cortex is one of the last regions to undergo myelination (oligodendrocytes wrap myelin around axon to speed up transmission) This is a contributing factor to more impulsivity mostly in teens.

Parietal Lobes

Moving towards the back of the head we get to the parietal lobes. It's circuitry Processes numbers and performs calculations.

Right- navigates spatial relations

Left- interprets sensation

Closer to the frontal lobe, it receives info from the opposite side of the body. Allows info from the skin and muscles to integrate with other areas of the brain via circuits in the brainstem + thalamus. Coordinates both side of the body.

Temporal lobes- part of brain above ear. Helps in forming memories and processing sound.

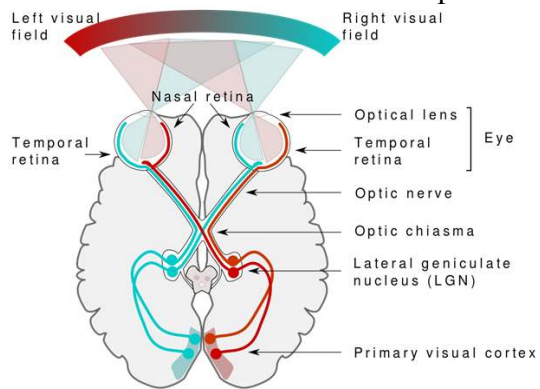
Lesions result in memory loss and ability to form new memories (anterograde amnesia)

Houses the **Wernicke's area** important for processing language. And house the **olfactory** that helps us smell.

□□

Occipital lobes □

A third of our brain is dedicated to processing visual information.



Module 5

Perception

- We use info from the world, to build our experiences – these are sensations. Sensations are features of the environment that we use to create an understanding of the world
- Sensations are raw material of perception.
- Sensations are transduced, or translated, by the sensory system into brain – then the brain takes a given message and combines it with previous experiences to create a perception.

Top-Down and Bottom-Up Processing

- Perception is only partly based on the information coming in from the world, we also use memories to interpret these messages.
- The brain uses your prior understanding from years of reading experience to make a ‘guess’ – you use memory to apply it to future problems.
- Bottom-up processing is the neural processing that starts with the physical message or sensations – early-level analysis that prepares the info for use.
 - Processing of the configuration of a face and the light and shadow showing depth.
- Top-down processing occurs when we combine the incoming neural message with our understanding of the world to interpret information so that it has value.
 - Combining different sensations with knowledge of how faces work to form the perception that a face is coming out at you (even if its concave)
- Bottoms-up processing involves processing the individual components of stimulus while top-down processing relies on your experience.
- Perceptions are created from the combination of these two processes working together.

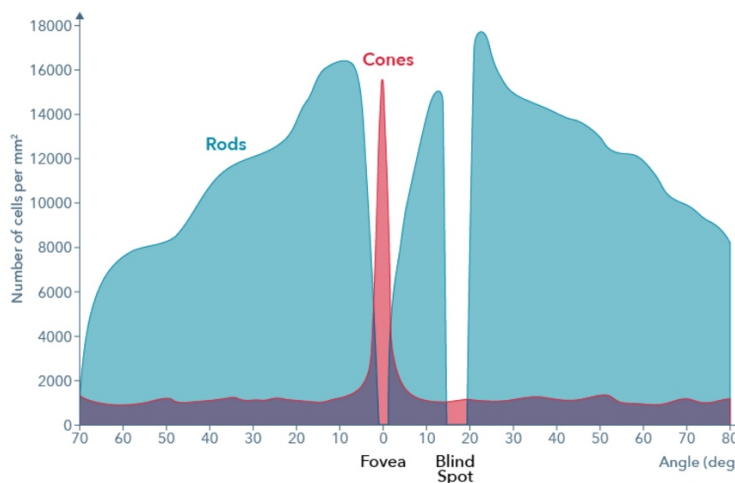
Principles of Gestalt

- Believed that perception was more complicated than just assembling messages – they believed that we are born with specific ways of organizing information, so it has use.
- The Gestalt principles of organization outline ways we see the world.
- Principle of figure-ground – Ex: Turning out the background noise at a party to participate in one conversation – Certain information has priority over the background.
- Principle of proximity - objects that are close to one another will be grouped together.
- Principle of similarity - objects that are physically similar will be grouped together.
 - Ex: spectators at a football game
- Principle of closure - people tend to perceive whole objects even when part of that information is missing
 - Ex: dotted lines making a circle: despite missing info, the lines present send a coherent message
- Principle of good continuation states that if lines cross each other or are interrupted, people tend to still see continuously flowing lines.
- Principle of common fate – objects that are moving together will be grouped together

The Eye

- Light is a form of electromagnetic radiation, we can only see 400-700nm of light.
- Light/the image goes through your cornea first. This is the outermost, protective, transparent layer that contributes to your ability to focus.
- It then enters your eye through the pupil. This is a hole that expands and contracts, based on environment – it is important to regulate how much light enters the eye due to the sensitivity of cells. In bright, pupil is small. In dimmer settings, pupil dilates so more light can reach retina. This is controlled by the band of muscles call the iris.
- The iris provides colour but does have function in vision.
- Light then goes through the lens, behind the pupil. Layered like an onion and is a flexible piece of tissue, which refracts the light and brings image into focus on the sensory cells.
 - This is accommodation; determined by the distance between lens and object being viewed.
 - When object is close, lens is thick and round. When object is far, lens elongates.
 - Nearsightedness (Myopia): lenses that bring light into focus before reaching the retina. Can see objects clearly when they are close but as they move far away it becomes harder

- Farsightedness: Can see objects in distance clearly, but as become blurry as they come closer. Due to the lens refracting light so it focuses behind the retina.
- Photoreceptors: where light is transduced into cellular activity.
 - Two kinds of photosensitive cells: Rods and Cones, which both transduce energy into neural language.
 - Chemical based, as the cells contain photopigment sensitive to light. This chemical reaction leads the cell to send a message to adjacent neurons and neural impulses are sent to the brain.
 - 126 million cells at back of retina.
 - Fovea: A dense cluster of approximately 6 million cones.
 - Cones respond when there is a lot of light in the environment.
 - Cones transmit info about fine details – visual acuity - because a few cells connect to adjacent ganglion cells.
 - Rods are found in periphery of retina.
 - Typically sensitive at lower levels of light.
 - The primary cells used for night vision.
 - Generate neural impulses even when there is only a small amount of light available.
 - Most nocturnal mammals have a large percentage of rods.
 - Dark adaptation occurs as rods and cones adapt to changes in light.
 - Ex: Coming into your dark classroom from being in bright light outside, you can't see much.
 - Your cells need time to adjust to the sudden change in light.
 - Occurs in two stages: Cones respond rapidly to change in light. After 8 min, the cones cannot become more sensitive. The rods will continue to increase their sensitivity for 20 more min.
 - Cones are the only cell that communicate info about wavelength (colour) of an object.
 - Rods only respond to quantity of light rather than quality.
- During refraction, the lens inverts the interpreted image.
 - The brain uses prior info of how the world works to present a conscious perception of the visual world right side up.
 - Only the center of image is in focus or in colour within retina. The center is full of high-acuity, colour-sensitive cones.
 - As we move away from the center, the image become blurry and is in black and white. This is where rods process the visuals. Rods help process location of objects and location of movement in the environment.



The Retina

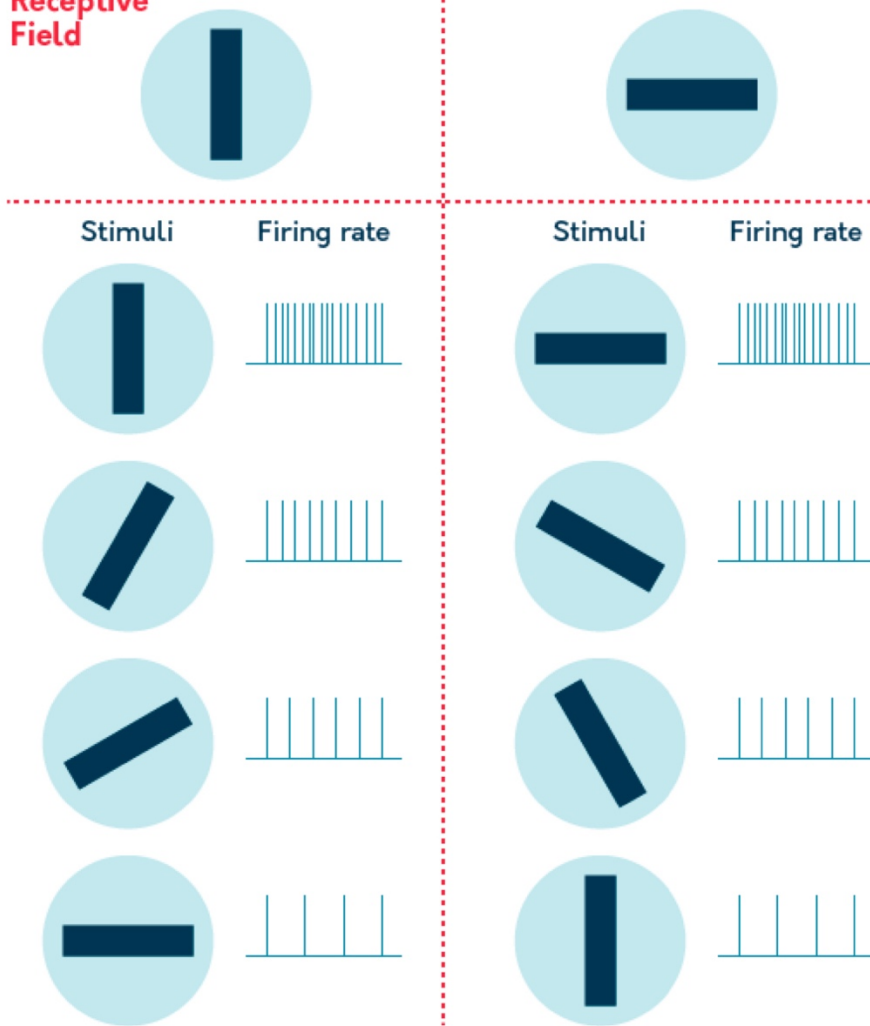
- Rods and cones send their messages to bipolar cells.
- Bipolar cells add together the firing of several photoreceptors and send a different kind of message to a ganglion cell. The number and kinds of connections that bipolar cells make are determined by their location.
- In peripheral vision: diffuse bipolar cells can receive messages from as many as 50 rods.
- Diffuse bipolar cells then add together the experience of the photoreceptors and send a single message to the ganglion cell.
- Midget bipolar cells receive input from only a single cone and this is sent to a single ganglion cell.

- This is the cause of the different in visual acuity across the surface of the retina. While midget bipolar cells in the center receive a large amount of information about the qualities of a single point of light, cells in the periphery receive little information from a much larger area of retina.
- This allows the brain to receive more complex message.
- Each ganglion cell has a receptive field – responds only when light falls on specific portion in eye or when specific cells are active.
- Ganglion cells are organized in center-surround fashion.
 - When light falls on the centre of the receptive field, the cell will respond more rapidly.
 - When signal falls on the surround part of the receptive field, the cell reduces the firing rate.
- The messages leave the eye and enter the brain via the optic nerve.
- This causes a spot on the retina where there are no photoreceptors – creates blind spot. Brain fills in this gap based on the other eye and prior knowledge.

Visual Cortex

- Message from optic nerve travels to the optic chiasm.
 - This is where axons from each eye are reorganized for processing.
 - Info from right side of both eyes goes to left hemisphere.
 - Info from left side of both eyes goes to right hemisphere.
- Image has first interaction with brain in lateral geniculate nucleus in the thalamus.
 - Thalamus is relay center of brain.
 - LGN has 6 layers, and each deals with specific info corresponding to M and P-cells. This info is combined and analyzed before going back to the brain in the visual striate cortex.
 - Visual cortex is in occipital lobe. Important features of visual world are assembled and identified here.
 - Every neuron maintains a spatial organization called retinotopic organization and this maintains a map of the visual world throughout processing.
 - In the VC these are assembled into lines and edges.
 - Feature detectors: specialized cells that respond most actively to specific stimuli.
 - One type of feature detector is simple cell: responds to stationary bars of light oriented at specific angles.
 - The second are Complex cells which respond to vertical lines in motion. They specifically respond to lines of particular orientations that move in specific directions.
 - Ex: One cell may increase its firing rate when a vertical line is moving from left to right, but not up and down.
 - The image then goes to other regions in your cortex
 - Information travels along the ventral stream (the ‘what’ stream, into the temporal lobe.
 - Here the visual information is identified and you know what you are looking at.
 - Then through the dorsal stream (‘where’ stream), which carries visual information to the parietal lobe, where you use the incoming visual information to understand where the object is.
 - Visual info also travels to the limbic system, which helps provide the emotional feelings.

Receptive Field



Colour Vision

- Colour is the perception of wavelength.
 - Longer wavelengths create the perception of red (~670nm).
 - Medium wavelengths make green (530nm).
 - Short wavelengths make blues(~450nm).
 - White light is actually an equal of all wavelengths.
 - Ex: The reason we see the colour red on a shirt for example is because the pigment in the shirt absorbs the medium and short wavelengths which reflect only red to the eye.
 - Ex: The reason we see rainbow is because light refracts through the water in the air.
- There is no colour in the world. Colour allows us to derive information.
 - Ex: Fruit and its ripeness.
- When light reaches retina, the cones in fovea respond to the quality of wavelength.
- There are 3 types of cones:
 - Short cones (S-cones) which perceive blue.
 - Medium cones (M-cones) which perceive greens.
 - Long cones (L-cones) respond to orange and reds.
- Trichromatic theory: colour information is identified by comparing the activation of the different cones.
 - Ex: Blue car = short wavelengths – S-cones activated.
 - Ex: Pumpkin orange = mixture of wavelengths – more than one cone is active.
 - Most colours are a mixture of wavelengths
 - This theory explains colour blindness. Individuals can be born without one type of cone.
 - Ex: Red-green colour blindness:

- Deuteranopia – occurs when green cones have red photopigment.
- Protanopia – occurs when red cones have green photopigment.
- Because the cells respond equally to these two wavelengths, the brain cannot perceive a difference between them.
- However, this theory does not explain how yellow is perceived.
 - Cones send their message to the midjet bipolar cells and then to the P-cells – the P-cells operate differently.
 - They respond vigorously to one wavelength and reduce their firing if they receive a signal indicating a different one.
 - These colours have been paired so that the cell will increase its firing rate if it receives a message from one colour and will decrease if it receives a message from another.
 - Six colours are created from this: red-green paired, blue-yellow, and black-white.
 - This opponent process organization is maintained in the LGN of the thalamus.

Depth and Depth Cues

- Bottom-up and top-down processing come together to communicate depth in retinal image.
- The brain uses cues to infer info about depth. Two kinds of depth cues:
 - Monocular depth cues (pictorial cues) – cues that can be represented on a 2D canvas. Require only one eye.
 - Occlusion – when one image partially blocks the view of a second object. Partially hidden object is seen farther away.
 - Relative height – objects closer to the horizon will appear farther away and the greater the distance between object and the horizon, the closer the object will appear.
 - Relative size – when two objects are of equal size, the one that is farther away will take up a smaller portion of the retina.
 - Ames room – depicts relative size by manipulating the size of the room while maintaining the shape. **
 - Perspective convergence – used in landscapes and for depth; parallel lines move farther away from us into distance, they seem to converge.
 - Familiar size – judge distance based on the knowledge of object's size.
 - Atmospheric perspective – when more distant objects appear hazy and often have a slight blue tint. This is because as the distance between us and an object increases, the more air particles, dust, pollution and water droplets occupy the space between our eyes and the object causing distortion.
 - Ex: Mountains in the distance
 - Binocular depth cues – requires input from both eyes. Each retina has a different image of the world – retinal disparity: a useful cue because as images become farther away, they have a smaller degree of disparity on the retinas. Depth is calculated in the brain by comparing the images of the right and left eyes.
 - The brain uses the degree to which the eyes must turn inward to focus on an object to process depth. When an object is in the distance, the eyes look mostly straight ahead. The brain uses tension in the eye muscles to figure out depth.

Hearing and Sound

- Using sounds, we can localize objects in space, and it works well in the dark.
- Sound is a form of energy that travels in a wave. It's a mechanical energy and requires a medium like air or water to move through space.
- Sound is actually many small vibrating air molecules. They collide with other molecules, and pressure travels across distance.
 - Ex: You can feel this pressure somewhere like a concert.
- Frequency – rate of vibrations. We perceive high-frequency sounds as having a higher pitch.
- People can hear frequencies between 20-20000 Hz, but we hear best around 1000-5000 Hz (range of speech)
- Intensity of wave – loudness. Increased intensity causes the amplitude of the wave to increase and the wave arrives at our ear with more force.
- >100db sound – the force of pressure can cause damage to the structures in middle and inner ear.
- We feel discomfort in our ears during rapid elevation shifts because the ear is a pressure sensor. (This is helpful)

in marine mammals to navigate 3D world)

The Ear

- Sound enters through your pinna – shaped in such a way that it helps to filter the sound into the ear canal towards the tympanic membrane (eardrum).
- The eardrum transfers energy to the three smallest bones in the body (ossicles of middle ear).
 - Ossicles consist of the malleus, incus and stapes.
 - These help amplify the vibrations as sound waves travel further into the ear. Stapes is connected to a small membrane called oval window.
- Oval window transfers vibrations to cochlea, where sound is transferred into neural language of brain.
 - Contains basilar membrane. (flexible piece of tissue).
 - Transduction occurs when the vibrations against the Oval window cause fluid inside the cochlea to move. Fluid pushes against cilia that are attached his sensory hair cells. sound causes the basilar membrane to ripple which causes the cilia to bend causing an excitatory message to cascade from the ear to the brain via the auditory nerve.
- Brain uses qualities of sound to infer meaning.
- Different frequencies will cause cells to fire at different locations on the membrane. Higher frequencies cause the cell closest to the oval window to excite, while lower frequency sounds excite the cells deeper in the cochlea. – This is place theory.
- Frequency theory - The brain also uses information related to the rate of cells firing. The more rapidly the cells fire, the higher perception of pitch.

Auditory Cortex

- Located in the temporal lobes.
- Different components of sound are organized and analyzed in the medial geniculate nucleus of the thalamus.
- The auditory system maintains a tonotopic organization from the basilar membrane to the auditory cortex.
- Auditory system also has a ‘what’ and ‘where’ stream.
- the auditory system has specialized neurons for transmitting sound. It has cells with rapid action potentials and abnormally large terminal buttons to help relate temporal components of the message.
- The organization is hierarchal, with simpler sounds being processed in lower regions and more complicated sounds being processed higher up.

Sound Localization

- The brain is able to locate objects from sound by comparing information arriving in both ears.
- Binaural cues – cues that require comparison from both ears.
 - Interaural time differences – comparisons made between the arrival time in each ear. The brain is able to localize sounds from left and right accurately. When it is in front, your ears will hear it at the same time.
 - Binaural recordings use two microphones, arranged to record sound in approximate location of human ears.
 - Interaural level differences – intensity difference of the sound. The ear closest to the sound will perceive the noise as slightly louder than those sound arriving at the second year.

Smell

- Perceptions of smell and taste begin with the activation of camera receptors.
 - Sensory cells respond to properties in air molecules that are interpreted as smell and taste.
- Smell is the only sense that does not first go through the thalamus.
- We have an adaptive response to evaluate food using smell and an emotional response.
 - The bear has a bigger olfactory bulb than humans
- Airborne molecules interact with Receptor sites in the mouth and nose and are drawn into the upper nasal cavity. Olfactory receptors bind to the cilia of hair cells embedded in the olfactory mucosa.

- Odorants come into contact with ORN (olfactory receptor neurons)
- ORNs are sensitive to specific odorants.
- There are 350 olfactory receptor types, each responding to specific ranges of molecules
- Each receptor seems to be specialized to code specific molecules, but smells are often made up of multiple molecules.
- ORNs send their signals to glomeruli in olfactory bulb. These cells connect with all messages from a particular receptor type. ORNs of a particular type will send their signals to just one or two glomeruli.
- Sometimes not this simple – some molecules with similar structures create different perceptions of smell and molecules with different structures can be interpreted as similar.
- Highly dependent on expectation.
- Links between structure of molecule, activation on ORNs and specific patterns of activation.

Taste

- Taste relies on the correlation between the molecular properties of a substance and the effect of that substance on the body.
- When the brain perceived sweetness we want to eat more and their gastrointestinal system begins to prepare for ingestion of sweets.
- The five basic tastes include sweet, salty, sour, bitter, and umami (savory).
- Papillae – the little bumps on our tongue which is the location of our taste buds. Not all bumps are the same. There are 4 forms:
 - Filiform papillae – fuzzy appearance, do not contain taste buds. (similar to blind spot)
 - Fungiform papillae – on the side and tips of tongue.
 - Foliate papillae – little folds on the back of the tongue.
 - Circumvallate papillae – back of tongue, shaped like mounds.
- Each tastebud contains 50-100 taste cells which protrude into taste pore.
 - Transduction occurs when chemicals bind to the receptor sites on taste pore. Messages are then sent through a system of afferent nerves not only to the brain but also to the stomach, as your body begins to metabolically prepare for food.
- Orbitofrontal cortex – where sensations from smell and taste are combined, as well as receiving info from ‘what’ pathway.
 - May contain bimodal neurons – neurons respond to more than one sense. These neurons specialize in determining sensations that occur together. We also believe that because this is the first place that taste and smell combine, it is the location of flavour perception.
- Some preferences in taste have their roots in the survival of our species.

Skin

- Source of information about the surface qualities of objects.
- Physical message of touch is pressure. Object makes contact with body and receptor cells in the skin lets the message travel up the spinal cord to the somatosensory cortex of parietal lobe.
- Most info we gather about texture come from the four mechanoreceptors in skin:
 - Merkel receptor – located close to surface of skin and respond to pressure that is applied then removed. Fire Continuously as long as the skin is made in contact with an object, sending information about fine details. High concentration.
 - Meissner corpuscle - located close to surface of skin and respond to pressure that is applied then removed. Fires when the skin first encounters the stimulus and when its removed.
 - Ruffini cylinder – deeper in the skin. Interpreting the stretching of the skin.
 - Pacinian corpuscle – deeper in skin. Feels rapid vibration and texture.
- Somatosensory Cortex organizes information from the body.
 - Spatially organized – two adjacent points of contact on skin to two adjacent points of neural activity in cortex. This is somatotopic organization.
 - Brain does not prioritize messages from all parts equally. Large portion of cortex is devoted to analyzing info from your hands and face. Only small portion from torso and limbs.
- Perception of objects depends on expectation.

Temperature

- Relative perception. Dependent on what we are comparing our current stimulus to.
- Sense temperature changes through hot and cold thermoreceptors. Cold fibers respond by increasing the firing rate to objects that are cool to the touch, while warm fibers increase firing to heat.
 - Fire in response to chemical stimuli – (why menthol is cooling and hot peppers burn if you touch your eye)

Pain

- Adaptive response to tissue damage.
- Nociceptors detect pain and send a signal to brain.
- Highly subjective.
- Highly dependent on a person's expectations and enculturation. – when a person is distracted, pain is reduced.
- Pain serves a purpose. When a limb has been damaged, we reduce the use of the limb because of the pain we experience.
- Gate-Control theory
 - Impulses that indicate painful stimuli can be blocked in the spinal cord by signal sent from the brain. Suggests that input happens along three pathways.
 - Small diameter fibers (S-fibers) fire to damaging and painful stimuli. When they are active, a transition cell becomes activated (T-cells).
 - Perception of pain in part depends on the excitation of the T-cell.
 - L-fibers then send signals to the brain about stimulation that is not painful. When they are activated, they inhibit the activation of the T-cells. This closes the gate, which decreases the perception of pain.
 - It does not explain chronic pain – phantom limb.
- Experience of pain depends not only on the sensations from the world but also what we expect to experience. Pain is particularly susceptible to the placebo effect.
- Congenital insensitivity to pain has two features: the inability to perceive pain and the inability to perceive temperature.
- Provides survival value.

Kinesthetic Sense

- Provides us with a basic understanding of where our body is in space and how to move our bodies to accomplish specific tasks.
- Relies heavily on our sense of touch.
- Receptors in the joints and muscles both send and receive information about where the body is in space. Information is sent to somatosensory cortex.

Vestibular Sense

- Sensory cells of vestibular system are located in the cochlea.
- Semicircular canals sense changes in acceleration and rotation of the head.
- Canals are filled with hair cells that respond to the force of gravity.
- Vestibular sacs respond to cues associated with a sense of balance and posture.
- Closely integrated with visual system.

Stimulus Detection

- Psychophysics evaluates the way the physical experiences are translated into psychological perceptions.
- Technique that attempts to answer 'what is the minimum amount of stimulus required to generate a sensation?'
- Absolute threshold – level of intensity required to create conscious experience. (it is not absolute; it can be different between individuals). Defined as the point of intensity required for a participant to detect the stimulus 50% of the time.
- Signal detection:
 - Individuals report the presence of a stimulus even when none has been presented. Have a high hit rate. These are called false alarms. Individuals with high hit rates and high false alarms have a more liberal response bias.
 - Individuals prefer to be certain that a stimulus was present before they say they heard, saw or felt it. Have a higher miss rate. Did not perceive a stimulus even when one was presented. Have a higher correct rejection rate = conservative bias.

- Different threshold - Smallest amount of a particular stimulus required for a difference in magnitude to be detected.
 - Depends on Weber's law: the ability to notice the difference between two stimuli is a constant proportion of the intensity or size of the stimulus. The more intense the stimulus, the larger the required change to notice a difference.

Module 6

Consciousness

- Direct relationship between the workings of the brain and the experience of thinking, feeling and acting
- Tremendous amount of processing needed to create a conscious perception of the world
- Dualism – the idea that the mind and body are fundamentally different entities
- Split-Brain
 - Procedure that severs a large band of axons that connect the two hemispheres (corpus callosum) – initial purpose was to reduce frequency and severity of seizures tied to epilepsy
 - Consequence: two hemispheres are unable to share info across of cortex and regions associated with perception are isolated from parts of the brain involved in language
 - Surgery is successful in reducing seizures, but awareness of behaviour is altered
 - Hemispheric specialization - some abilities are processed more on one side than the other
 - Ex: If I send a message to a sensory system on the right, the message will travel through various pathways lower in the brain and arrive at the contralateral left hemisphere, tying to the left temporal lobe which is the location of several important language related structures. However if given a message on the left, this would travel to the right Occipital lobe - When the brain is intact this message is sent to the left temporal lobe and people are able to name the object but because of split-brain the message never arrived at the language portion of the brain
- Consciousness is the result of several processes in the brain that can operate independently and interact with one another depending on what the task demands
- Conscious content - Subjective experiences of your internal and external world ('sense of self', plans, dreams, day to day perception of time and space)
- States of consciousness - Different levels of arousal and attention; your experience of a particular state of consciousness is based on several unconscious and involuntary processes
- Conscious content is heavily dependent on your state of consciousness

Attention

- Attention - The processing of selecting information from the internal and external environment to prioritize for processing (it can be involuntary and automatic)
- Passive attention - occurs when bottom-up information from the external environment requires a response
 - Ex: Loud noise in quiet room
- Active attention - when attention is directed by goal and top-down processing
 - Ex: Search cluttered tables for your keys
- Some features of the environment are noticed readily and effortlessly while others may miss entirely by the attention system
- What is noticed depends a great deal on the goals, experiences, and state of mind of the individual
- It is difficult to study this in a laboratory because under controlled conditions, Attention is often directed based on the instructions given by the experimenter - in the real world, attention is often directed by an individual's goals, expertise, and state of mind

Selective Attention

- Selective attention - Occurs when you attend to one source of information while simultaneously ignoring other stimuli
- some teachers are necessarily more important and relevant than others, and some elements are simply more noticeable based on their qualities
- Stimulus salience – the low level properties; The bottom-up qualities of a scene that influence how we direct attention
 - Ex: Colour, loudness
- Attention capture - When attention is diverted because of the salience of a stimulus
- Top down processing plays a role in guiding selective attention - as we gain knowledge in a given area, we are better able to allocate attention to the more important features of the scene and ignore information that is less relevant
- Example of selective attention in everyday life
 - Focusing on the road while driving or listening to a single conversation in a loud room
 - Cocktail party effect - Being in a loud room where several people are talking and there is a lot of noise,

but you can block out all of this and listen to a conversation you are having with one person

- Even when some information is not part of conscious awareness, this does not mean it is not being processed
- We see shift of attention when something is surprising, personally relevant, or emotionally engaging
- Dichotic listening task
 - One message is placed in one ear and another in the other ear
 - People have difficulty reporting details of what occurred in the unattended ear
 - This suggests that the process is not as simple as the brain just 'blocking out' the information it doesn't want
 - Specific kinds of unattended information are processed and can later be recalled - participants can often report the gender of a speaker and will notice if a male speaker changes to a female speaker and the unattended here

Divided Attention

- Divided attention (multitasking) - When we simultaneously attend two or more tasks at the same time
- We are not proficient at multitasking and make errors
- Experience contribute to your ability to complete divided attention tasks - when you are well skilled at a task, it becomes automatic; it takes a lot of directed attention to reach proficiency at a task, but you will be able to accomplish it without awareness
- Automaticity - Refers to fast and effortless processing that can be accomplished without conscious thought (one performance is not impaired by other tasks) - when a skill is automatic, it frees up attention to focus on other features in the environment
- Some automatic tasks are far more predictable than others
 - QWERTY keyboard
 - Driving is automatic however it is quite variable; accidents occur when something unexpected happens an immediate response is required by one or more drivers - why you need focused attention, which is diverted if you are using a cell phone. People are slower to react to traffic signal, miss more relevant information such as pedestrians and changing traffic lights, and make more mistakes when using devices

Inattentional Blindness

- Inattentional blindness - When we are engaged in one task and completely missed other information
- Inhibition - When your attention is held in one location, your brain actively blocks the processing of other parts of the scene

Subliminal and Subconscious Messages

- Subliminal stimulus - A sensory stimulus that is processed but does not reach the threshold for conscious perception
- Subconscious processing - information we are aware of, but not necessarily aware that it is influencing our behavior
 - Ex: French music in liquor store = French wine > German wine. German music in store = German wine > French wine
- Subliminal processing - Information we cannot consciously detect, even with we are looking for it; includes:
 - Subvisual messages - messages that are presented too quickly for the visual system to perceive
 - Subaudible messages - played at a low volume, typically with a louder message played over it
- Subliminal messages have minimal to no effect on behavior
- It is important to note that even though subliminal messages cannot consciously perceived, the images still activate photons in the eye and the auditory messages bend the hair cells in the ear; the messages are just not considered salient enough to receive extra attention or processing

Attention Disorders

- When regions of the brain that facilitate attention are damaged or work differently from normal, the experience of consciousness is also affected
- Deficits in attention influence our ability to perceive and respond to information, and influence perceptions of reality itself
- Visual Neglect
 - Lesions on the right parietal lobe of the cortex - causes people to lose awareness of visual stimuli on the left

- Late processing of the dorsal visual system travels to the inferior parietal lobe, which helps identify the location a visual stimuli
- Individuals who have in visual neglect are still able to report some details of colour and form of visually neglected stimuli
- The intact 'what' visual system is still evaluating several components of the entire visual message despite people being unaware of them

Sleep

- An altered state of consciousness - the brain is still active
- It is critically important; it has been observed in marine mammals like Dolphins - They have evolved the capacity to sleep with half of their brain at a time, to prevent drowning
- Fatal familial insomnia - a rare hereditary disease affecting the thalamus, which causes individuals to die from lack of sleep
 - This insomnia is accompanied by weight loss and an inability to maintain homeostasis (death usually occurs within 12 to 18 months after the symptoms start)
- Electroencephalograms (EEGs) measure activity across surface of the brain
- Electrooculograms measure the movements of your eyes as you sleep
- Electromyograms measure the tension in the muscles of the jaw

Stages of Sleep

Relaxed Wakefulness



Awake and Alert

Beta waves

Stage 1



Stage 2



Slow Wave Sleep



REM sleep



- Three important features:
 - Frequency - The number of up and down cycles of the wave/second
 - Amplitude - These Heights differ between stages of sleep
 - Regularity of the wave - measure of how consistent or erratic the waves appear
 - Ex: SWS consists of regular, high-amplitude waves that occur at a rate of less than 3.5Hz
- Beta waves
 - Occur when you are alert and engaged
 - Irregular, mostly low amplitude, occur with a frequency of 13-30Hz
 - Waves are desynchronized and erratic - this desynchrony reflects the fact that many neural circuits in the brain are actively processing information
- Alpha activity
 - When an individual is awake but relaxed
 - Waves themselves look far more regular and predictable, occur at 8-12 Hz
 - Regular, medium-frequency waves occur when a person is quietly resting and not thinking about anything too difficult
- As you transition from a relaxed state to the early stages of sleep, your brain transitions from Alpha waves to theta activity (3.5-7.5Hz)
- While in stage one sleep you begin to move from a state of relaxation to early sleep, and the firing rate across the cortex becomes more synchronized
 - Stage one is a very light stage of sleep; If startled or awoken, most people report that they were not even sleeping
- Transition from stage one to stage two
 - Some theta activity, waves are irregular
 - Sleep spindles are present – these are brief bursts of energy that occur roughly two to five times per minute during the non-REM stages of sleep (may play a role in memory consolidation)

- Increased sleep spindles are also correlated with higher scores on IQ tests
 - K-complexes are easily identifiable on EEG as bursts of activity – only occur during stage 2 sleep around once a month
 - Can be triggered by unexpected noises
 - Wave itself is a large period of coordinated excitation followed by neural inhibition
 - In stage two you would be soundly asleep - if woken you would not necessarily have any sense that you have been asleep at all
 - These waves prepare the brain to enter Delta wave activity
- After 15-20 min after the start of stage two we transition into slow-wave-sleep
 - Firing across the cortex becomes coordinated and we transition to Delta activity
 - Delta is easily recognizable as it consists of slow (<4Hz), regular, high-amplitude waves
 - Each oscillation is a biphasic wave reflecting one period of neural inhibition and one period of excitation
 - SWS is the deepest stage of sleep – only a strong stimulus will wake you and you will feel groggy and confused upon waking
- Stages 1,2 and SWS are non-REM sleep
- After 45 minutes after the beginning of SWS, the brainwaves change dramatically
 - As we transition from SWS to REM (rapid eye movement) differences appear on the physiological measures we are collecting
 - Desynchronized Theta waves will start to appear on the EEG, and your eyes will start to move side to side beneath your closed eyelids
 - Brain becomes highly active; EEG looks similar to when you are awake and alert then the slow, predictable waves from earlier
 - Body will be quite still despite occasional twitches - generally become paralyzed during REM sleep
 - Blood flow in the brain is generally reduced, but visual Association cortex and prefrontal cortex receive a large proportion of oxygenated blood - this is possibly the basis for the vivid visual images and hallucinations we experience while we sleep
- Following REM, brain returns to stage 1 sleep and cycle repeats
- It is typical that as the night goes on, less time is spent in SWS and more in REM
- A brief nap of 20 minutes will allow you to send into stage two sleep, and you should wake feeling refreshed - if your nap is much longer than that, you will enter SWS , which is the reason we often wake from afternoon nap feeling groggier than before we fell asleep

Functions of Sleep

- All warm-blooded animals exhibit REM sleep – this includes elements such as muscular paralysis, rapid eye movements, characteristic brain waves; suggest that there is an important function to sleep
- Prolonged periods of sleep deprivation can lead to irritability, confusion, slurred speech , hallucinations
- One of the benefits of the different stages of sleep seems to be the consolidation of different kinds of memories
- Early hypothesis suggests that the role was to wrest the body from physical exertion; results are mixed - people do tax both the body and brain through activities that we engage in while awake, thus it is not unreasonable to assume that some restorative behaviors occur during sleep
- If the function of the brain is not primarily to rest the body, then sleep is really to rest the brain
- After sleep deprivation, cognitive abilities are impaired especially for tasks that require sustained attention
 - Sleep is important for cognitive functioning
- Different stages have different functions
- SWS
 - Through the study of effects of deprivation on functioning, results show that SWS is more important for restoring the brain than the rest of the body
 - Minimal evidence that one night of sleep deprivation impedes performance on physical tasks as the sleep deprived participants performed similarly to the well-rested participants
 - People deprived of sleep can be irritable, disoriented, have more difficulty completing cognitive tasks - after a few days of deprivation, it is not uncommon for people to report symptoms that include mild hallucinations
 - During SWS, the metabolic rate and blood flow to the cortex decline substantially relative to wakefulness

- Regions that have the highest activity during waking hours showed the greatest reduction in metabolic activity and the most Delta activity during SWS, suggesting that this part of the brain is resting
- REM
 - Eyes move rapidly from side to side
 - Your heart rate will suddenly quicken or slow
 - Breathing becomes less regular
 - Brain activity changes across the surface of cortex
 - REM is studied by researchers waking people up just as their brain transitions into REM
 - as a brain is deprived of REM for several days, the brain tries to enter REM more quickly and spends proportionately more time there
 - This is a rebound phenomenon that suggests a need for a certain amount of REM
 - There is an increase in the percentage of time spent in REM during periods of intense brain development
 - Infants that need more time to mature spend proportionately more time in REM than animals that mature more quickly
- Benefits of REM include the brain's ability to consolidate information
- SWS is important for explicit memories

Dreams

- Freud believed that our experience of consciousness was only a limited part of our internal world - he felt that a greater contribution to our behavior can be attributed to unconscious processes
- We are unaware of the content of the unconscious, but Freud argued that these unconscious impulses play a direct role in our behavior
- Freud developed techniques for identifying the messages we receive in our dreams and identified common patterns, such as dreams that deal with unfulfilled wishes, anxiety, childhood traumas
- There are a lot of problems with examining dreams through self-report
 - Individuals do not always remember the dream
 - Cannot accurately describe them
- Limited evidence that symbols from dreams actually translate into conflicts between conscious and unconscious processes
- Although most of our narrative-based dreams occur in REM, we also experience dreams during non-REM sleep
- Vivid narrative-based dreams that participants often report tend to occur in REM
- Activation-synthesis hypothesis - Suggests the experience of dreaming really has no explicit or reliable meaning; Rather it is a consequence of the other processes that occur across the cortex during sleep
- Accounts for the seemingly disorganized and bizarre occurrence of events we experience while we sleep - it doesn't mean anything; it is just the result of the brain as it sleeps - Processes of the higher brain try and interpret this disorganized lower brain activity and attribute meaning to it
- Evolutionary hypothesis of dreams - Argues that we often dream about things that are directly related to survival and that they can lead to enhanced performance when encountering threatening events

Dyssomnias

- Refer to problems with the quality of sleep
- Insomnia - the inability to fall asleep or the inability to remain asleep (most commonly diagnosed sleep disorder)
 - Experience of stress in the environment can lead to periods of sleeplessness
 - May be a symptom of a serious underlying medical condition
 - Abuse of certain substances or other underlying mental disorders can lead to periods of secondary insomnia
 - Result from something in the environment; can often be adjusted by making changes to daily habits
 - Can easily be caused by drinking caffeine later in the day, napping excessively during waking hours, looking at bright screens before bed
 - Sleep hygiene - Habits and behaviors that are conducive to sleeping well; Psychologists often recommend that individuals create routines that are conducive to sleep
 - Conditioned insomnia - Insomnia is learned; going to bed becomes associated with the inability to fall

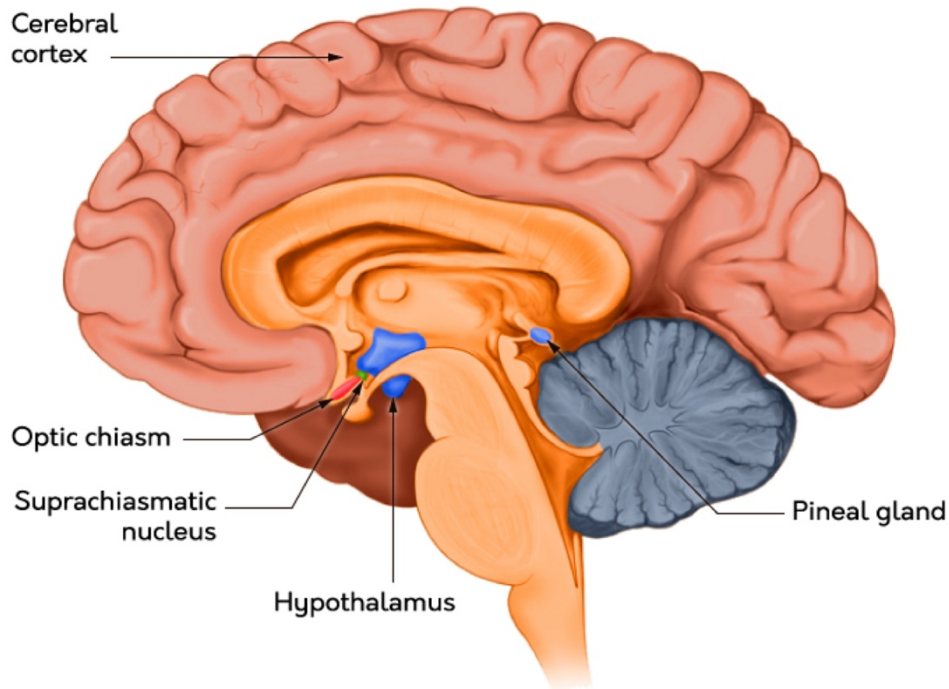
asleep, so cues that would traditionally be used to help a person relax create feelings of tension and worry about falling asleep - anxiety about insomnia becomes a self-fulfilling prophecy making sleep impossible

- Idiopathic insomnia - Results from a neural physiological abnormality in the central nervous system (begins in childhood and is experienced through adulthood)
 - Much more resistant to treatment
 - Diagnosis of childhood sleep problems is difficult
- Hypersomnia - characterized by excessive sleepiness
 - Caused by poor sleep quality during the night
- Sleep apnea - a condition where the intake of oxygen is reduced as the person sleeps usually for only short periods of time, but on occasion for as long as a minute
 - Breathing may become shallow
 - In severe situations individual stops breathing for short periods of time
 - Brain sends signals to the body's blood oxygen decreases and the sleeper wakes
 - People do not realize that this is occurring, formal diagnosis can only be made in a sleep lab
 - People receive relief after using pressurized air mask called CPAP
- Narcolepsy – a rare genetic neural degenerative disorder characterized by a sudden and extreme need to sleep
 - These sleep attacks are uncontrollable and can last from a few seconds to minutes
 - When awoken most people say they feel alert and refreshed
 - In its most extreme form, the individual enters a kind of REM sleep, losing all muscle tone while unconscious
 - Cataplexy - Paralysis typically experienced during REM sleep initiates at inappropriate times
 - Often Initiated by emotionally engaging events like arguments, laughter, sex
 - In addition to these symptoms it is possible for patients to experience paralysis accompanied by vivid sensory hallucinations that occur upon the onset of sleep (hypnagogic hallucinations) or just before waking (hypnopompic hallucinations)
 - These hallucinations can be terrifying - people cannot move or cry out, but feel the sensation of their heart beating quickly in their chest as sinister forces close in around them

Biological Clocks

- We are diurnal species that evolved under predictable conditions of light and dark - these cues influence a number of deep rooted, biological functions
- Circadian rhythm: daily clocks; circa = about, dies = day - Our free running cycle is actually closer to 25 hours than 24, but the Clock is reset every morning by cues associated with morning activity
- Zeitgebers – time cues that are Reliable stimuli in the environment that provide information about the time of day
 - Ex: Presence or absence of light
 - Exposure to light resets your clock and initiates cues in the brain associated with wakefulness
- Jet lag – occurs when you travel someplace far away and your internal clock does not match the external cues you receive from your new environment (same effect in shift work)
- When people are forced to abruptly alter their sleep-wake cycles, it results in sleep and mood disturbances and interferes with their ability to function during working hours
- The change has real consequences on our collective ability to focus attention and make decisions; these consequences can be measured as many as five days after the shift
- There is a measurable increase in traffic accidents and accidental deaths that can be attributed to sleep deprivation
- People are able to adjust the time changes after a few days, by adjusting to changing shifts at work is more problematic - solution is to ensure that your internal Clock matches the demands of the external world ~ artificially stimulating and repressing your Clock
- it is also possible to chemically regulate the clock
 - Light signals from the eye split in the centre of the brain at the optic chiasm - directly above the chiasm is the suprachiasmatic nucleus (SCN) – location of your body's 'timekeeper'
 - SCN sends signals to several regions of the brain, including the pineal gland
 - In response to light/dark cycles, the pineal gland secretes melatonin

- Melatonin levels are highest right before bed and seemed to signal to the brain that light is absent



Altered State of Consciousness

- Psychoactive drugs - Substances that influence mood, thoughts, behavior
- Drug tolerance - when a larger and larger dose is required to achieve the same physical and psychological effects – brain has learned to adapt to the presence of chemical
- Dependence – physical or psychological need for the drug to maintain normal functioning
 - Once dependency has been achieved, the absence of the drug is met with physical withdrawal
- Psychoactive drugs are defined by their effects on the body; One method of categorizing drugs to sort them according to the effect they have on the nervous system - it is a good demonstration of how each drug can differently alter our level of conscious awareness and perceptual experiences

Depressants

- Depressants slow or depress the arousal of the central nervous system
- Alcohol is classified as a depressant
 - one reason for its frequent abuse is that it is readily available most of the time
 - In low doses, alcohol creates sensations of relaxation or drowsiness, improved mood, and increased self confidence
 - As consumption increases, the effects include impaired judgment, slowed reaction times on physical tasks, uncoordinated motor movements
 - In large doses, individuals can experience alcohol poisoning, when the effects of the depressant on the central nervous system cause extreme disorientation and irregular heartbeat and breathing - it is possible for individuals to become comatose and die from alcohol poisoning
 - Glutamate – one of the primary excitatory neurotransmitters in the nervous system; alcohol inhibits the effectiveness of glutamate especially in the hippocampus (why memory is altered after a night of heavy drinking)
 - Alcohol also increases the effectiveness of GABA - one of the main neurotransmitters implicated in relaxed states
 - The relaxing effects of alcohol are most easily attributed to its effects on these two neurotransmitters; However, consumption of alcohol also increases the dopaminergic system
 - Dopamine - is often implicated in reward states in the brain; many drugs are reinforcing because of their effects on the production of dopamine
- Barbiturates and Benzodiazepine
 - Are prescribed to treat psychological disorders such as anxiety, OCD, epilepsy

- Create a subjective sense of relaxation, most probably because they also act on the amount of GABA in the brain
- in large doses, concentration becomes quite difficult and speech can become slurred
- Barbiturates can become quite addictive - body's metabolism slows and patients develop a tolerance for the drug
- Dosage must be increased to have the same effect; But the lethal dose of barbiturates does not change which makes continued use dangerous and fatal
- Benzodiazepines are more commonly prescribed (Xanax, valium, clonazepam)

Stimulants

- Drugs that increase the activity of the nervous system
- Common stimulants include caffeine, nicotine, cocaine, amphetamines
- Caffeine is most widely used psychoactive drug
 - Consumption produces increased energy, creativity, ability to focus on work
 - Works by blocking the inhibitory neurotransmitter adenosine
 - Because adenosine receptors are plentiful throughout the brain, it is difficult to understand exactly how caffeine works
 - Possibly, by blocking adenosine, this drug may increase the number of excitatory neurotransmitters in the brain
- Nicotine stimulates the release of acetylcholine and other neurotransmitters in the brain
 - Acetylcholine is a prominent excitatory neurotransmitter
 - Increases activity in areas of the brain related to cognition
 - Addictive due to the delivery system: nicotine is often inhaled into lungs - means that absorption into the body and effects in the brain occur rapidly after administration
- Cocaine and amphetamines have similar effects as both enhance the effects of dopamine
 - Stimulants that combat the effects of hunger and fatigue and create a subjective sensation of grandeur or euphoria and a heightened sense of alertness
 - Cocaine binds to and activates the proteins that aid in the reuptake of dopamine, prolonging its effects
 - Although amphetamines also inhibit the reuptake of dopamine, they also stimulate the release of dopamine from the terminal buttons
 - By preventing reuptake, these stimulants prolong the effects of dopamine - in both instances, chronic use leads to the impairment in the way dopamine operates in the brain; long-term use can cause hallucinations, delusions of paranoia, psychotic behavior

Hallucinogens

- Also known as psychedelic drugs
- Influence the sensory systems and our interpretation of reality
- Cause distortions in our sense of time and space
- Creates feeling of synesthesia - an experience where the senses seemed to blend
- LSD is a synthetic drug that causes altered emotions and a sense of being in a 'waking dream'
 - Causes vivid sensory hallucinations, alterations in perceptions of time and space, blurring of perceptions between the senses
 - Ex: music may create sensations of colours
 - Drug acts as an agonist of serotonin; specifically, serotonin receptors in the thalamus
- Mescaline used in religious ceremonies in native culture
 - Colour Perception is enhanced, repeating patterns appear in the visual field, people often report that they feel 'out of their body'
 - Other effects include numbness, tension, anxiety, intense nausea
- Cannabis is the most commonly used
 - Has diffused effects on the nervous systems including an increase of appetite, feelings of euphoria, relaxation, and even paranoia
 - Specific neurons have been identified that respond to THC
 - Cannabinoid receptors have been found in brain regions such as the cerebellum, hippocampus, basal ganglia, cerebral cortex
 - Receptors do not act directly with the brain, but rather influence how other neurotransmitters are

released

- Ex; when cannabinoid receptors are activated, they influence how other neurons respond to GABA - because GABA is affected, dopaminergic neurons increase their release of dopamine
- Cannabinoid receptors inhibit many neurotransmitters including norepinephrine, acetylcholine, glutamate, GABA

	Drug	Neurotransmitters
Depressants	Alcohol	Inhibits glutamate and increases GABA and dopamine
	Barbiturates/ Benzodiazepine	Increases GABA
Stimulants	Caffeine	Blocks adenosine
	Nicotine	Stimulates/imitates acetylcholine and increases dopamine
	Cocaine	Prevents reuptake of dopamine
	Amphetamines	Inhibit reuptake and stimulate release of dopamine
Hallucinogens	Lysergic acid diethylamide (LSD)	Serotonin agonist
	Cannabis (Marijuana)	Anandamide

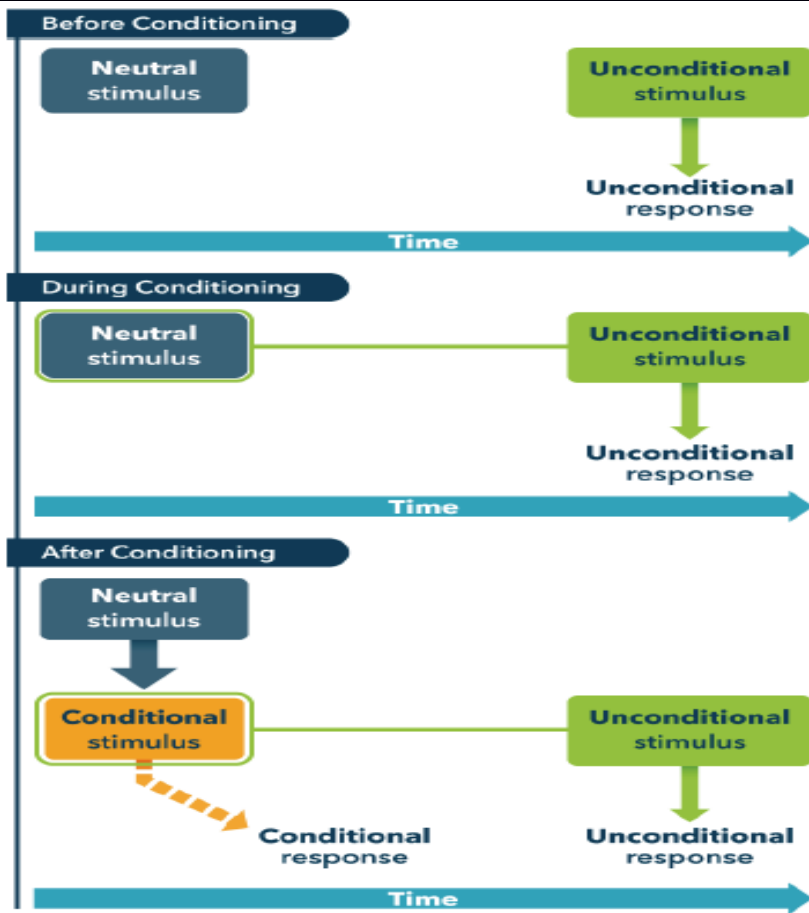
Module 7

Scientific Study of Learning

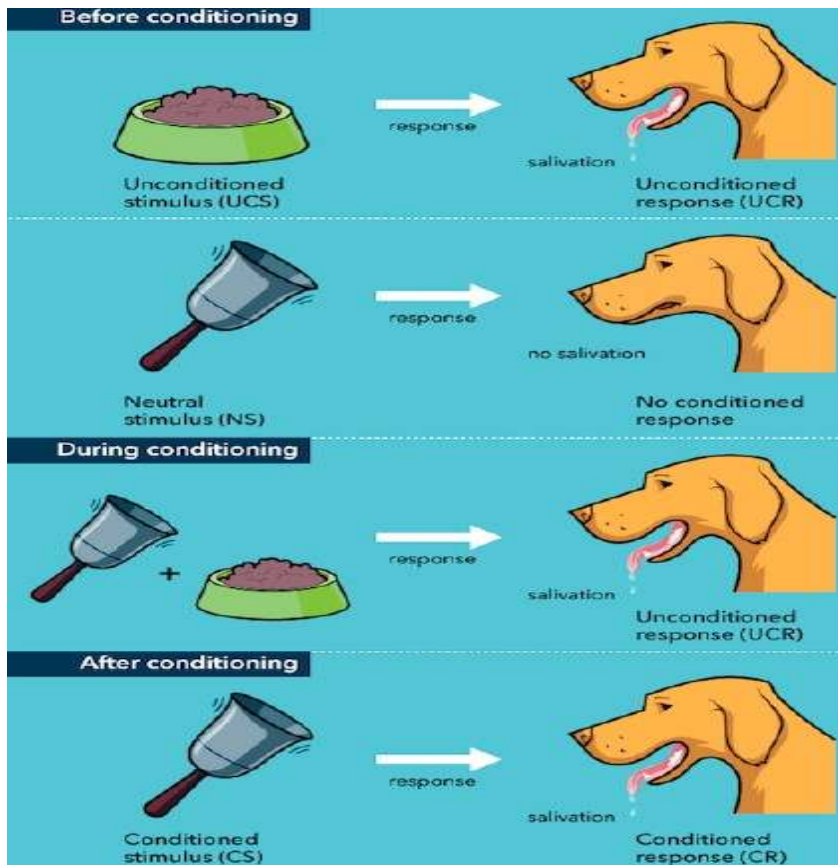
- Learning is defined broadly as a relatively permanent change in behavior not due to drugs (first administration), maturation/development, injury or disease
- Events we can perceive in the world around us affect behaviour and behaviour produces effects on the environment as well
- Some skills are innate – they are not a result of learning; we're born with them – once started, they cannot be stopped
- Reflexes involve situations that naturally produce corresponding behavior
- Reflexes – automatic and simple responses - Only apply to a relatively small proportion of our behavior, but they are important lies in their ability to be conditioned to other cues
- Pavlovian conditioning occurs when we associate 2 events – a signal and what is signaled
- Operant conditioning is how we learn what happens when we do something
- Social learning is when we learn something by watching others
- Latent learning occurs when we learn something but don't show it until we have a reason to use our new knowledge
- Can be social, operant or pavlovian
- Biological constraints dictate what we will or won't associate in each type of learning

Pavlovian Conditioning

- Ivan Pavlov studied how dogs digest food, starting at the beginning of the process with salivation
- The dog started salivating when he put on his lab coat
- Dogs don't typically salivate in response to laboratory coats, but they do salivate to meet powder as a reflex
- Pavlov saw that he reliably put on his lab coat before feeding the dogs, and the dogs were preparing (involuntarily) for the meat powder they would receive
- Food is the unconditional stimulus that produces Salivation as an unconditional response
- The conditional stimulus is a lab coat and the conditional response is Salivation to prepare for the upcoming food
- Conditioning is learning
- Pavlovian conditioning involves associating two events that occur together - this makes our environment more predictable
- A stimulus can be anything in the environment that we can detect, is measurable, and can evoke a response or behavior
- We start with an unconditional stimulus that produces an unconditional response - an innate reflex
- We produce a conditional stimulus that signals or predicts an unconditional stimulus
- We know learning has occurred when the conditional stimulus forces a conditional response - a conditioned reflex
- Conditional responses are learned, but unconditional responses are not



- Reflexes involve unconditional stimuli and responses; In these cases, the stimulus forces/triggers/elicits the involuntary response



- In Pavlovian conditioning, we want to change a neural stimulus that does not naturally elicit a response

- Our initial neural stimulus was a white lab coat that did not naturally make dogs drool - overtime this neural stimulus is repeatedly presented just before an unconditional stimulus and in doing so, the neural stimulus becomes a conditional stimulus
- Pavlovian conditioning takes advantage of reflexes and involves associating a previously neural stimulus with an already-meaningful stimulus
- We know that the neural stimulus has become a conditional stimulus when it elicits a conditional response before the unconditional stimulus appears, therefore, the conditional response is a measure of learning
- The conditional and unconditional response is often looked the same, but the conditional response occurs in preparation for and prior to the unconditional stimulus
 - For example: Eye doctor puff air into your eye, and you blink to the puff of air because blinking reflexively protects the eye from injury
 - For example: Covering our ears during loud noises is voluntary behavior, which is not part of Pavlovian conditioning
- A conditional stimulus is important because it predicts when the unconditional stimulus will occur
 - Ex: a five month old infant will learn to blink to a tone (CS) when it signals that the puff of air (US) is likely to occur even if the puff of air doesn't occur every time - however infants will not learn to blink to the tone if it doesn't reliably predict the puff of air
- We experience spurious correlations every day in which there seems to be but is in some relationship between events - this is the basis for superstition because it's easy to associate events that occur close together in time
 - Events that occur together can be associated, even when they are not related to each other
- Trace Conditioning
 - Ex: You were lucky during a test and therefore attribute that luck to a physical object - thus you have made an association between the object (CS) and the luck (US)

Pavlovian Taste Aversion Learning

- An important type of trace conditioning is taste aversion learning - we eat a food and then several hours later we experience illness; the next time the food is encountered, not only do you want to avoid that food, quite often people report feeling ill all over again
 - Conditional stimulus = taste of food
 - Conditional response = nausea
 - Unconditional stimulus = illness-causing bacteria
 - Unconditional response = sickness
- We learn to avoid eating food that smells or tastes or looks like the food that made us sick - this is a special type of Pavlovian conditioning - it can develop with a single pairing, it tends to be long lasting, and it is resistant to extinction

Pavlovian Extinction

- During conditioning we learn to respond to a conditional stimulus when it reliably signals an unconditional stimulus
- Once we learn what a conditional stimulus means, it loses some associative strength when a conditional stimulus is presented without the unconditional stimulus
- We see this loss of associative strength as an increasingly weaker conditional response in a process called *extinction*
- Pavlovian extinction is a procedure that involves repeatedly presenting a conditional stimulus without an unconditional stimulus
 - A conditional stimulus is only valuable because it predicts an unconditional stimulus, and changing that Association changes how we interact with the conditional stimulus
 - We learn not to prepare for an unconditional stimulus and a conditional response no longer occurs
- Extinction is not unlearning - you have simply learned that the conditional stimulus does not reliably predict the unconditional stimulus at the time
- A conditional stimulus presented alone after a rest period will elicit a conditional response - *spontaneous recovery*
 - Ex: If Pavlov stopped giving the meat after wearing a lab coat for several days, that dogs would stop salivating to the lab coat (extinction); he then stopped wearing the lab coat and it only took one time for him to wear it again for the dogs to salivate
 - Cancer survivors also experienced spontaneous recovery - they received the initial diagnosis in a doctor's office, and usually this pairing of the doctor's office with a cancer diagnosis elicits intense fear (acquisition)

– over time, they receive treatment in the hospital until their cancer tissue shrinks and their blood work returns to normal (extinction) - they then have a rest period where they don't need to visit the hospital - when they visit the hospital for follow up scans or a check-up , many survivors say they experience anxiety (spontaneous recovery)

Other Principles Associated with Pavlovian Conditioning

- Sometimes more stimuli elicit responses than were originally conditioned, as in *stimulus generalization*, and sometimes only one stimulus elicits that response, as in *stimulus discrimination*
- Other times, we want to add a conditional stimulus to one that has already been conditioned, as in *higher-order conditioning*

Stimulus Generalization

- Stimulus generalization involves responding similarly to conceptually or physically similar stimuli - an event that has not been paired with the unconditional stimulus also elicits or causes the conditional response
- This generalization can be natural or conditional
 - Ex: Pigeon (Page 28)
- Tends to happen with phobias
 - Ex: A person may be bitten by a Brown recluse spider and develop a fear of all spiders
- In conditional generalization, a fear response condition to one arbitrary geometric figure would generalize to the others
 - Ex: with a spider phobia, you might also fear objects or locations associated with spiders: webs, addicks, basements

Stimulus Discrimination

- Involves responding differently to different events - the opposite of stimulus generalization
- Conditional responses only occur when the original conditional stimulus is introduced - when organisms encounter stimuli that are similar to their conditional stimuli, these similar stimuli do not elicit a response
 - Ex: Pigeon (Page 29)
 - Ex: A person may come to fear Brown recluse spiders, not Wolf spiders or tarantulas, after being bitten by a Brown recluse and not a cellar spider
 - Ex: Purple Square Study (Page 29)

Higher-Order Conditioning

- A neural stimulus is systematically and repeatedly paired with conditional stimulus that reliably elicits the conditional response
 - Typical Pavlovian Conditioning: neural stimulus -> unconditional stimulus
 - Higher-Order Conditioning: (already paired neural stimulus -> unconditional stimulus) neural stimulus -> conditional stimulus

Development of Behaviourism and Little Albert

- Behaviorism is an approach to science that focuses on how we learn new behaviors and how those behaviors change across different situations
- We can account for behavior without considering thoughts or feelings
- Watson recognized the role of genetics in determining behavior, but he was still trying to make a point about the importance of the environment

- Little Albert
 - He developed a Pavlovian fear response to many furry, white objects in a 9-month-old baby
 - Little Albert was shown a variety of animals such as dogs, rabbits, white rats, and objects such as fire and a fur coat
 - Albert was not afraid of them and seemed to like the rat - they then made a little Albert afraid by striking an iron bar with a hammer in the presence of a white rat
 - The loud, unexpected noise made little Albert cry
 - After several rat-loud noise pairings, little Albert would start crying just at the sight of the white rat; The rat signaled the loud noise
 - Little Albert demonstrated stimulus generalization - crying and crawling away from objects similar to the furry rat
 - However, little Albert did not generalize his fear to some white objects
 - The researchers noted that little Albert's fear responses during the experiment were relatively weak and inconsistent and presumed that he would not further generalize the sphere to other animals and objects
 - Despite not receiving the planned systematic desensitisation, little Albert lived a relatively normal life

Systematic Desensitization

- Our conditional fears can interfere with day-to-day functioning and with activities that we might otherwise enjoy with lower anxiety levels
- These types of fears are the basis for some anxiety disorders like *phobias*, which are intense, unrealistic fears directed towards people, objects, or situations - The fear we experience with phobias is much more intense than it should be to any realistic threat
- Joseph Wolphe developed a therapeutic treatment for phobias called systematic desensitization

Operant Conditioning

- Operant conditioning describes situations in which we can choose among different options based on our previous experiences - we learn that our behavior has consequences
- Operant conditioning can predict whom you choose to spend more time talking to - we choose to talk to people who offer us something appetitive in return, like supportive comments, and we match how much behavior we allocate to them in direct proportion to how much we get from them

Thorndike and Instrumental Processes

- Thorndike is best known for his work with cats in puzzle boxes
 - He put Cats into a box that required a certain set of behaviors to open a door to see how long it took them to escape - at first the cats tried various methods to get out of the box (Thorndike called this 'trial-and-error learning')
 - Because cats learn how to manipulate an instrument such as a pedal, Thorndike called this type of learning instrumental; This is why operant conditioning is also called instrumental conditioning
- Developed the law of effect - he was interested in how the consequences of behavior influenced subsequent behavior
 - The 'effect' in law of effect referred to the consequences of behavior, so think of it as the law of consequences
 - Two elements:
 - Behaviors that yielded satisfying consequences are more likely to recur
 - Behaviors that result in discomfort are less likely to be repeated

Skinner and Operant Processes

- Skinner founded radical behaviorism - the philosophy of science that treats thinking and feeling like any other behavior
- We have to be able to measure behaviors and see their effects on the environment
- We also want to study complex behavior like thinking and feeling, the term operant replaced instrumental conditioning
- Skinner and Thorndike both recognized the importance of environmental events that preceded behavior; But Skinner called these antecedent stimuli

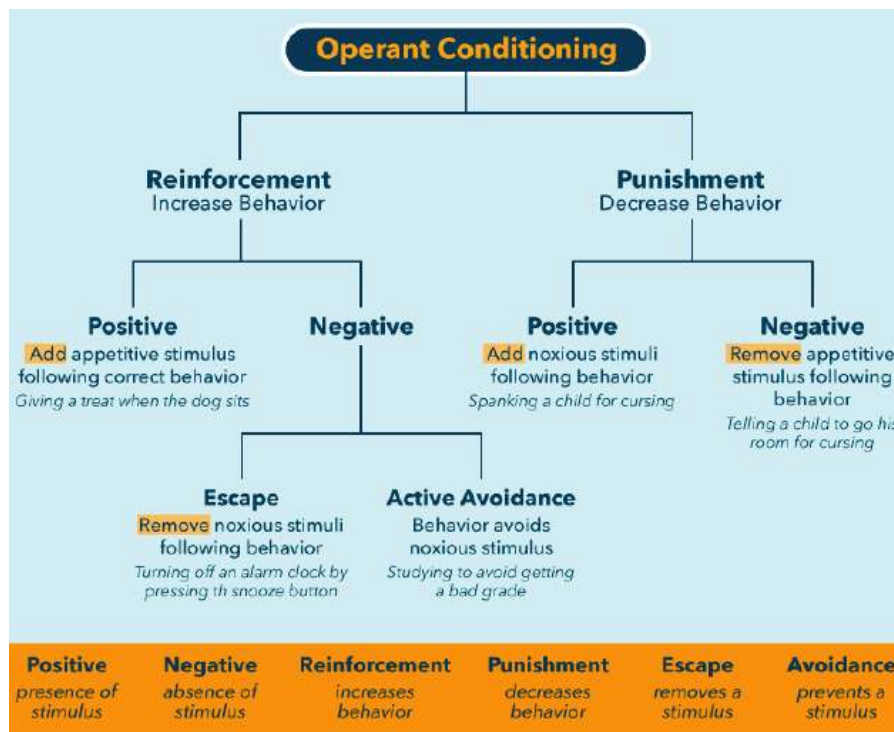
- Skinner included the consequences as a part of what we learn about our behavior
- *Antecedents* are anything in the physical environment that we can detect and tells us something about the consequences of our actions (Other people, inanimate objects, and signs are some of the many potential antecedents or cues that we encounter every day)
- *Behavior* is anything that we can do that is affected by the environment, can be repeated and counted, and affects the environment - what we think might be behavior has to pass the dead man's test: if a dead man can do it, then it isn't behavior
- Consequences are stimuli that can increase or decrease the probability of future behavior - they are simply events that happen after and because of a response
 - Ex: Test on Children with Autism
 - One group of children received the same consequence (raisin) for every correct behavior across several tasks; A second group of children received different consequence (chip/cookie) for each correct answer across different tasks
 - Differential Consequences: When one child correctly picked up and handed the file to the experimenter, he would receive a chip. He would receive a cookie for handing the experimenter a clip. These were the differential consequences – file=chip, clip=cookie; learned in fewer trials
 - Non-differential Consequences: When one child correctly picked up and handed the nail to the experimenter, he would receive a raisin and period he would also receive a raisin and for handing the socket to the experimenter. Raisins were his preferred snack. These were the non-differential consequences – nail=raisin, socket=raisin; learned in longer time

Reinforcement Contingencies

- There are four contingencies between responses and their consequences to describe situations
- Reinforcement - the consequences of a response increase the probability of the behavior
- Punishment - decreases the probability of the behavior
- When trying to determine whether a contingency is reinforcement or punishment, consider the likelihood that the behavior will occur in the future
 - The application or the addition of some consequence = positive
 - The removal of some consequences = negative
- The four are as follow:
 - *Positive Reinforcement*: some behavior produces a stimulus that leads to more of that same kind of behavior in the future; It is positive because of the added consequences and it is a reinforcement because of the effect of increasing the behavior
 - *Negative Reinforcement*: some behavior removes a stimulus that leads to more of that kind of behavior in the future; It is negative because of the removed consequences and it is a reinforcement because of the effect of increasing the behavior
 - *Positive Punishment*: some behavior produces a stimulus that leads to less of that kind of behavior in the future; It is positive because of the added consequences and it is a punishment because of the effect of decreasing the behavior
 - *Negative Punishment (Omission/Time-out)*: some behavior removes a stimulus that leads to less of that kind of behavior in the future; It is negative because of the removed consequence and it is a punishment because of the effect of decreasing the behavior
 - *Read Examples on Page 48*
- Negative reinforcement occurs in two forms; escape and avoidance - in both, the response is more likely in the future
 - *Escape* is a situation in which the aversive stimulus is already present, and a response removes or stops the unpleasant stimulus
 - Examples include:
 - We go to the doctor when we are sick to get antibiotics, which kill bacteria
 - We quickly run to the nearest building to get out of the rain when we forget an umbrella
 - Our behavior changes because we keep going to the doctor when sick, turning off the alarm, running out of the rain - our behavior is reinforced
 - The operant response removes an already occurring aversive stimulus therefore you get away from or escape the thing you don't want to happen
 - Avoidance is a situation in which the aversive stimulus is not currently present but will occur unless you

produce a response to cancel or omit the unpleasant event - we must experience the escape situation before we will make an avoidance response

- Examples include:
 - I go to my physician when I am sick so the doctors treatment will remove the illness – escape conditioning. I also go to my physician twice a year for checkups to detect problems early before they become unpleasant – avoidance conditioning.
 - We may get a flu shot to avoid contracting an illness.
- Our behavior changes because we keep going for checkups, getting flu shots, muting our phones - through avoidance of unpleasant stimuli our behavior is reinforced
- The aversive stimulus is not present yet, therefore the operant response cancels the otherwise scheduled aversive event
- The four basic operant processes change behavior using consequences that involve two elements
 - The type of consequence (positive/added and negative/removed)
 - Effect on future behavior (
- An appetitive stimulus is simply a stimulus that you will work to obtain - a reward
- A noxious stimulus is a stimulus you will work to avoid – aversive stimulus
- Appetitive and noxious refer to the intrinsic value of a stimulus, assuming that this stimulus functions this way for most people



- According to Skinner, operant processes are not equal in their effect on behavior - positive reinforcement has a longer-lasting effect on behavior
- The positively reinforce behavior will occur more frequently even without the contingency, but positive punishment will not suppress behavior without the contingency
- Positive reinforcement is also preferred because it can be used to decrease behavior without employing aversive events or producing unpleasant emotions
 - Specifically, we can take the consequence that reinforce one behavior and deliver it only when another behavior occurs
 - When working with children who have behavioral issues, the goal is to decrease and inappropriate behavior like self-injury or aggression and replace it with an appropriate response like asking for a break or a toy
- When punishment procedures are used correctly, they can decrease behavior faster than extinction
- Most of the contingencies we encounter daily are aversive
 - Legal system is based upon negative punishment in the form of fines and imprisonment (positive punishment)
 - Spanking a child (positive punishment)

1. Punishment alone doesn't teach a person what to do to get reinforcers
2. Punishment involves aversive stimuli, including some that cause pain
3. A person who uses punishment successfully once is more likely to use it again
4. The person whose behavior is punished also learns to use punishment to control others' behavior
5. Punishment only decreases behavior if the response is punished
 - a) immediately,
 - b) every time, and
 - c) with a large aversive stimulus

Step	Aspect of Operant Conditioning	What it is
1.	Identify the response or target behavior	What someone does; action
2.	Identify the consequence	What happened after behavior; event
3.	Determine whether consequence was added or removed	added = positive; removed = negative
4.	Determine what will happen to future behavior	increase = reinforcement; decrease = punishment (or extinction)
5.	Identify the antecedent stimulus	What happened before behavior; event

Operant Extinction

- Behavior goes where reinforcement flows - if you're seeing some behavior, then it must be maintained by some consequence
- Easiest way to have less behavior is to stop delivering those rewarding outcomes
- *Extinction* is a procedure in which a consequence previously followed behavior but now no longer does - responding is less likely to occur in the future without that consequence
- Three behavioral effects of extinction:
 - temporary increase in responding - an extinction burst
 - emotional and aggressive responding
 - responding eventually stops
- When you look for and analyze examples of operant processes, look for two clues indicating extinction
 - Nothing is added or removed when the target response occurs
 - The target response decreases
- Extinction decreases responding, but this process takes a while - it gets worse before it gets better
- Researchers have seen that the target response often increases in frequency, duration, intensity (an extinction burst) before beginning a slow deceleration
- People treated with a combination of interventions like extinction for self-injurious behavior and positive reinforcement for appropriate behavior show less aggressive behavior and fewer extinction bursts
- Extinction eventually decreases behavior, but how quickly it decreases behavior depends on how regularly the

consequence was being delivered

- Responses can be reinforced every single time they occur (continuously) or occasionally (intermittent)

Continuous

Intermittent

Extinction

- Partial reinforcement extinction effect - behavior exposed to a continuous reinforcement schedule will stop faster without reinforcement than behavior exposed to an intermittent reinforcement schedule
 - Ex: Candy at the bank

Shaping New Operant Responses

- Positive reinforcement is used to keep behavior going, an increase the magnitude of behavior, and it can also be used as a part of shaping by the method of successive approximations to teach new responses
- Shaping involves selecting and reinforcing more complex responses that look like the response you want while extinguishing simpler forms of the target response
 - We shape lever pressing for rats and key pecking for pigeons because it's easy to measure those arbitrary responses in many experimental paradigms - shaping is important outside the laboratory too; most obvious use in training service animals and with heroRats to detect land mines

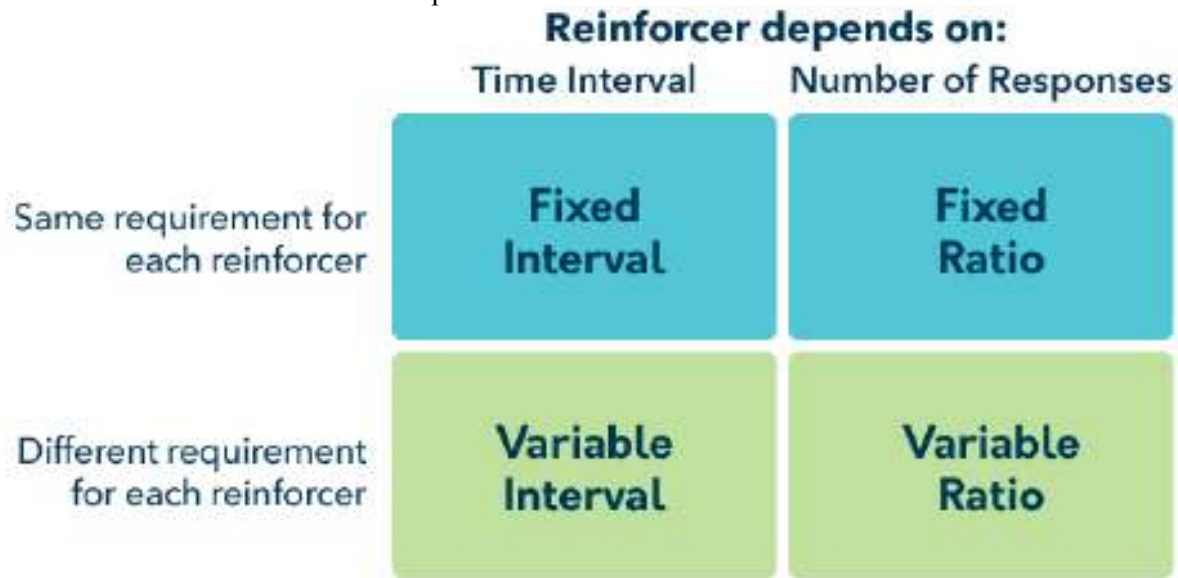
Reinforcers

- Reinforcers are events or stimuli that follow behavior an increase the future likelihood of that kind of response - reinforcers are stimuli and reinforcement is a process/procedure
- We will only know that we have a reinforcer if we test it out with a reinforcer test or a contingency analysis
 - For this, we need an initial baseline to tell us how often the behavior occurs before we start to change things
- Positive reinforcers are produced by the response, and negative reinforcers are removed by the response
 - Trophies, money, praise, and food are often positive reinforcers given when a response occurs
 - Negative reinforcers are a little more awkward to talk about because there are around when the response occurs and are taken away by it - they are the absence of something
 - Ex: Washing hands after touching a dirty surface means that you have clean hands
- Reinforcers are subdivided into primary and secondary
 - Primary or unconditioned reinforcers are not learned; They naturally affect the responses they follow and include stimuli/events needed to maintain life
 - Include aversive events such as heat and pain
 - In these cases, when you do something to successfully remove an aversive event, you will do that thing more often, as an escape or avoidance
 - Primary reinforcers tend to be involved in those contingencies provided by the natural environment, not mediated by other people
 - Secondary or conditioned reinforcers influence responses because they signal or have been associated with a primary reinforcer - they are not universal; They depend quite a bit on what has already been learned
 - A stimulus that is a reinforcer for you right now may not function as one for you later
 - Generalized conditioned reinforcers - objects traded for several other reinforcers - are special because they don't lose their power to reinforce behavior
 - Are paired /associated with many different primary and secondary reinforcers and not as dependent upon a specific motivating variable

Schedules of Reinforcement

- The rules that we use to determine when we get reinforcers for behavior
- 4 main schedules of intermittent reinforcement: fixed ratio, variable ratio, fixed interval, and variable interval
- Ratio schedules delivery enforcers after a specific number of responses - this schedule can be fixed and can also be variable, where the required number of responses change with each trial
- Interval schedules delivery enforcers after at least two responses and a specified amount of time - the first response starts a timer, and the next response after the timer finishes producing a reinforcer - they can also be fixed or variable
- We can change behavior using the reinforcement schedule - ratio schedules generate more responding than interval schedules; a fixed ratio or continuous reinforcement schedule produces the highest rate of response is because it is

a one to one ratio four responses to reinforcers - a fixed interval schedule produces the lowest rate of responding because the time between reinforcers is predictable/constant



Ratio Reinforcement Schedules

- In a fixed ratio schedule, we must produce the target response a specific number of times, and the last response produces a reinforcer
 - This sequence then resets the counter to the same response requirement
 - A fixed ratio schedule is characterized by a break and run pattern of responding - a run happens when we produce many responses quickly until we earn a reward; thus, the response rate is the second highest - a break occurs after the delivery of a reinforcer
- In a variable ratio schedule, we have to respond to a different number of times for each reinforcer, and the number of responses changes around an average for each reinforcer – this is why the reinforce are deliveries are sometimes closer together and other times farther apart
 - A variable ratio schedule is characterized by a high and constant pattern of responding because responding faster directly produces more reinforcers in less time - we don't know when we will get a reinforcer, so we keep responding to maximize the number of reinforcers we earn; it's this unpredictable or delivery of reinforcers that makes responding constant (there is no pause)

Interval Reinforcement Schedules

- In a fixed interval schedule, a response starts a timer, the specific amount of time must elapse, and the next response will trigger the delivery of a reinforcer
 - A fixed interval schedule is characterized by a scallop pattern of responding - we respond little at the beginning of the interval and then respond increasingly faster toward the end of the interval; once we get a reinforcer, we take a break
- In a variable interval schedule, we have to wait different amounts of time for each reinforcer - we still have to respond once to start the timer and once more to produce a reinforcer after the time ends - some intervals are longer, and some are shorter than the previous one
 - A variable interval schedule is characterized by a slow and constant pattern of responding - Variable interval schedules produce the third highest rate of responding
 - reinforcers are unpredictable, so we keep responding without pausing to maximize the number of reinforcers we earn - more responses don't produce as many reinforcers in interval schedules, so it's slow and steady wins the race
- In interval schedules, responding is slowest because the rate of response determines the rate of reinforcers less directly - we have to respond to earn reinforcers, but we also need to wait
- Most schedules that control our behavior are intermittent schedules of reinforcement

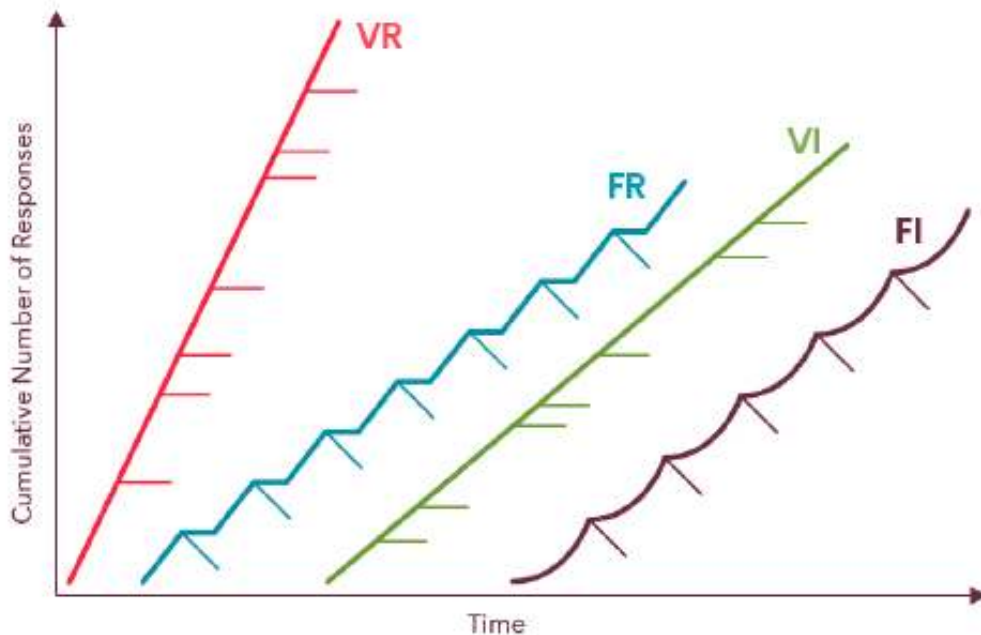


Figure 7.25: Total number of responses for each reinforcement schedule over time. Schedules of reinforcement are ranked from highest (VR; variable ratio) to lowest (FI; fixed interval) rate of responding. FR (fixed ratio) and VI (variable interval) schedules produce intermediate rates of responding. The shorter, thin, diagonal lines indicate reinforcer deliveries.

Comparing Pavlovian and Operant Conditioning

- When one type of learning occurs, the other does too
- The most important difference between Pavlovian and operant conditioning involves the unconditional stimulus (Pavlovian) and reinforcer/punisher (operant)
 - In Pavlovian conditioning, the unconditional stimulus will occur regardless of our responses - This is why sometimes we say that the response doesn't matter
 - Ex: When you see the pretty colours of the firework – the conditional stimulus - you also hear the loud explosions - the unconditional stimulus; startling to the colours of the fireworks - the conditional response - does not affect the loud explosion
 - The conditional response isn't meaningless; it means that you've learned to associate the conditional stimulus with the unconditional stimulus
 - With operant conditioning, the animal is required to respond in order to receive the consequence
 - Ex: When you watch fireworks and see all the pretty colours (antecedent stimulus), then you can cover your ears (operant response) and not hear the loud explosion (consequence) - covering your ears before the loud explosion and omitting the sound that hurts your ears as an example of avoidance; if you cover your ears after you start hearing the sound for the first time, this is escape
 - Covering your ears before or during a loud explosion is negative reinforcement
 - If you're confused about which type of conditioning occurred, ask yourself if the response changed the probability of the unconditional stimulus or consequence
- We talk about involuntary responses in Pavlovian conditioning and voluntary response is an operant conditioning, but our behavior is determined in both situations - we can't simply stop responding if we want

Tolman and Latent Learning

- *Mediational neobehaviourism/Operational behaviourism*: Tolman reintroduced mental events in the form of cognitive Maps that occurred between, or mediated, environmental stimuli and behavior - these unobservable, mental events were characteristics of the animal-like expectations, moods, or attitudes that acted on behavior directly
- *Latent Learning*: Learning that we can't see until we're motivated to show it; that is, there is no change in our performance until we receive a reward
 - Rat Maze (Page 76)
- *Cognitive map*: A detailed representation of the physical environment and all possible routes that we can use when deciding where to go (Possessing a mental map means that rats could take the learned route as well as use a shorter, alternate route)

- We are capable of amazing things (perception/attention, working memory, conceptual/categorisation learning, transitive inference, imitation, etc.) because of cognition - learning does not have to involve changes in performance that we can see

Bandura and Social Learning

- *Social learning*: We learned from other people - In imitation, your friend does what you just did (You are the model or demonstrator, and your friend is the observer who imitates you)
- Sometimes there is an explicit 'do what I do' instruction, but there doesn't have to be - the observer doesn't have to imitate the behavior immediately; It maybe sometime later when the observer has had an opportunity to use this new knowledge in a similar situation
- Social learning does not make the other behavioral approaches to learning invalid or unimportant - social learning expands animal learning further into the cognitive domain
- This theory was revolutionary because observational learning did not require reinforcement for learning to occur
 - Ex: Bobo doll; Children who observed an adult aggressively interact with the bobo doll were more aggressive and engaged in new aggressive behavior toward the doll more than the children who observed an adult playing gently with the doll or the control children who were not exposed to an adult model interacting with a doll
- Observation a learning does not have to actually change the observer's behavior - it can influence what we might do; cognitive orientation
- *Transferred Association* - In order to copy the behavior of another, the observer must see the models behavior and see the model earn a reward for that behavior
- An application of social learning is to teach new skills
 - Ex: People with special needs
- Observational learning entails four phases:
 - *Attention Phase*: We must notice the model's behavior - we are more likely to imitate the model when we like and respect that person (sometimes people with autism have trouble with this phase, so they don't always benefit from social learning)
 - *Retention Phase*: we think about performing the models actions ourselves
 - *Production Phase*: we actually perform the model's actions
 - our imitated behavior produces the same reward that the model earned - if we earned the same reward that we thought we would, were more likely to repeat this behavior in the future

Biological Constraints on Learning and Learned Helplessness

- Biological preparedness refers to the fact that it's easier to condition a Pavlovian fear to snakes and spiders than to arbitrary stimuli like Flowers and tones – it has implication for phobias
- Phobias are different than fear conditioning in the lab:
 - Phobias can be learned in a single trial
 - Phobias can persist even when we know that the feared object is harmless
 - Phobias are of things that could harm our ancestors (like a non-human animal) that we probably won't encounter
 - Phobias do not extinguish quickly or easily
- We see biological preparedness in the laboratory when we use shock as an unconditional stimulus to associate with snakes and spiders as conditional stimuli
 - Participants don't always easily learn to associate a shock with snakes and spiders because these creatures don't 'belong' with shock and pain - conditioning would be more reliable if we were to associate snakes and spiders with nausea, because snakes and spiders can be venomous which makes people sick
 - Ex: Rhesus monkeys and snakes
 - A lab monkey would show No Fear of snakes because in the lab they would just reach across the snake from marshmallow
 - Wild monkeys screech in fear when they see a snake, and a previously fearless lab monkey will fear snakes after seeing this fear response from a wild monkey
 - Socially conditioned fear even generalized to a fake snake
 - We can't just condition fear to anything

- Learned helplessness: When we experience an aversive stimulus, usually involving pain, the aversive event/unconditional stimulus activates the sympathetic division of the autonomic nervous system
 - The resulting unconditional responses provide us with the energy and motivation to escape or avoid the situation - when our avoidance responses don't work, we stop trying to get away from the aversive stimulus; We've acquired learned helplessness
 - Can be specific to a particular setting or generalized to many settings
 - People acquire learned helplessness that pervades many areas of their lives - lack motivation and coping mechanisms needed to be successful at work and with social relationships

Module 8

Metaphors for Memory

- Most of the way we talk about memory in day-to-day life uses what is called a search metaphor
- We talk about the mind as a place that holds things - as if they are real spaces that can be opened or closed, and a place that you can be 'out of' when you're feeling disoriented/strange
- Thoughts and memories are things of the mind - they are objects to be held, have texture, and can be looked at
- The actor remembering is often discussed as some way of searching through the contents of our minds and coming up with the correct object, which represents a particular memory
- Phrases like 'bringing it to the front of your mind' and 'finding a solution' both describe the active search-oriented language that we use when discussing how memory works
- Search metaphors for memory date back as far as Plato and Aristotle, who described memory as a wax tablet - experience is pressed into the tablet, creating shapes and patterns of writing; when we remember, our task is to search all over the wax tablet to find the correct written passage
- Metaphors about memory have become more oriented towards computers. shifting the search into a virtual space
 - Memory to some is like a computer program, searching through recorded information for the proper bytes

Questioning the Search Metaphor

- In most cases, we might describe the inability to remember something as a failure of search - we simply weren't able to remember it; we couldn't 'find it' in our mental space
 - Apple Logo + Penny

Thinking About Function

- It seems as though our memory systems don't simply record the world around us, allowing for an easy 'search and retrieve' system
- Because the past can never occur again in exactly the same manner, simply replaying a memory in our minds isn't necessarily useful - what is useful, is using information about the past in combination with the information in the present to form a useful response
 - Ex: Birthday Card – Green = Frog
 - Ex: Facemasks in Coronavirus Pandemic
- Memory is more about the present than the past, a much better metaphor for memory is not search but reconstruction
 - Much like how perception involves taking information about the world and constructing what we see and hear, memory takes information from the environment to help trigger useful memories
 - Reconstruction is a better metaphor because rather than specifically searching for information, you create a useful response given the situation at hand and what you've stored - makes more adaptive sense as memory is here to help you in the present
 - Ex: Dinosaur Skeleton
 - Some bones are found, but many are often missing or degraded - to complete this skeleton for display in a museum, paleontologists frequently have to make their educated guesses about what the missing bones were like
 - Our brains also make their best guesses about what happened in a situation when we try to remember it
 - Therefore, a complete Dinosaur skeleton is similar to a complete memory

Encoding Memories: Prolonging the Present

- Scientists use information processing models to talk about how memories are formed and retrieved; these models draw comparisons between human memory and how a computer processes information
- The first step in the memory process is the occurrence of an event - something has to occur before we can remember it
- The process for how our brains commits an event to memory is called *encoding* - thus the problem our brains have to

solve in order to encode information is called the *encoding problem*

- After encoding, the brain must store the memory - the brain is a collection of neurons and not a physical landscape, memories must be stored as part of its physical structure
 - This process is called *storage* and the associated problem is the *storage problem*

Sensory Memory: Icons and Echoes

- Sensory memory is a system that keeps information translated by the senses briefly active in a relatively unaltered, unexamined form - is what allows us to perceive the world as a unified whole rather than a series of staggered images and sounds
- Sensory memory holds onto information in our nervous systems long enough for us to stitch one moment of our experience to the next
- Sensory memory is thought to feed into the more general immediate memory, a system that actively holds onto a limited amount of information so we can manipulate and process it
- In the visual system, we call this fleeting afterimage: '*iconic memory*' and the neuronal activity that loiters in the brain itself is an icon
- In the auditory system, the lingering neuronal activity is called an echo, while the process in general is called '*echoic memory*'
- Both experiences are thought to be brief, with icons and echoes lasting only a few tenths of a second - however, echoes have been demonstrated to last longer, on the order of up to three or four seconds
 - Ex: Why you can remember the last few words of a conversation to which you weren't paying much attention
- George Sperling tested the sensory flashes with blocks of letters arranged in three-by-three rows
 - Partial report technique (Page 18-19)

Immediate Memory: Manipulating Information

- While sensory memory performs the job of bridging the gap from perception to memory, immediate memory is a system that actively holds information at the front of your mind
- A more general term for what researchers often calls short-term or working memory
- Holding information in consciousness is extremely important
- Many students ask whether immediate memory is really 'memory' if you're only holding on to information rather than actively remembering it
 - Researchers who favor computer driven metaphors for memory often compare immediate memory to the RAM in a computer; it is a place where currently active programs are operating, much like immediate memory is where currently active information is being manipulated

Characteristics of Immediate Memory

- To address memory's representation, we can think about what kind of information immediate memory can contain - this can be answered through experience
- The *inner voice* is evidenced that information in immediate memory can be represented verbally
 - The most compelling evidence for the inner voice comes from the kinds of errors people make in immediate recall
 - Ex: Pizza ordering
 - The primary mode of coding information and immediate memory is believed to be auditory because of the experimental results similar to what happened in the pizza ordering example
- For most of the information that we interact with in our daily lives, the auditory coding is enough - speech and written text or how we consume and produce most meaningful information; interacting with others requires language of some kind, and are increasingly digital cultures requires reading pages and pages of online text
- In cases where auditory information isn't sufficient, we can use visual coding or the *inner eye* to guide us
 - Ex: Stephen Kosslyn experimented by telling people to imagine two animals standing next to each other (Page 22) - Answering questions about the goose when it is next to the elephant is more difficult, because you have to mentally 'zoom in' to the image before making a response
 - Mental imagery like that represented by the inner eye actually taps into the same brain structures as the perception does - further strengthening the argument that the inner eye is much like perception in general
- Duration is best talked about in terms of forgetting
- In order for information to remain an immediate memory, you have to engage in rehearsal - Rehearsal is a process of repeating information to help yourself, helping you 're-hear' the information over and over
 - You could continue to rehearse something indefinitely, or at least until you become distracted

- After about 3 seconds the amount of information in immediate memory begins to drop off precipitously - after 12 seconds or so, participants are essentially reduced to guessing
- The capacity of immediate memory is another important element - its contents may persist for only seconds without rehearsal, but how much information can fit into a single instance of rehearsal before the contents began to breakdown?
 - 7 plus or minus 2 has become the standard answer for the average person's memory span (how many items can be kept active in the mind at one time)
 - Not all units of information are created equal - while 'seven plus or minus two' is still generally accurate, psychologists believe that it is not the number of items in immediate memory that defines its capacity, but instead simply how long it takes you to rehearse information to yourself
 - Ex: Chinese students can generally keep roughly one more number in their mind than Americans because The Chinese words for numbers take less time to pronounce
- While gravity is a potential route to immediate memory capacity improvement, a much more effective way is through the process called chunking
 - If we don't care about the order of the items, we can keep them in mind more effectively by grouping or chunking them together - by using a meaningful structure, we can affectively increase the capacity of our immediate memory
 - Ex: basketball experts can simply glance at a 4 second clip of a game and remember where each player was on the court and chess experts can glance at a game in progress and remember the exact positions of all the pieces - these experts can only remember chunks of information; they draw on their knowledge of their fields of expertise to understand complex layouts in simpler terms however drawing on that knowledge cannot be done when the layouts presented are meaningless or impossible

Working Memory Model

- The working memory model argues that immediate memory is not simply a place for the storage of information, but primarily a place for the manipulation of information (why it is called working memory rather than short-term or immediate memory)
- Information that exists in working memory is managed in one of two places the final logical loop or the visuospatial sketchpad
 - The final logical loop is where auditory and verbal information is temporarily stored and manipulated - it is the manifestation of the inner voice in the working memory model
 - The visuospatial sketchpad is the representation of the inner eye in the model, and it represents a place where visual and spatial information is stored and manipulated
- Central executive has the job to direct the flow of information are only two and from the phonological loop and the visuospatial sketchpad, but also to and from long-term memory

Long-Term Memory: Connections and Storage

- Our long-term memory systems are what we use to store and recall information over lengthy periods of time –an expensive and versatile system
- Long term memory is employed whenever you are cued to remember information that you've encoded previously
- Long-term memory is assumed to be practically limitless and total storage capacity – however, despite its potentially unlimited capacity and varied uses, it's often difficult for us to remember specific information without the right kinds of prompts
- Autographical memories that are based on life events are *episodic memories*
 - Episodic memories can be as elaborate as a birthday party or as simple as remembering what you did last Saturday night
 - Key feature is that they are based on a specific event that you experience and encoded
 - When memory researchers study episodic memory, they might be interested in any of its varied forms - some researchers may be interested in the kinds of mistakes people make when remembering big, significant memories like weddings and funerals, while others may ask people to remember simple lists of word in a lab experiment
- *Semantic memories* relate to meaning to void of a specific context, whereas episodic memories are all about specific context
 - You may remember a fact, or a piece of knowledge about the world
 - Ex: An episodic memory of a dog might be remembering up time you played fetch with your pet dog, Marty, but the simple act of recognizing that Marty is a dog would involve semantic memory instead

- Useful not only for language - recognizing that certain patterns of letters written on your computer screen have actual meaning, but also for remembering other things of general knowledge as well
 - Ex: fire is hot and sharp things are dangerous
- *Procedural memory* is about process
 - While episodic memory recalls what happens and semantic memory recalls what something is, procedural memory recalls the process of how a task is completed
 - People are often good at recalling procedural memories but have poor insight into the contents of these memories
 - Procedural memories are particularly resistant to amnesia, suggesting that the procedural memory system operates on a different level from episodic and semantic memory

The Transfer to Long-Term Memory

- The best way to ensure that new information is incorporated affectively into what we already know is by meaningfully relating the new information to what is already stored - this is elaboration or elaborate if rehearsal
- Elaborative rehearsal refers to a process of actively manipulating information in immediate memory so that we can meaningfully connect it to other information that we've already stored in long-term memory - Elaborating on the new information with connections to old information
- Elaborate if rehearsal is an answer to the encoding problem, although researchers disagree about the finer points of this process
 - One way to demonstrate the effectiveness of elaborate if rehearsal is through what is called a 'levels of processing' experiment
- Deep processing involves making meaningful connections to existing knowledge - it encodes information semantically, based on meaning (making the decision about whether or not the word 'chipmunk' is a living thing)
- Shallow processing is encoding information based on only its surface characteristics (simply asking whether 'chipmunk' is written in capital letters)
- When we compare the effectiveness of these two different encoding strategies, people who encode information meaningfully tend to remember more information than people who encode information based on only its surface characteristics

Effective Encoding Strategies

- Massed practice/cramming is particularly ineffective for performance in the long term
- Studying the same material repeatedly over a short time frame yields diminishing returns; last learning occurs during the 5th or 6th repetition compared to the first or second
- In comparison, spacing out your studying over multiple hours, days, weeks, or months is the key to long-term learning - spacing effect
- The spacing effect works not only for improving episodic and semantic memory, but also improved procedural memory
- Using mnemonics is another way to improve memory - they work by providing a framework for you to engage in meaningful processing
 - The peg word technique is a mnemonic device that provides both order and imagery to a list of items
 - The method of loci is where a person places to-be-remembered information along a well-known pathway, such as the route to work/school
 - This method dates back at least as far as ancient Rome and Greece and was used to help remember oral stories, histories, speeches
 - This technique is also called the mind Palace or memory Palace technique
 - Acronyms, phrases and initializations can also be mnemonics by providing us with cues to the to-be-remembered information's organizational structure
- A third strategy for effective encoding is to engage processes that are believed to fit naturally with the way our brains are structured - adaptive memory research
 - One finding in this subfield includes the observation that information processed for its relevance to our own survival leads to high levels of later recall possibly due to enhanced levels of elaboration under these conditions
 - Certain types of information appear to be privileged as well; living, animate things are more memorable than nonliving, inanimate things
 - Animate things represent particularly important and salient aspects of the environment that our brains have evolved to pay attention to and remember

- Many of the memory experts described earlier incorporate some of these ideas into their memory strategies, consciously or not - one common strategy for remembering ordered information is called the person action object strategy (PAO); in this strategy, memory experts assigned to each card in a deck a person, an action, and an object
 - The unique images then often placed in a memory Palace - when it comes time to remember the cards, the expert simply walks through his or her memory Palace and remembers the images that were placed inside
 - Adaptive Memory - Indirect connection; First, the experts are integrating people into the memories - second, the images memory experts use are often humorous or disgusting - it's possible that by integrating imagery that is emotional or sexual in nature, there tapping into some of the more basic functions of our brain in general
- Retrieving information is actually beneficial for trying to remember the same information later – retrieval practice
 - It starts to occur because we retrieve information, the relationship between the memory and the cues that help us retrieve it is enhanced
 - We have improved the distinctiveness of the information by improving how effectively certain cues help us retrieve it

Memory Retrieval: Putting the Pieces Together

- The retrieval problem is also fundamental to memory
- Memory is a function of both what we have stored and the situation at hand ; Thus, retrieving information from memory is less like picking out a book from the library and more like putting the pieces of a Dinosaur skeleton together

Centrality of Cues

- Cues are the piece of information in the present that help us remember events from the past, and they are central to remembering - they can be specific or broad, and how diagnostic a cue is for a particular memory influences the likelihood that the information will be remembered
- Queues are the reason why elaboration works so well at improving memory - when we encode information meaningfully, we are creating natural networks of cues that help us retrieve the information at a later date; all we have to do two remember, it's to latch onto one of these cues to help us route back to the original information

Encoding Specificity Principle

- A natural consequence of the importance of cues is that how we encode information affects how we are able to retrieve it - encoding specificity principle
- A retrieval cue is only useful as long as it matches how a piece of information was originally encoded
- Context at encoding matters
 - Factors such as location, mood, and mental state can influence your memory - you are more likely to remember happy events when you're currently happy, remember things you did while you were drunk one year drunk again, an even more likely to remember information in the place you originally studied it

Transfer-Appropriate Processing

- Relating to the encoding specificity principle is the idea that not only should we attempt to match the context that occurs at both encoding and retrieval, but we should also attempt to match the physical and mental processes that are occurring - you should try to engage in the same processes one in coding that you will be expected to engage in when testing to ensure that the appropriate cues are available to you

Implicit Memory

- Sometimes we remember information without consciously realizing it or intending it - in these cases, we say that the information was recalled implicitly, and the information recalled is an implicit memory
- Researchers measure the presence of implicit memories behaviourally - one way to do this is through memory tests that are not described as memory tests to the participant
- The kinds of elaborative encoding strategies that facilitate explicit remembering often have no effect on implicit memory - no difference would be seen in implicit memory tasks like the word stem completion
- Some researchers believe that these data are enough evidence to assume that explicit and implicit memory are governed by different systems in the brain

Memory Errors

- The seven sins of memory come in two types:

- Errors of omission: memory errors where information cannot be brought to mind
- Errors of Commission: memory errors where wrong or unwanted information is brought to mind
- Ex: in our Dinosaur skeleton metaphor, errors of omission are when bones that make up the skeleton are missing for one reason or another, while errors of Commission are when we put a bone in the wrong place or use bones from an entirely different species of Dinosaur

Errors of Omission

- Transience described how the memory for any particular event or piece of information tends to degrade overtime, often simply called forgetting - when we commit an error of transience, we simply can't remember the information we were trying to recall
 - Most forgetting is caused by lacking appropriate cues to aid recall
 - In theory, providing the correct cue would trigger the information to be remembered - however, other forces can also be at play to erode our memories
 - Memory decay can be assumed as the memory simply fade away due to the passage of time - decay can't explain the vast majority of forgetting
- There are two types of interference that often cause forgetting and lead to transience
 - Retroactive interference is when newly learned information makes it more difficult to recall older information, and it happens all day every day - it isn't time that causes forgetting, but instead the constant flow of new information that bombards us every minute
 - Proactive interference happens when old information interferes with new information
- If inference isn't to blame for the inability to recall information, a problem lies not at retrieval but at encoding - When we don't attend to information we should remember or process it in meaningful, elaborate if ways, we call this the sin of absentmindedness
 - Absent mindedness is when information is not encoded to begin with, whether due to a lack of attention or a failure to elaborately rehearse the information
 - Ex: Misplacing your keys
- Final sense of omission is blocking - relates to whether the cues we have available are enough to help us remember a piece of information
 - most common example of blocking is tip-of-the-tongue state - people are in a taut state when they cannot remember a piece of information, but have a powerful feeling that they know what they are trying to remember

Errors of Commission

- While errors of omission simply cause information to be unremembered, errors of Commission are more insidious - they allow for information to be remembered, but with pieces altered or missing
- There are four errors of Commission:
 - The sin of misattribution occurs when we incorrectly recall the source of the information we are trying to remember - these source errors range from the innocuous to the egregious
 - Deja vu is likely an example of a relatively simple source error - We simply can't remember the source of the information rather than misattribute it
 - By presenting participants with a series of symbols subliminally, roughly half of the participants reported experiencing Deja vu with the symbols were shown later in the experiment
 - An example of misattribution in action can occur in what are called flashbulb memories - memories for events that are both surprising and particularly significant (Page 58) - Flashbulb memories are more susceptible to errors - they are not so much elaborately encoded as they are tinged with emotion
 - The sin of suggested ability requires the information that is misremembered to have been suggested by an outside source
 - Ex: if a witness to a robbery is asked 'which hand was the robber holding his gun in?' Two assumptions can be made about the witness' memories as part of the question - That the robber is male, and that he had a gun - if one or neither of these pieces of information is true, the witness may accidentally miss remember that the robber was a few inches taller or that the robber had a gun
 - This is the misinformation effect - the suggested information is not the direct target of the question being asked, but simply a component of the question itself
 - Suggestibility can implant even whole autobiographical memories
 - Our ability to recall information is also influenced by the information we have available to us when we are

- trying to remember, both from the world around us and from previously storing memories - sin of bias
 - Bias in remembering can take many forms, but one of the most common biases in remembering is caused by what are called memory schemas
 - Memory schemas are highly organized sets of facts and knowledge about specific kinds of information - schemas are actually highly useful for remembering, as they allow us to remember new information by fitting it into a set of knowledge that is already highly organized
 - Schemas can also be simpler clusters of facts as well, such as 'things found in the bathroom: toilet, sink, shower' - More elaborate schemas might tell us about the kinds of actions and routines that are common in certain situations, such as classrooms and restaurants; schemas are useful because they act as organizing principles for information out in the world - they help us fill in the gaps in our memories and these gaps are typically filled in ways that we expect and are correct
 - Sometimes information organized into schemas becomes overgeneralized, or exceptions to the schemas are not noticed - in these cases, we say that the sin of bias has occurred
- The sin of persistence occurs when the memory system fails to prevent the recall of a memory that is unwanted (typically negative or traumatic)
 - In PTSD, people who have had a traumatic experience often experience intrusive and disturbing thoughts and feelings that forced them to think back to the original events - they often have memories that are difficult to suppress, deep conscious effort to do so
 - The sin of persistence occurs when these memories come flooding back without warning - persistent illustrates why forgetting can sometimes be a good thing

Forgetting and the Brain

- Forgetting not only helps us smooth over unpleasant events in our lives, but also helps us to keep in mind only information relevant to our present circumstances - remembering too much can make it difficult to function in daily life if the memories interfere with our activities
- Hyperthymesia - a rare medical condition that leads to near perfect auto biographical recall
 - For AJ, her amyglada (the portion of her brain responsible for processing emotion especially emotional memories) what's 20% larger than in most adults
 - Additionally, her amyglada contained far more connections to the hippocampus
- Physical problems or damage to the brain and areas associated with memory (such as the hippocampus) can cause forgetting
- Amnesia can come in two primary forms retrograde and anterograde
 - Retrograde amnesia is the kind that is usually depicted in films and popular culture when someone hits their head and forgets everything about themselves
 - Some portion of the events prior to the incident that caused the amnesia to develop are lost, typically only temporarily
 - The only events that are lost, are those directly leading up to the event that caused the amnesia, which could be an accident or a blow to the head
 - Sometimes the memory loss can be more severe, with patients losing access to months or even years of time
 - Luckily most people with amnesia eventually recover
 - Anterograde amnesia is an inability to make new memories - information that occurs after the injury is lost and never coded or stored
 - Only develops as a result of specific brain damage to the hippocampus - this kind of brain damage can occur in multiple ways, such as from a particularly nasty viral infection the chronic abuse of alcohol over many years, or as an unintended consequences of brain surgery
 - Ex: H.M -

Module 11

What Are Emotions? How Do We Define Them?

- Some emotions have different functions now than they did in ancient times
 - Anxiety evolved in the context of specific dangers (ex: predation) and has been co-opted for slightly different purposes today (ex: test anxiety)
- When we talk about emotions, we are really describing a feeling that we have toward an object or event
- Some emotions are short-lived states that correspond to situational events
 - Ex: Happy when we adopt a puppy
- Moods are longer-lasting, less-intense states and are not affected by a specific object or event

Role of Rewards and Punishers

- Emotions have more local causes in the physical environment due to Pavlovian and operant conditioning as well as more far-removed causes due to evolution
- We tend to feel happy about earning rewards and avoiding punishers but sad/angry about losing rewards and earning punishers
- Emotions are states elicited by rewards and punishers, which have particular functions
 - Remembering or planning for rewards and punishers can also induce similar emotional states
- Emotions are conditioned to antecedent (or discriminative) stimuli, behaviours, and consequences
 - Antecedent stimuli signal whether you'll get a reinforcer or a punisher for responding
- Because emotions persist longer than the delivery of a reward, one function of emotions is to keep us responding until we get the next one
- Emotions keep us responding when they become part of the reinforcement contingency and to help us learn, store and remember information

	Category	Example
Source	Reinforcement contingency	Happy to obtain a reinforcer or avoid a punisher; unhappy to obtain a punisher or avoid a reinforcer
	Intensity of reinforcer	Happier for a larger reinforcer than a smaller one
	Discriminative stimuli	A stimulus can signal the availability of a reinforcer (happy) as well as a punisher (unhappy)
	Unconditioned reinforcers	Different emotions for different unconditioned reinforcers: happy for food and relief for water
	Conditioned reinforcers	Different emotions for different conditioned reinforcers: happy for good grade and relief for money
	Positive punishment	Happy to not respond in order to (passively) avoid an aversive stimulus
	Negative reinforcement	Relief after responding in order to actively avoid an aversive stimulus
Function	Elicitation of hormonal and physiological responses	Rush of adrenaline and fear to avoid a stranger
	Arbitrary responses for rewards; motivational	Fear elicited by a tone to motivate lever pressing to avoid shock
	Communication	Expressing fear tells other members of your species to stay away from that aversive stimulus
	Social bonding	A parent experiencing fear will protect her offspring
	Mood state dependency; evaluation of memories	Learning something while afraid will make you more likely to recall that information when you are afraid
	Storage of memories	You knew you were afraid when you saw that scary movie last week at the theater across from campus
	Perseveration	Fear lasts longer than shock, so rats who are still afraid after the shock stopped will press the lever

Evolution of Emotion

- Each distinct emotion is a distinct adaption and has multiple behavioural elements that occur over time
- For each distinct emotion, we have to state the following
 - Under what evolutionary relevant conditions we experience and emotion

- How an emotion affects us
- How behavior evoked by an emotion solves an evolutionary problem
- Each emotion evolved to serve a specific purpose
- Emotions generally include temporary changes in the following
 - Hormones and physiology
 - Behaviour, including thinking and feeling
 - Facial expression
 - Sense perception
- We see changes in Physiology and behavior when women experience fear and disgust and show different associated heart rate and blood flow patterns while avoiding a threat or illness - not every expression of emotion will include all possible bodily changes (you don't feel a rush of adrenaline every time you experience fear)
- We also see changes in facial expression and sense perception with fear and disgust. Fear helps us avoid danger via our facial expressions by opening our eyes and flaring our nostrils. Wide eyes and nostrils allow us to see more objects in our visual field and detect the scent of an attacker. Disgust is the opposite emotion of fear and prevents us from inhaling noxious odours. Our eyes and nasal passages close with disgust to restrict our perception.

Expressing Experience and Emotion

- Charles Darwin originally suggested that emotions are adaptive and function as communication through three principles
 - *First principle of serviceable habits* emphasizes that the way emotions are expressed serves a purpose in nonhuman animals but not people
 - Ex: Dogs bare their teeth as a warning before attacking an opponent - people show their teeth when they are displeased but don't attack with them (non-functional response)
 - *Second principle of antithesis* emphasizes how opposite emotions have opposite bodily expressions
 - Ex: In communicating anger, a dog might arch its back, lower its head, tense its muscles, and bark at another dog to defend its territory – happiness is anger's opposite and is characterized by a straight back, head held high, relaxed muscles, and wagging tail
 - *Third principle of direct action of the excited nervous system on the body* emphasizes how the body could expel unused excitement via laughter

How Do We Identify Emotions in Others?

- James (1884) described the way that most people incorrectly assume that emotions proceed:
 - We perceive the physical stimulus in the environment
 - We experience an emotion
 - We express that emotion publicly through bodily gestures or moving our facial muscles
- This perception-experience-expression order fits with our subjective timing of events, but is not the way James argued that we experience emotions
- James-Lange theory of emotions:
 - We perceive the physical stimulus from the natural environment
 - We express the emotion publicly - physiological changes occur as a result of perceiving the physical stimulus
 - We acknowledge the privately experienced emotion
- Here, the second and third stages are inverted - We also respond to physiological arousal and use that to identify the emotion (even when we don't have words to identify an emotion specifically, we still feel the effects)
- Cannon-Bard thalamic theory of emotions:
 - We perceive the physical stimulus in the environment
 - We simultaneously produce bodily or facial expression changes and acknowledge the emotion
- In this theory, the thalamus mediates these emotional reactions and reports back to the cortex
- Many bodily changes occur in conjunction with emotions - heart rate, skin conductance, facial expressions, gastrointestinal shifts, and endocrine changes
- If an animal's brain could no longer communicate with the facial muscles to display emotion, the rest of the animal's body would still express the emotion - this explains why it seems that bodily changes are not a

- necessary middle step to produce an emotional experience
- Therefore, the difference between the James-Lange and Cannon-Bard theories of emotion is that events surrounding the expression of emotion occur sequentially within the James-Lange theory but simultaneously for Cannon-Bard
- People can also lie with emotions
 - As observers, we rely on the outward signs of emotions: words, vocal inflections, gestures, body posture, facial expressions
 - However, it's possible to show a facial expression without the typical corresponding emotion
 - Ex: Perhaps the person wants to seem happy, so he smiles with lips turned up at the sides. For a moment, one of the corners of his mouth turns down to unintentionally reveal sadness. - This leakage from the true emotion occurs because some parts of emotional facial expressions are uncontrollable; However, we can't accurately train airport security personnel to identify potential threats by concealed facial expressions
- We also find evidence for consistent emotions when people in an isolated culture in New Guinea agreed that specific situations had corresponding facial expressions - sadness at the death of a child, anger after a fight, and happiness upon seeing a friend
- Facial expressions and emotions are not arbitrary feelings and configurations; Rather, basic emotions and their outward expressions are universal

Four Universal Facial Expressions That Correspond to Specific Emotions

- There are seven basic emotions that have a set of distinct facial expressions: happiness, sadness, fear, anger, sadness, discussed, and contempt
- If these emotions and expressions are heritable, then these different emotions/expressions should be recognized by all people
- Each facial moment that we can detect as an action unit that describes how eyebrows, mouth, cheeks, or the eyes change with each expression
- We don't always label them in the same way; Fear and disgust are sometimes categorized as surprise and anger
- We say these are the same emotions due to their shared features - fear and surprise share wide eyes and an elongated face with the mouth opened in an O shape, and disgust and anger have narrower eyes, a wrinkled nose, and the size of the mouth pointed down and an intense frown

Emotion	Semantically Related Words and Expressions	Action Units
Happy	glad, pride, pleasantly surprised, happy and pleased, cheerful, delighted, embarrassment, joyful, joy, contempt, and feel well	lip corners turned up, cheeks raised, and dimples
Anxious	shame, embarrassment, upset, anxiety, sad, have a hard time, scared, sorrow and sadness, vexed, dismay, despise, heart-broken, fear, worry, distressed, miserable, unhappy, depressed, anguish, afraid, and grief	lowered eyebrows, stretched and pressed lips, and closed eyes
Surprise	alarmed and panicky, greatly surprised, excited, fear, terrified, frightened, amazed, ecstatic, scared, and surprised	outer and inner eyebrows raised, dropped jaw, stretched lips, and raised upper eyelids
Disgusted	disgust, hate, rage, wild wrath, anger, fury, wrath, storm of fury, furious, bristle with anger, storm of anger, and indignant	wrinkled nose, raised upper lip, and tightened eyelids

What Specific Emotions Influence Our Behaviour?

- When people express pride, they are momentarily granted higher social status by others
- When people express anger, other people can reciprocate that anger or avoid them entirely
- When people express fear or anxiety, other people can confront them, defend them, or escape danger themselves
- Emotional contagion - When people catch an emotion from another person

How Conditioned Responses Like Fear Arise

- In the lab, we can use a conditioned emotional response procedure to produce fear
 - A tone might be presented a few seconds before a shock - Page 16

How Animals Respond to Distress/Stress

- Distress accompanies fear
 - When an animal shows outward signs of stress in the natural environment - freezing in place or crying out - another animal might respond to help the animal in distress
 - Juvenile rats emit ultrasonic vocalizations, some of which indicate anxiety when separated from litter mates or an adult female rat
 - Mallard ducklings travel together with their siblings and a parent, and ducklings become distressed when they are separated from their family - when one or more ducklings become separated from the rest, they take turns calling out for help using distress vocalizations
 - Ducklings produce a lot of call variability when multiple ducklings have been separated to help the mother and notice, find and retrieve the lost ducklings. If ducklings produced consistent calls, their siblings and mother might habituate to the calls and not make calls in return or locate the lost ducklings
 - Newborn chicks also emit these distress vocalizations when they are separated from other chicks and their mothers – Page 16 – modeling depression
 - We can also get rats to press a lever to avoid an aversive stimulus like shock. Wistar-Kyoto rats have routinely been used to model anxiety because of abnormalities in their medial prefrontal cortex - a brain region that modulates conditioned fear and avoidance - they continue to press a lever to avoid shock even when they don't need to; Perseverance in responding is a measure of stress (Page 17)

Amsel's Frustration Theory as an Explanation for Behaviour

- There are two parts to a conditioned response:
 - The physical stimulus related to producing rewards that we encounter in the environment
 - The perception of a goal related stimulus
- The individual responses, stimuli, and perception keep an animal responding until it receives a reward - we already know that will work for rewards and try to avoid punishers, but Amsel recognized a third type of goal event: Frustrative events
 - Frustrated events are situations in which rewards are not as quickly available as they once were or are omitted entirely
 - Amsel added emotion to Hull's theory to explain why animals continue to respond longer in extinction when they are frustrated
 - Ex: Basically, rats were frustrated when reinforcers were occasionally available - and responding while frustrated was reinforced. Those rats continue to use frustration as a cue to keep responding and extinction. Frustration only occurs in extinction for rats that have experienced continuous reinforcement schedules and responding while frustrated has never been reinforced

Hunger and Interoceptive Stimuli as Occasion Setters for Behaviour

- Pavlovian conditioning has always been a social relationship with eating
- Hunger might have far reaching effects on people - it regulates many other systems, like our priorities for engaging in goal related behavior, perception, attention, problem solving, categorisation, and memory
- If we haven't eaten in a long time, we may forgo a sexual encounter for food, remember all the places we previously found food, purchase food, and ignore all things unrelated to food
- Hunger's modulating effects are related to those of emotions - in addition, stress related emotions can modulate hunger
- In addition to conditional stimuli the signals are presence or absence of unconditional stimuli, we also have stimuli that modulate the conditional stimulus - unconditional stimulus Association - these are called occasion setters: an event that tells the Organism that something is about to occur
- Hunger is an occasion setter that refers to the pang or ache that we feel when we haven't eaten in a long time - this is most likely caused by a change in metabolite usage, neuropeptide activity, or source energy
- When we feel hungry and eat an Apple, we become satiated (feel full) and no longer feel these hunger pangs
 - The taste of an Apple (conditional stimulus) becomes associated with that feeling of fullness

(unconditional stimulus). If we eat an Apple when we are full, we do not experience this restoration of energy or balance in nutrients. Thus, like other animals, we learned to eat when we are hungry

- We can learn to use interoceptive stimuli as occasion setters and conditional stimuli - interoceptive stimuli are those that come from within our bodies (Page 23)

Caching and Hoarding Behaviour

- Some non-human animals do not migrate to warmer places in colder seasons, so they need to be sure they have enough food saved for when food is scarce - this means that they must plan ahead and find food (forage) when food is plentiful in the fall and store that food for the upcoming winter season (cache or hoard)
- Hoarding generally refers to instances in which things that don't need to be stored are
- Coyotes and Wolves have long behavioral sequences that occur while caching, which occurs over large territories
 - At first, they carry food to a specific place and inspect the ground for appropriateness. Then, they paw at the chosen location before digging a hole to store the food. Digging is followed by tamps - head motions in which their nose touches the soil - and then scoops - head motions in which the nose scoops soil and trees leaves over the site. Some variability occurs within the sequence, but each of these actions as involved in caching food

Preparatory Responding Explanation: Digestion and Diluting Acids

- Our saliva helps to breakdown food as we chew it
- Salivating at the sight of food is also correlated with how hungry we are
- In addition to helping with normal digestion, salivation helps to dilute acids
- Salivation makes the taste of acid less intense and neutralizes the acid by increasing the pH level

Sexual Behaviour

- Sex isn't a biological need in the same way that hunger is - organisms can survive without sex because we cannot obviously survive without food
- The focus here is on selecting a mate and producing offspring, which is the ultimate cause of all behavior - progeny will necessarily contain 50% of the mother's genes via her egg and 50% of the father's genes via his sperm

Belongingness and Conditional Responses Facilitating Reproductive Success

- Belongingness, or constrained learning, is a type of cue-consequence learning in which it is easier to condition some responses to certain outcomes
- As with a conditional response facilitating digestion when food is the unconditional stimulus, a conditional response can facilitate reproductive success

Attractiveness of Potential Mates

- In species in which the females bear most of the energetic work of reproduction, the female selects the partner
- Ejaculation and fertilization occur on a much shorter timescale than just station - the implication is that men are capable of reproducing far more frequently than women and for many years
- Women tend to select mates according to the good genes hypothesis
 - Good genes are really just fitness advantages due to particular adaptations or mutations that parents pass along to their children
 - We are generally attracted to two good gene traits
 - Artists prefer rounder and larger eyes and lips but less roundness in the jaw
 - Women use more masculine features and symmetrical features as an indication of good genes to select short term partners
 - For long term partners, women prefer men with resources to provide for a child - these preferences are modulated by the menstrual cycle: women choose more masculine and aggressive men when they are ovulating and choose more developmentally stable men on low fertility days
- Women aren't the only ones who choose mates - men also decide with whom they will have children
 - While women judge attractiveness based on genetic fitness and resources, men typically judge attractiveness solely on fertility and reproductive value - a poor mating choice is much less costly for males
 - Among the best predictors for female fertility is hip to waist ratio - a ratio of approximately 0.7

indicates fertility; The further away from this ratio, the less likely it is that a woman will become pregnant in a single meeting

Organisms That Change Sex for Better Reproductive Success

- Some animals are hermaphrodites, which means they have the ability to contribute sperm or receive sperm to fertilize eggs during a sexual encounter
 - Ex: Shrimp, Sea Slugs (Page 34)

How Pheromones Affect Sexual Behaviour

- Pheromones are a type of chemical signal to indicate the reproductive success of a potential partner
- Mammals show different olfactory sensitivity to pheromones during the phases of their menstrual cycle - when a female is in estrus (most fertile right before and after ovulation) she is more receptive to male odors
- Estradiol, A female sex hormone produced by the ovaries, seems to enhance the sensitivity to odors
- Female rats and humans still discriminate between individual meals during this time, and women tend to prefer the scent of men with good genetic markers like symmetry between the left and right halves of the body and face. Additionally, male and female rats tend to be more sensitive to olfactory signals when they have their reproductive organs
- We see the effect of chemical signals in people by observing how women react to the scent of other women who are currently breastfeeding
 - Women who are not dating experience more sexual fantasies when they smell the chemical signals from breast milk and sweat
 - Women who were in relationships also experienced more sexual desire for their partners after smelling the chemical signals
 - Exposure to chemical compounds in breast milk can indicate to other fertile women that the local environment would support a successive pregnancy
 - Women who raise and nurse their babies together ensure that their children survive with less effort
- When men smell copulins or vaginal secretions produced during a women's fertile part of her cycle, they tend to rate themselves as more sexually desirable and rate photographs of women's faces without makeup as more attractive than they would without pheromones
 - Men who feel more confident and find women particularly attractive will express their sexual interest - pheromones work by increasing attraction or sexual desire for the purpose of reproduction

Coolidge Effect

- The Coolidge effect occurs when a habituated sexual response increases with the new animal - at occurs once a male rat has copulated multiple times with the same female and is satiated
- If a new female, one that he has not copulated with, is introduced, he will express eh renewed sexual interest in the new female
- Habituation of ejaculation occurs with the first female rat, and had she been presented again the male rat would be less likely to copulate with her because he was satiated
- With the new female rat, ejaculation returns - this is dishabituation
- Changing the scenery but not the partnered female also brings back copulation with ejaculation

Mate Poaching

- Mate poaching occurs when an individual attempts to copulate with an individual that is already in a relationship
- Describes infidelity on the part of at least one member of a monogamous relationship initiated by an outsider
- Mate poaching can be particularly costly for men because of a phenomenon known as paternal uncertainty - men are at a particular disadvantage because they cannot know directly whether the child their partner it's carrying is theirs or someone else's
- It is thought that the emotion of jealousy may have evolved to limit mate poaching
 - Men and women were instructed to either imagine their partners having sex with another person or imagine that they emotionally invested in a sexual arrival. Men perspired more when they imagine their partner having sex with another man, but women perspired more when they imagined their partner falling in love with another woman
 - This can be attributed to the costly resources that men invest when they stay with their pregnant partner, assuming that the child is theirs. When a woman is pregnant she knows the child is hers and

passes on her genes regardless of her sexual partner

- Women pay more attention to other women around their partner and cues of infidelity - men, on the other hand, pay more attention to their own partner and her intentions
 - These differences in attention are by both sexes are consistent with the rivalry sensitivity hypothesis - women focused on rivals in their partner's immediate vicinity while men focused on their partner if arrival is nearby; these strategies have evolved to help people retain their mates