WHAT IS PSYCHOLOGY

What is psychology, anyway?

❖ A science of exceptions

- See Blackboard for the document "*Planning a Career as a Psychologist*"
- **Psychology** is the scientific study of the mind, brain, and behaviour… at multiple ***levels of analysis***.

Types of psychologist

- **Clinical Psychologist**
  - Assessment, treatment and diagnosis of mental disorders
  - Research on mental disorders
  - Work in schools, health centres, private practice
  - You do not need a Ph.D to become a therapist
    - Ph.D is for researchers mainly
  - You can get a Psy.D or or M.S.W., a master's in social work, instead
    - Intended for therapists
- **Counselling psychologist**
  - Work with people who have temporary or self-contained issues
    - Marital issues, sexual problems, job issues
  - Work in counselling centres, health centres, private practice
  - Sometimes work in research
  - Not the same as clinical psychology as you don't deal with people with serious mental illness
- **School psychologist**
  - Work with teachers, students and parents to deal with behavioural, emotional and learning difficulties
  - Not the same as educational psychology
    - It focuses on helping teachers learn better methods for teaching and evaluating learning
- **Developmental psychologist**
  - Learn how people change as they age
  - Research the emotional, cognitive and physiological processes and how they change in infants, children, adults and seniors
  - In this role, you won't spend all your time playing with kids, instead you'll probably be in a lab collecting and analyzing data instead
- **Experimental psychologist**
  - Uses research methods to learn about memory, language, thinking and behaviours
  - Work in research mostly
  - Real-world research is possible, not just lab settings
- **Biological psychologist**
  - Examines the physiological bases of behaviour
  - Mostly work in research
  - Don't only work with animals in a way which is harmful to them
- **Forensic psychologist**
  - Work in correctional facilities to help diagnose and treat inmates

    - OR research witness testimony, jury decision making, etc.
    - Normally have a degree in clinical or counselling psychology
    - Don't work in "profiling"
- **Industrial-organizational psychologist**
    - Environmental psychologists work in a business to help with hiring, performance evaluation, examining working conditions, etc.
    - Engineering psychologists help to design equipment to raise efficiency and reduce accidents
    - Most of this job is creating tests or procedures to better productivity and satisfaction within a company

Levels of analysis

- Biological (or molecular/neurochemical level) – molecules and brain structure
    - Low - "brain"
- Psychological (or mental/neurological level) – thoughts, feelings, and emotions
- Social Cultural (or social/behavioral level) – relating to others, personal relationships
    - High - "mind"

Mind - brain in action

Psychology is complex

- Multiply determined
    - Produced/caused by many factors
- Interacting factors
    - Multiple causes
- Individual differences
    - Differ in thinking, emotions, etc.
- Cultural influences
    - Influence of your traditions, history, musical choices, etc.
- Social influences
    - Influence of the community

Single variable explanations are bad
The truth is an interplay of many factors

Psychology is universal (in context)

- Music example
    - Universal vs Social

THE HISTORY OF PSYCHOLOGY

Psychology has a rich past…

- Psychology's philosophical roots: What is thought? Are the mind, body, and soul separate?
- 1875 – Psychology is born
    - Late 1800s, psychology broke away from philosophy & began to use the tools of science to explore the mind.
    - In 1875, William James created a small psychology laboratory at Harvard University.
    - In 1879, Wilhelm Wundt conducted the first psychology experiment in Leipzig, Germany.
        - Used introspection, thinking aloud
- 1880s – Mental Processes: Psychology's first scientific questions centered around the structures and functions of the mind (mental processes).
    - **Structuralism** focused on basic elements, or "structures" of psychological characteristics.
    - **Functionalism** focused on the adaptive ***purposes*** of psychological characteristics.
- 1890s – Psychology as a practice: In 1896, Lightner Witmer created the first psychology clinic, launching psychology as a ***clinical practice***.
- 1900s – Psychodynamic Theory: In 1900 Freud launched the field of psychoanalysis focused on unconscious internal processes (outside of awareness).
    - Said that introspection was bogus
    - Childhood trauma - adult behaviour
- 1920s – Behavioural Revolution: In the 1920s behaviourists advocated that scientists and practitioners should focus **only** on ***observable behaviours***.
    - Pavlov
- 1950s – Reactions and Technology: In the 1950s, the cognitive revolution, the humanist movement, and new technologies helped to redefine psychology as a dynamic, complex and multifaceted field of study, focused on ***behaviour and mental processes***.

- **Structuralism** - identifying structures of experience, or the basic elements, by using introspection
    - E. B. Titchener
    - All about systematic observation
    - Study of conscious experience
- **Functionalism** - understanding thoughts, behaviours and feelings by examining their functions or adaptive purposes
    - William James, influenced by Charles Darwin
    - Still influences psychology
- **Behaviourism** - look at observable behaviours to understand the general principles of learning
    - John B. Watson, B.F. Skinner
    - One of the first to focus on objective research
- **Cognitivism** - looking at how cognitive processes affect behaviour
    - Jean Piaget, Ulric Neisser

- **Psychoanalysis** - understanding how early life experiences and the unconscious affect behaviour
    - Sigmund Freud

EVALUATING PSYCHOLOGICAL CLAIMS

Psychology as a Science

- Intuition versus science
- **Heuristics** are mental shortcuts that help us streamline our thinking. Some of the time shortcuts work…sometimes, they lead us down the wrong path…
    - Assumption based on current knowledge
    - **Representative heuristic** – make judgments based on a "typical" prototype.
        - Judge a book by its cover
        - Stereotypes
        - Like goes with like
    - **Availability heuristic** – judgment based on how easily something comes to mind.
        - Speed
        - Recent knowledge
        - Mental images
- Is psychology just common sense?
    - **Overconfidence** – tendency to overestimate our own predictions.
    - **Hindsight bias** – things often seem obvious "after the fact".
- To prevent us from fooling ourselves (and doing potential damage to others), psychology relies on **science**, not intuition or common sense…
- Psychology is guided by **scientific theories**, which provide explanations for a large number of findings in the natural world.
    - **Hypotheses** are testable predictions derived from scientific theory.
    - Through a process known as **empiricism**, hypotheses are tested through systemic observation.

THEORIES are broad, hypothesis are focused.

Science versus pseudoscience

- Not all "theories" are created equally. A good theory:
    - Explains a large number of phenomenon.
    - Can be used to predict future phenomenon.
    - Is well supported by multiple sources and types of evidence.
- **Pseudoscience** are a set of claims that seem scientific, but are not. Warning signs include:
    - Exaggerated claims
    - Overreliance on anecdotes
        - "some" "others" "people" "I knew someone"
        - No cause and effect
        - Were other factors at play?
    - Lack of connectivity to other research
        - No connection to research, medicine, etc.
    - Lack of peer review

        - New study without a follow-up
    - Lack of self-correction
        - Doesn't let go of bad beliefs
        - Doesn't accept new theories which disagree with their own
    - Meaningless “psychobabble”
        - Fake words
    - Talk of “proof” instead of evidence.
        - Science never claims to prove anything lightly
        - Science uses "evidence suggests"
- Imposter of science
- "Popular psychology"
- Claims which seem scientific, but are not
- Have no safeguards against bias
- To separate good science from pseudoscience, it is necessary to adopt **scientific skepticism** and **critical thinking** when evaluating any claim.
    - Open mind and acceptance of supported claims

Critical - exercising careful judgment or judicious evaluation

6 Principles of Scientific Thinking

- **Ruling out rival hypotheses** and **critical thinking** – set of skills for evaluating all claims in an open-minded and careful fashion.
    - Are there other explanations?
    - Example: some claim autism causes a terrible reaction to vaccines, others believe the reaction to the vaccine causes the autism
- **Correlation versus causation** and the **Correlation-causation fallacy** – error of assumption that because one thing is associated with another, it must cause the other.
    - Can we be sure that A causes B?
    - There could be a third cause, C
    - Example: because kids who develop autism have a terrible reaction to vaccines, the vaccine must cause it
- **Falsifiability** (the ability to prove something false) and **metaphysical claims** are assertions about the world that cannot be tested and disproved.
    - Must be provable with today's science tools
    - Example: "Vaccines are evil." You cannot prove the "evilness" of an inanimate object.
    - Example: ad hoc immunizing hypothesis
- **Replicability (the ability to replicate an experiment and get the same results)** – When a study’s findings are able to be duplicated by other independent professionals.
    - Independent experiments remove bias
    - Peer review
- **Extraordinary Claims** require extraordinary evidence.
    - Example: if you claim that ghosts are real, you have to have an abundance of evidence to prove it, including physical evidence.
    - You can't just have case studies, you need to have experimental designs.

- **Parsimony** – if two explanations account equally well for a phenomenon, select the simpler of the two.
    - Occam's Razor
    - Logical simplicity
- **Example:** Do Vaccines Cause Autism?

Pseudoscience is powerful

- **Naïve realism** – the belief that we see the world precisely as it is.
    - Believing is seeing
    - Drinking peppermint tea calmed my nausea, so it should work for everyone else, too
- **Bandwagon Fallacy** – the error of assuming that a claim is correct just because many people believe it.
- **Emotional reasoning fallacy** - using emotions to judge a claim
- **Either-or fallacy** - believing that a question can only be answered by two extreme answers
    - I read that many schizophrenic patients had good childhoods, so the disease must be genetic, not environmental.
- **Not me fallacy** - believing we can't be affected by the same errors other people make
- **Appeal to authority fallacy** - accepting a claim because someone in authority made it
- **Genetic fallacy** - believing a claim because of its origins
    - My parents told me 1+1=216, so it must be so
- **Argument from antiquity fallacy** - a belief has been around forever so it must be true
- **Argument from adverse consequences fallacy** - judging a claim based on its real-world consequences
    - If x was true, y would happen, so x can't be true.
    - Sex can't be determined in a zygote otherwise expectant parents could abort fetuses which were a sex they don't want.
- **Appeal to ignorance fallacy** - a claim is true because there is no evidence against it
- **Naturalistic fallacy** - inferring a moral judgment from a scientific fact
    - The belief in God is a product of natural selection, therefore killing in the name of religion must be ethically justifiable.
- **Hasty generalization fallacy** - drawing a conclusion without enough evidence
- **Circular reasoning fallacy** - basing a claim on the same claim slightly reworded
    - Mike's claim is valid because it has a lot of evidence supporting it.
- **Confirmation bias** – the tendency to seek out evidence that supports our hypotheses and deny, dismiss, or distort evidence that contradicts them.
- **Belief perseverance** – tendency to stick to our initial beliefs even when evidence contradicts them.
    - Not wanting to believe we are/were wrong
- **Adhoc immunizing hypothesis** – provides an escape hatch or loophole that defenders of a pseudoscientific theory use to protect their theory from falsification.
    - Claims which are impossible to test
    - "I wasn't able to read your mind because you doubt my powers"

The Dangers of Pseudoscience

- **Opportunity costs** – funds and resources are misdirected

- **Direct harm** – people's well-being and lives are put at risk
    - People miss out on effective treatments
    - People try false treatments which harm them
- **Uninformed citizens** – there are fewer scientific advances.

Beware of "pop" psychology…True psychology is a <u>science</u>

Base rate - how common a behaviour or characteristic is
Base rate fallacy - neglecting to consider the base rate

Pareidolia - making sense of things we see by creating an explanation, such as ghosts, UFOs, etc.

Apophenia - connecting unrelated or random phenomena meaningfully, such as claiming to have ESP when you think of a friend and they call you right after

Risky prediction - there is a strong chance that it could be wrong, which means the evidence which proves it to be right has to be strong, too

Bias - opinion based on insufficient reasons

Terror management theory - awareness of death brings terror, which is why we created ideas like heaven

Basic research - how the mind works
Applied research - solving real world problems with basic research

Evolutionary psychology - not falsifiable, inductive

Illusory correlations - no demonstratable relationship or association
- Examples: Friday the 13th is unlucky, rain causes arthritis to get worse, when there is a full moon there is also more crime

THE SCIENTIFIC METHOD

- ***Psychology as a Science***: S**cientific theories** are used to form **hypotheses**, which are then **empirically tested** through systematic observation.
    - **Science of exceptions**
    - **Collect data to base a theory on or derive conclusions from**

- **The Scientific Method**:
    - **Observe, question, hypothesis, experiment, conclusion**
    - **Develop** an idea →
    - Research your idea to **identify previous theories/research findings** on the topic →
    - Use previous/theory research to identify a **testable hypothesis** →
        - Educated prediction
    - **Plan your study** using an appropriate **research design** →
    - **Collect** and record **data** →
    - Use the results to **come to a conclusion** →
    - **Submit the results to your peers**/the general public for peer review →
    - Develop new ideas → background → hypothesis → study → results → review → …

- **Hypotheses**
    - Are **testable (falsifiable)**
    - Are **based on prior** theory/**research**
    - **Describe relationships between variables** (If X…then Y…).

PLANNING A STUDY

Who: The Sample

- **The theoretical population** – who you want to generalize to.
    - **Large group**
    - **Example: "all students"**
- **The study population** – the population for which you can gain access.
    - **Smaller group**
    - **"Ryerson students"**
- **The sampling frame** – the procedure by which you plan to access the population.
    - **Subject pool**
    - **"PSY 102 students"**
- **The sample** – who is actually in your study.
    - **Participants**
- **Representative sample** – having the same characteristics as the population.
    - **Geography, financial standing, religion, age, sex, etc**.
- **Random selection** – the selection process is random.
    - **Truly random**
    - **Anyone in the population could potentially have been selected**

What: The Variables

- When a **concept** is measured in a concrete manner it becomes a **variable** that can take on multiple **values**.
- Variables can be measured based on:
    - Physiological markers
        - Lie detection, blood pressure, heart rate, respiration rate, temperature, etc.
    - Behavioural measures
        - Exams, decision making, length of time
    - Observation
        - Encoding
    - Self-reported surveys
        - Good to ask directly for accurate answers, but…
        - Problem: lying, change response to fit what they think is expected, change response in order to ruin the data, change response in order to save face, forgetfulness, exaggeration, etc.
        - May not understand what introspection is
        - Mental illness can interfere
        - Response sets - offer social acceptable answers, "just play happy, even if you're not"
        - Positive impression management - make me look better
        - Malingering - make me look disturbed in order to reach goal, like get out of a jail term or get a payment in a civil case or get out of army duty
    - Ratings from others
        - Halo effect - overly positive because they like one thing, such as looks
        - Horns effect - overly negative because they don't like one thing, such as looks
    - It isn't a variable if it can't have other options
- Types of variables:
    - In an "If X, then Y" statement:
        - X is the predictor or independent variable
            - Skipping class
        - Y is the outcome of dependent variable
            - Getting poor grades
- Variables must be measured in a way that ensures:
    - **Reliability** – the consistency of a measure over different items, time points, or raters.
        - **Test-Retest Reliability - each repeat comes up with similar results**
        - **Interrater reliability - same diagnosis between two doctors, for example**
    - **Validity** – the extent to which a measure assesses what it purports to measure.
        - **"Truth in advertising"**
    - A measure can be reliable, but not valid – but if it is valid then it also has to be reliable.
- An example of reliability and validity: Facebook's Gross Domestic Happiness Index
        - **Facebook happiness index (reliable measure, but isn't actually measuring happiness)**

When: The Time Frame

- **Cross-sectional** – single time period.
    - Single test opportunity

- **Longitudinal** – over time.
    - Return for multiple tests

Where: The setting
- Laboratory study versus field studies
    - Field = natural

How: The research design

Research Design	Defining Features
Case Studies	Examines one person over time; can provide existence proofs; or the study of rare events.
Naturalistic Observation	Observes behaviour in real world settings without manipulating/changing the situation.
Correlational Designs	Examines the association between two or more variables; can be used to predict outcomes.
Experimental Designs	Manipulates "independent variable(s)" to examine their causal impact on an outcome.

Case Studies
- **Low internal validity, low external validity**
- **Single individual, often with a rare condition**
- **First discoveries**
- **From which you can general hypotheses**
- **Can't prove your hypothesis as it is just anecdotal**
- **Might not generalize**
- **Provides insights for later testing**
- **Can't infer causation**

Naturalistic Observations
- **Low internal validity, high external validity**
- **Can't infer causation**

Correlational Designs
- **Low internal validity, high OR low external validity**
- **Predict behaviours**
- **Can't infer causation**
- **Can use one to determine if other is valid**
    - **Example: you connect autism with vaccine reactions**
    - **You need to select a group of people to test for autism**

- **Select those who have had vaccine reactions**

Experimental Designs
- **High internal validity, low external validity**
- **CAN infer causation**

Why: Validity
- **Internal validity** – cause-and-effect inferences (X → Y).
  - Extent to which we can draw cause-and-effect inferences
  - Manipulating variables = high internal validity
  - Use replication to increase external validity
  - You can determine a cause
- **External validity** –*generalize* to real world settings.
  - Extent to which we can generalize our findings to real world settings
  - Observing natural behaviour = high external validity
  - Representative sample
  - Random sample

Existence proofs - demonstrate a psychological condition can occur

RESEARCH DESIGN AND VALIDITY

Research Design	Internal Validity	External Validity
Case Studies	Low	Low
Naturalistic Observation	Low	Typically high
Correlational Designs	Low	High OR Low
Experimental Designs	High	Typically Low

CORRELATIONAL DESIGNS

- **Do 2+ variables co-relate?**

Correlational Designs

- In a correlational design variables are **measured** to examine if they are associated.
  - Can be +, 0 or -
  - + = if one variable increases/decreases, the other does too
    - Valid if it matches the hypothesis
  - 0 = there is no relation between the increase/decrease of either variable
    - INVALID
  - - = if one variable increases/decreases, the other does the opposite
    - Valid if it matches the hypothesis
  - When determining **absolute value**, just remove the + or -
  - **Correlation coefficient** - +1.0 <-> = 1.0
    - 1.0 is a perfect score, meaning the correlation is strong

Correlation ≠ Causation

- Correlational designs pose too many ***threats to internal validity***.
- Correlation ≠ causation because one:
  - Cannot establish ***temporal order*** (X → Y versus Y → X)
  - Cannot rule out alternative explanations (i.e., ***confounds***)

The Conditions of Causality

- How does one establish ***causality***?
  - Must show a ***comparable difference*** or ***association***.
  - Must establish the ***temporal order*** of the variables (X → Y, not Y → X).
  - Must ***rule out alternative explanations*** (i.e. confounds).

Indicator words - associated / related / lead to / linked / went together

EXPERIMENTAL DESIGNS

Experimental Designs

- **In an experimental designs:**
  - **The independent variable (X), is *manipulated* by the researcher.**
  - **The dependent variable (Y) is then *measured*.**

The Experimental Procedure

- **Acquire sample**
- **Randomly assign** people to groups – ensures that groups begin the same
- Time 1: create the **independent variable**, hold everything else constant
- Time 2: measure the **dependent variable (outcome you are measuring)**
- Compare the groups to **see if they differ** on the dependent variable

- If they do, you have your cause

Experiments and the conditions of causality

- ***Association***: By comparing the experimental groups, a comparative difference is established.
- ***Temporal Order***: Because the IV is created before the DV is measured, the temporal order is established.
- ***No Confounds***: **Random assignment** and **experimental control** (i.e., holding all other variables constant) ensures that the groups are the same on every factor but the IV, ruling out alternative explanations.

Between-subjects design - control group + independent variable group

Within-subjects design - control is testing done on the group before the independent variable is applied to the same group

Potential Issues with Experiments

- People's behaviour may change based on the mere suggestion of an effect (**placebo effect** and **nocebo effect)** – or if clues in the study result in participants trying to guess the hypothesis (i.e., **demand characteristics [change behaviour]**).
  - **Placebo effect -** they think they'll get better, so they do
  - **Nocebo effect** - they think they'll get worse, so they do
- **Attention – placebo control** – The researcher introduces a control condition that is as close as possible to the experimental condition (minus the active "ingredient").
  - **Hiding the independent variable through a…**
- **Blind study** – The participant does not know whether he/she is assigned to the experimental or placebo control condition.
  - **Informed of the risks, but not which group they are in**
  - **They don't know if they are in the placebo group or not**
- **Experimenter expectancy effect** – the researcher unintentionally biases the outcome.
  - **Expectation bias**
- **Double blind study** – Neither the participant, nor the researcher knows whether the participant is in the control or experimental group.

Informed consent - researchers must tell participants what they are getting into

- Some deception is allowed

Deception is justified if:

- Without it, the study wouldn't work
- Won't negatively affect the participants
- Doesn't involve medical or therapeutic intervention

Debriefing - researchers tell participants what the study was about or which group they were in

REB - research ethics board

TCPS - Tri-Council Policy Statement
- National guidelines

CCAC - Canadian Counsil on Animal Care

Random Selection vs. Random Assignment
- ***Selection*** refers to how the participants are acquired. **Random selection increases external validity!**
- ***Assignment*** refers to how the participants are divided into conditions. **Random assignment increases internal validity!**

STATISTICS BASICS

Types of statistics
- **Descriptive statistics** – organize and summarize (describe) the data.
  - **Central tendency** - central score where results cluster, made of the Three M's (Mean, Median and Mode)
- **Inferential statistics** – allow one to infer beyond the data.
- (Fruit snack example)

Descriptive statistics
- Three M's
  - **Mean** – the mathematical average
  - **Median** – the literal center (50% above / 50% below)
  - **Mode** – the most frequently occurring
- **Range** – difference between minimum and maximum value
  - **Outlier** - result far off the general scores/statistics
  - **Variability** - dispersion; how scores are bunched
- **Standard deviation** – average amount that each data points deviates from the mean.
- **Distribution curve** – the overall "shape" of the data
- The shape of the distribution can skew the descriptive statistics.

Inferential statistics
- The **p-value** indicates the probability that you would make an error if you were to use the findings to make inferences beyond the data.
- **Significance level** (α) defines the accepted level of risk.
- **5% significance level** ($\alpha = .05$) – Conclude that the effect is ***statistically significant*** if the probability of making an error is less than 5%.

Inferential statistics caveats
- Conclusion
- "Probably real"? **Statistics = uncertainty**

- The conclusions of any <u>one</u> study are a bit of a gamble…
- **Replication** is the tool on which scientific knowledge is built.
- **Statistically significant** - <5 in 100 chance of occurring by chance
    - P-value < 0.05
    - The larger the sample, the higher the statistical significance
- **Practically significant** - real-world importance
- Statistical significance does not necessarily mean that the results will be **practically significant**.

Scatterplot - 2 dimensional graph using points

Media - consider the source - is it a journal or a tabloid paper?
Journal - primary source
Tabloid - secondary source

Sharpening - exaggerate the gist to control the message
Levelling - minimize the less central details in order to focus on "important bits"
- Creates a misleading picture

Pseydosymmetry - scientific controversy appears to exist, but doesn't
- Media article includes a study and then "Experts" debunking it
    - There actually is no controversy, they just brought in the "experts" to appear neutral

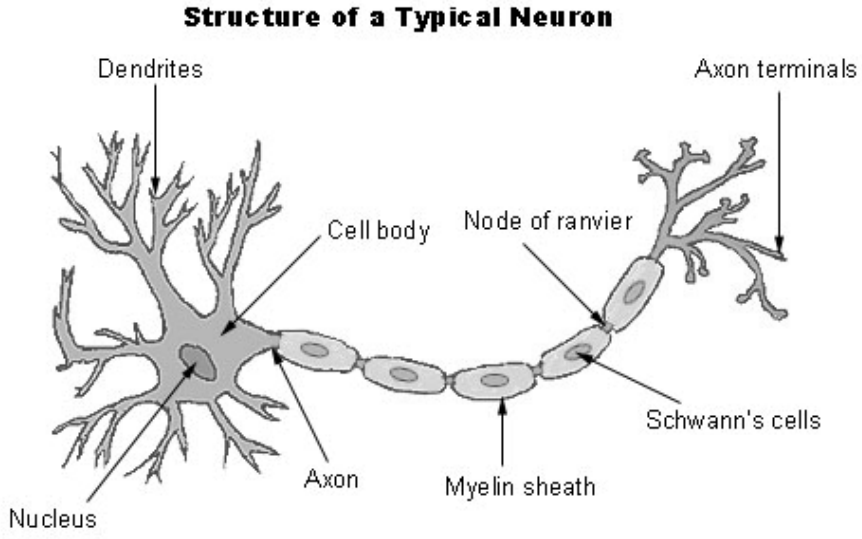
CHAPTER 3 LECTURE GUIDE

All page numbers and figure references are from: Lilienfeld, S. O., Lynn, S. J., Woolf, N. J., Cramer, K. M. & Schmaltz, R. (2013). *Psychology: From Inquiry to Understanding (2nd Ed)*. Toronto: Pearson Canada.

OVERVIEW

- The Neuron
  - Communication network
- The Brain
  - Control centre
- The Nervous System
  - The brain is context
- Our genetic blue print
  - Nature is nurture

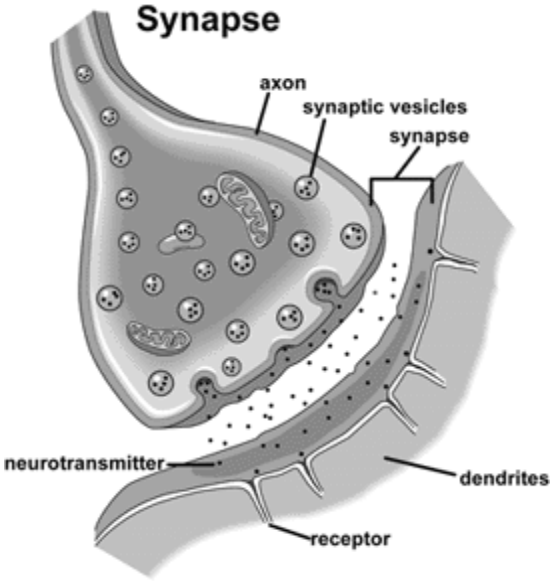
THE NEURON



Structure of the Neuron

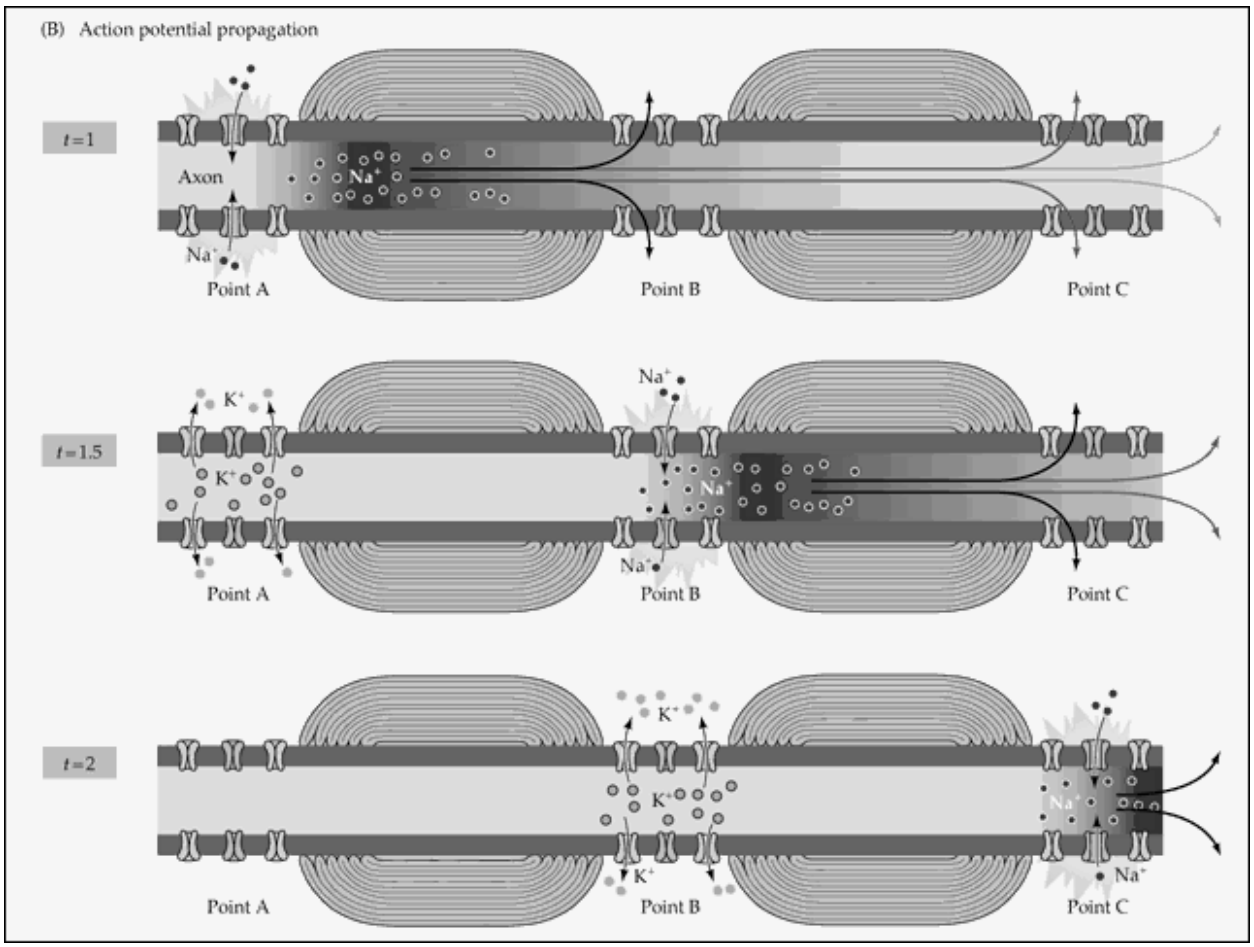
- Our nervous system is made up of an estimated 100 billion neurons, with approximately 160 billion connections between them…
  - Sensory neurons - optical, smell, auditory, taste, etc.
  - Motor neurons - muscle control
  - Memory neurons
- The **neuron** is composed of:
  - **Cell body** – the cell's life support
  - **Dendrites** – receive messages
  - **Axon** – carries electric nerve impulses
    - Can be short or long
  - **Myelin Sheath** – insulates the axons of some neurons, increases transmission speeds

- **Axon terminal** – where messages are released into the synaptic cleft to be received by other neurons.
- **Terminal branches** - hold synaptic vesicles
- Chemical-filled **Synaptic Vesicles** - contain neurotransmitters, release them into the synapse when in action and reabsorb after done
- **Synapse** - space between dentrite and axon terminal; contains fluid



Action Potential

- When stimulated by signals from our senses or when triggered by chemical signals from neighboring neurons a neuron fires in what is known as an "**action potential**":
  - **Resting Potential –** balance of positive and negatively charged particles (sodium ions).
  - **Action potential** – positively charged particles rapidly flow into the axon.
    - Either fires in full or not at all, there is no in-between
    - Can fire at different speeds, but not different strengths
    - "Wave" goes through axon
  - **Refractory** – positively charged particles flow back out of the axon.
  - Some neurotransmitters are reabsorbed (reuptake), some break down
- The action potential "pushes" the electric charge down the length of the axon
    - Only can move in one direction
    - Rate of fire is controlled by refractory period



Neurotransmitters

- The result of the action potential is that neurotransmitters are released into the synapse for relay to other neurons if they bind with receptors
- The receptor sites on the dendrites of a neuron are specialized to receive only certain types of signals, don't bind otherwise.
- Different neurotransmitters relay different messages
    - **Excitatory neurotransmitters** → increase activity.
    - **Inhibitory neurotransmitters** → decrease activity.
- **Graded potentials** can be excitatory *or* inhibitory. If the **excitatory** inputs prevail over **inhibitory** inputs to reach a certain ***threshold***, an action potential will occur.
    - Still ALL or NONE

Common Neurotransmitters

- Glutamate
    - Main excitatory neurotransmitter
    - Participates in relay of sensory info and hearing
        - Alcohol and memory enhancers interact with glutamate receptors
- Gamma-aminobutyric acid (GABA)
    - Main inhibitory neurotransmitter
        - Alcohol and anti-anxiety drugs increase GABA activity
- Acetylcholine (ACh)

        - Muscle contractions in the PNS
        - Cortical arousal in the CNS
            - Nicotine stimulates ACh receptors
            - Memory enhancers increase ACh
            - Insecticides block the breakdown of ACh leading to overactivity of muscles
            - Botox blocks ACh, causing paralysis
    - Norephinephrine (NE)
        - Brain arousal
        - Mood, hunger, anti-sleep
            - Amphetamines increase NE
    - Dopamine
        - Motor function and reward
            - L-Dopa increases dopamine, helps treat Parkinsons
            - Antipsychotic drugs block dopamine action
    - Serotonin
        - Mood and temperature regulation, aggression and sleep cycles
            - Serotonin-selective reuptake inhibitors (SSRIs) treat depression
    - Endorphins
        - Pain reduction
            - Narcotics mimic endorphins, bind to receptors
            - Body reacts by limiting the effects of those receptors, increasing tolerance
    - Anandamide
        - Pain reduction, increase in appetite
        - Cannabinoid
            - Tetrahydrocannabinal (THC) is another cannabinoid, binds to the same receptors

Neurons: Our brain's communicators

- Neurons allow the brain and body to communicate with one another.
- Other nerve cells, called **glial cells**, protect and provide structure for neurons and aid in learning and memory and injury response.
    - Astrocytes (brain/spine)
        - Most abundant glial cell
        - Makes up blood-brain barrier
    - Oligodendrocytes (CNS)
        - Makes up myelin sheath on neurons
    - Neurolemmocytes (PNS)
- The spinal cord provides a path way for the relaying of information from the outside world to the brain.
- At the center of the activity of the Central Nervous System (CNS) is the **brain** – the control center of our nervous system.
- Cerebral ventricles hold cerebro-spinal fluid
- Meninges are three thin layers of membrane

THE BRAIN

Mapping the brain

- Computed Tomography (**CT**) and magnetic resonance imaging (**MRI**) allow researchers to examine the ***structures*** of the brain.
    - Produce static images
- Functional magnetic resonance imaging (**fMRI**) and positron emission tomography (**PET**) allow researchers to examine the ***functions*** of the brain in action.
    - Brain lights up
    - Real time view

The brainstem

- Performs basic bodily functions that keep us alive
- Relay station between the cortex and the rest of the nervous system
- Contains **midbrain, pons** and **medulla**
    - **Midbrain** controls movement, tracking visual stimuli, reflexes triggered by sound
    - **Reticular activating system (RAS)** connects to the forebrain and cerebral cortex
        - Plays a key role in arousal
        - Damage to this area leads to coma
        - Activates the cortex by increasing the signal-to-noise ration in brain neurons

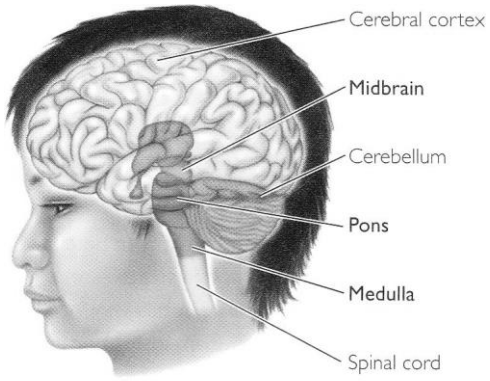
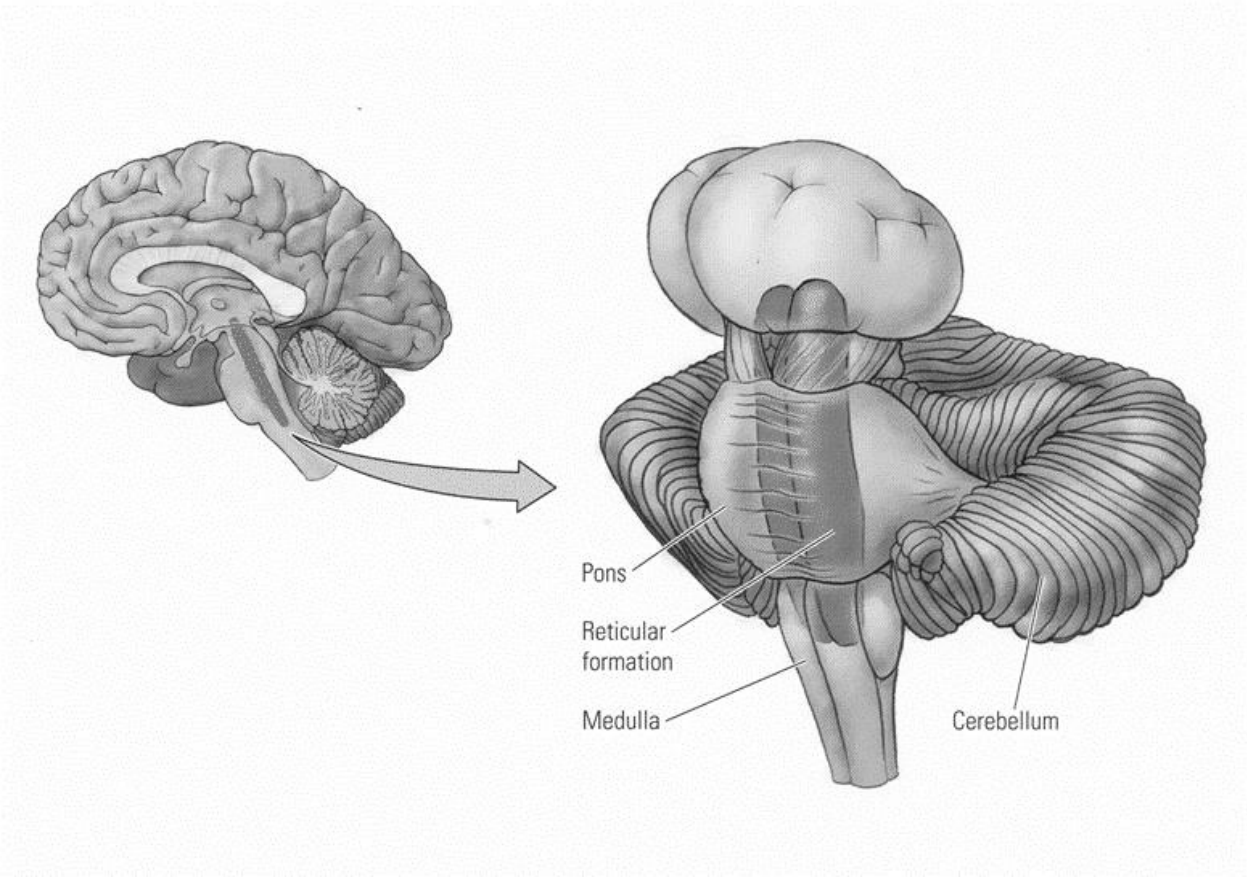


FIGURE 3.14 The Brain Stem. The brain stem is located at the top of the spinal cord, below the cerebral cortex.

The hindbrain

- Inner brain
- The oldest parts of our brain control arousal (awake or asleep), movement, coordination and survival functions (breathing, blood pressure, heart rate, etc.) The **thalamus** relays sensory information to the cerebral cortex.
- Consists of the **cerebellum, pons** and **medulla** (the last 2 being part of the brain stem)
    - **Cerebellum**
        - Is like a mini cortex
        - Plays a predominant role in sense of balance, enables us to coordinate movements and learn motor skills
        - Also contributes to executive, spatial and linguistic abilities

- **Pons**
  - Triggers dreams
  - Connects cortex and cerebellum
- **Medulla**
  - Regulates breathing, heartbeat and other vital functions
  - Damage causes brain death (irreversible coma)
    - Can't even breathe
  - Not persistent vegetative state which is damage to the higher functioning parts of the brain, allowing you to breathe but not be conscious



The limbic system

- The limbic system cooperates with the endocrine system to regulate your hormone levels and is the "**emotional centre**" of your brain.
- Processes information about our internal states, such as blood pressure, heart rate, respiration and perspiration along with emotions
- Also plays roles in smell, motivation and memory
- Evolved from primitive olfactory system (dedicated to smell)
- Made up of the **thalamus, hypothalamus, amygdala,** and **hippocampus**
  - **Thalamus**
    - Greek word for bedroom
    - Sensory relay station
      - Most sensory info passes through here, receiving initial processing
  - **Hypothalamus**

        - Located on floor of the brain
        - Regulates and maintains internal bodily states
        - Regulates hunger, thirst, sexual motivation, and other emotional behaviours
        - Also controls body temperature
    - **Amygdala**
        - Named for its almond shape
        - Controls excitement, arousal, fear
        - Helps us predict when something scarys is about to happen
    - **Hippocampus**
        - Plays crucial role in memory, especially spatial memory (the memory of layouts)
        - Damage causes problems with forming new memories
            - May be because it stores memories temporarily, like RAM in a computer, before storing it elsewhere
            - Could also store memories at multiple sites, then some become stronger and others fade away
        - Taxi drivers have a large hippocampus
            - Is that because it grows as they learn where they drive?
            - Or is that because a large hippocampus helps them to become taxi drivers?
            - Or is there a third factor I haven't thought of?

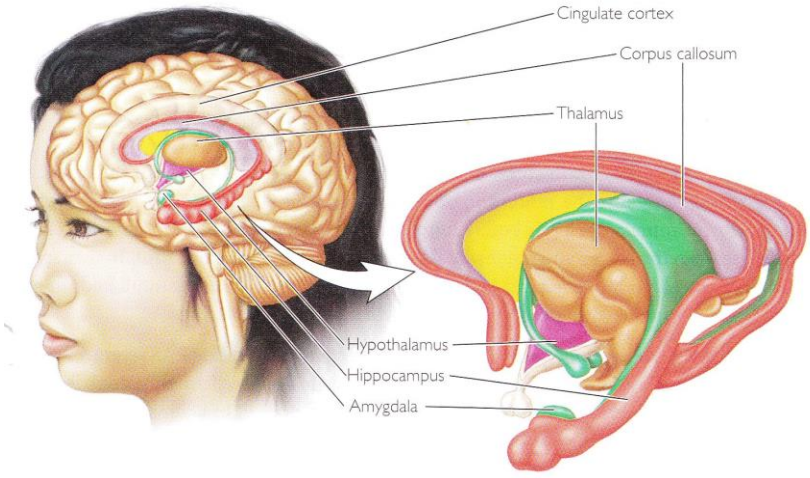


FIGURE 3.13 The Limbic System. The limbic system consists mainly of the thalamus, hypothalamus, amygdala, and hippocampus. (*Source:* Left art modified from Dorling Kindersley and right art from Kalat, 2007)

The cerebral cortex

- Outer brain
- The cerebral cortex controls "higher level" functions and can be divided into four types of lobes and the central sulcus and association cortex
- **The cerebral hemispheres** – The left side of the brain controls the right side of the body and the right side of the brain controls the left side of the body.

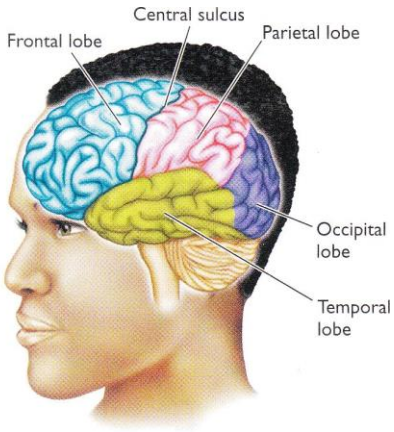
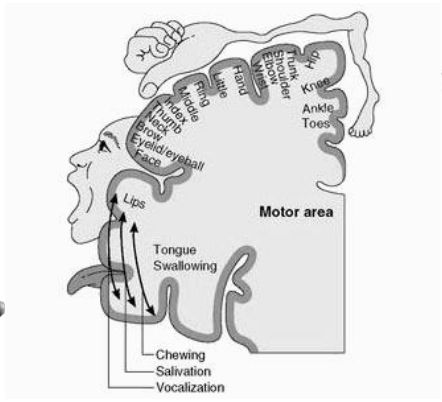
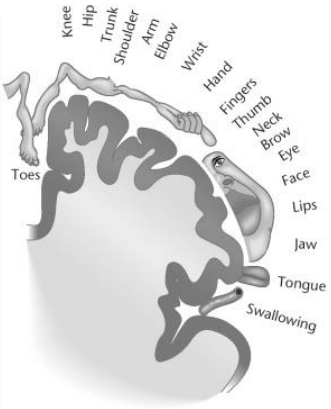


FIGURE 3.10 The Four Lobes of the Cerebral Cortex. The cerebral cortex consists of four interacting lobes: frontal, parietal, temporal, and occipital.

- **Frontal lobe**
  - The **frontal lobes** control ***executive functioning,*** overseeing and organizing other functions of the brain.
    - CEO of the brain
    - "Human" brain
  - The prefrontal lobes are important for higher emotions, social interactions, personality, and **decision making.**
  - **Broca's Area**
    - Named after French surgeon Paul Broca
      - Discovered that this site plays a key role in language production
    - Damage causes trouble producing speech
- **Central sulcus** – the motor cortex (movements) and sensory cortex (makes sense of external senses like touch)
    - **Humunculous**
      - Man represents how many neurons there are in each area of the body
        - Lips, hands, genitals, tongue are huge as a result
        - Represents which section requires more computing power
      - Body draped across cortex represents what each section of the cortex relates to (for example, if you electrify the inside section of either cortex, the feet are affected)





- **Parietal lobe**
  - The **parietal lobe** is responsible for touch and perception, including tracking object's locations, shapes, and orientation.
- **Occipital lobe**
  - The **occipital lobe** is responsible for our visual systems.
- **Temporal lobe**
  - The **temporal lobe** is responsible for hearing, understanding language, and storing memories of our past.
  - Separated from the rest of the cortex by the lateral fissure
  - **Wernicke's Area**
    - Language area
    - Slightly above and behind your left ear (unless you are left handed, then it is behind your right ear)
    - Damage causes difficulty understanding speech
- **Corpus Callosum**
    - Connects the hemispheres, coordinates their processes

- **Association cortex –** 'Uncommitted' **association areas** of the brain are devoted to interpreting, integrating, and acting on information.

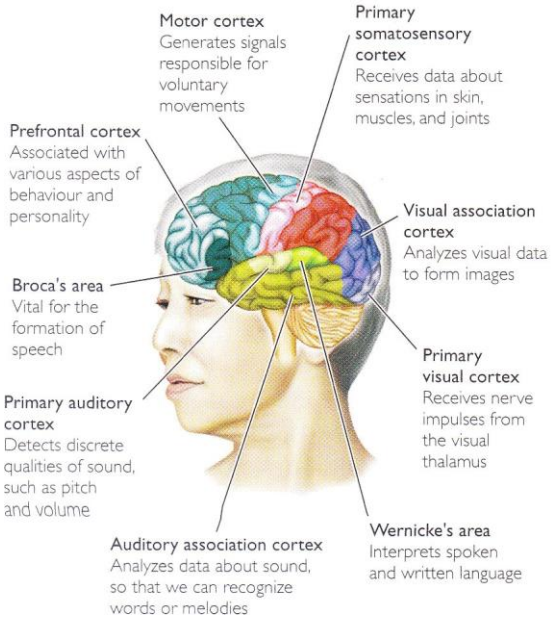


FIGURE 3.12 Selected Areas of the Cerebral Cortex. The prefrontal cortex controls various aspects of behaviour and personality. Broca's area is vital for the formation of speech, and Wernicke's area interprets spoken and written language. Other cortical areas include the motor cortex, primary sensory areas, and association areas.

Hemispheric lateralization

- **Lateralization** – some brain functions rely on one hemisphere more than another.
- …But, most brain functions require careful coordination of the two hemispheres.

Neural plasticity

- The brain has amazing powers to continuously grow and adapt, a process known as **neural plasticity**.
- Neurons can change in four ways
    - *Growth* of dendrites and axons
    - *Synaptogenesis*, formation of new synapses
    - *Pruning* of neurons that are no longer helpful
    - *Myelination*, insulated neurons are more efficient
- Neural plasticity and learning
    - Long term potentiation – "neurons that fire together wire together"
        - *Use it or lose it*
- Neural plasticity and age
    - Children show remarkable ability for brain plasticity, but this ability decreases rapidly in adulthood.
    - Still, animal studies suggest that **neurogenesis** (the generation of new neurons) may occur in the brains of children and adults.

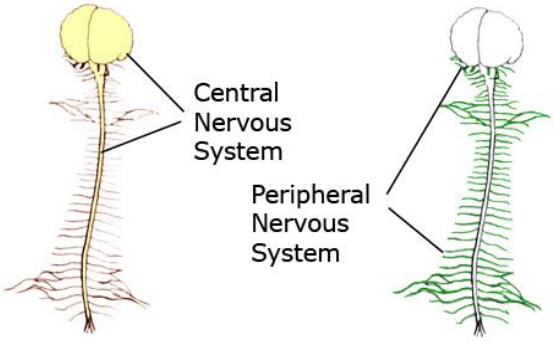
THE NERVOUS SYSTEM

The Nervous System

- Sensory information **comes into** - and decisions **come out of** - the **central nervous system** (**CNS**)
    - "The Boss"
    - **Cortex**

        - Frontal Lobe – executive functions, coordinates other brain areas, motor planning, language, memory
        - Parietal lobe – processes touch information, integrates touch and vision
        - Occipital lobe – processes visual information
        - Temporal lobe – processes auditory information, language, autobiographical memory
    - **Basal Ganglia**
        - Controls movement, motor planning
    - **Limbic System**
        - Thalamus – conveys sensory information to the cortex
        - Hypothalamus – oversees endocrine and autonomic nervous system
        - Amygdala – regulates arousal and fear
        - Hippocampus – processes memory for spatial locations
    - **Cerebellum**
        - Controls balance and coordinated movement
    - **Brain Stem**
        - Midbrain – tracks visual stimuli and reflexes triggered by sound
        - Pons – conveys information between the cortex and cerebellum
        - Medulla – regulates breathing and heartbeat
    - **Spinal Cord**
        - Conveys information between the brain and the rest of the body
        - Extends from brain stem to middle of our back
        - Conveys messages to and from brain to body
        - Nerves extend from neurons to the body, provide two directional information
            - Sensory nerves - sensory information
            - Motor nerves - motor commands
            - **Interneurons** - connect sensory and motor nerves so automatic actions can be taken, such as in a fight or flight situation, without having to consult with the brain

- The nerves outside the CNS are called the **peripheral nervous system (PNS)**



Peripheral Nervous System

- The **somatic nervous system** conveys information from the CNS to the muscles in the body, coordinating ***voluntary*** movement.
- The **autonomic nervous system** controls the ***involuntary*** actions of our internal organs and prepares us for "fight or flight".

Autonomic Nervous System

- **Sympathetic**
  - Arousal, blood pressure, heart rate, oxygen levels
- **Parasympathetic**
  - Relaxation, uses less energy

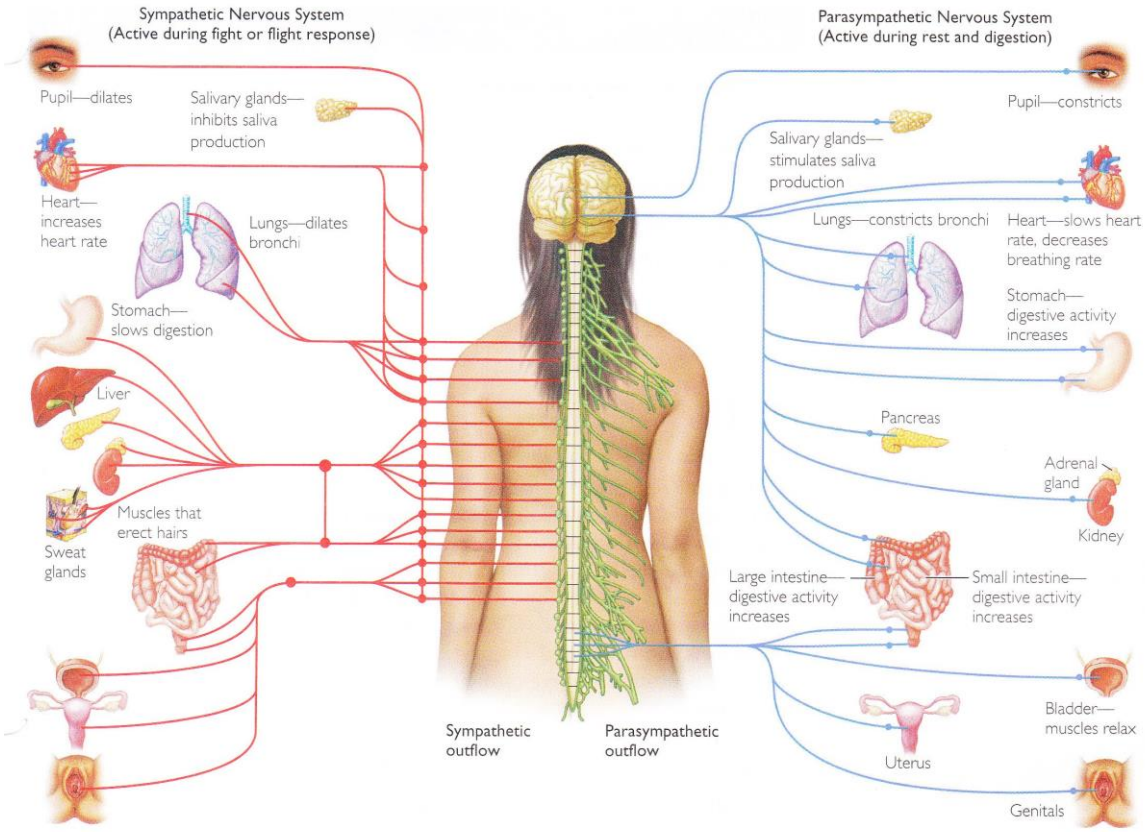


FIGURE 3.16 The Autonomic Nervous System (Female Shown). The sympathetic and parasympathetic divisions of the autonomic nervous system control the internal organs and glands.

The endocrine system

- The **endocrine system** interacts with the limbic system of the brain to control ***hormones***.
- **Hormones** influence particular organs and help to regulate emotion.
- Chemical messengers
- Slower than neurotransmitters due to passage through blood
- Longer acting than neurotransmitters for the same reason
- **Major glands**
  - **Gonads/ovaries**

        - Sex hormones
        - Testosterone and estrogen
        - Both hormones are found in both sexes in varying amounts
    - **Pancreas**
    - **Adrenal glands**
        - Emergency centre of the body
        - Located atop the kidneys
        - Manufacture adrenalin and cortisol
        - **Adrenalin**
        - Boosts energy production in muscle cells
            - Sympathetic system nerves call for adrenalin release
            - Triggers contraction of heart muscle, constriction of blood vessels, opening of bronchiols, breakdown of fat into fatty acids, breakdown of glycogen into glucose, opening of our pupils
            - Allows for the performance of fantastic feats in a crisi
        - **Cortisol**
            - Increases in response to stress
            - Anxiety disorders are often connected to high levels of cortisol
            - Regulates blood pressure and cardiovascular function, and body's use of proteins/carbs/fats
    - **Thyroid gland**
    - **Pineal gland**
    - **Pituitary gland**
        - Controls other glands in the body
        - Once called "master gland"
        - Under control of hypothalamus
        - Releases multiple hormones which do everything from regulating physical growth, to controlling blood pressure, to determining how much water to retain in our kidneys
        - **Oxytocin** deals with reproductive functions, maternal and romantic love, and trust
    - **Hypothalamus**

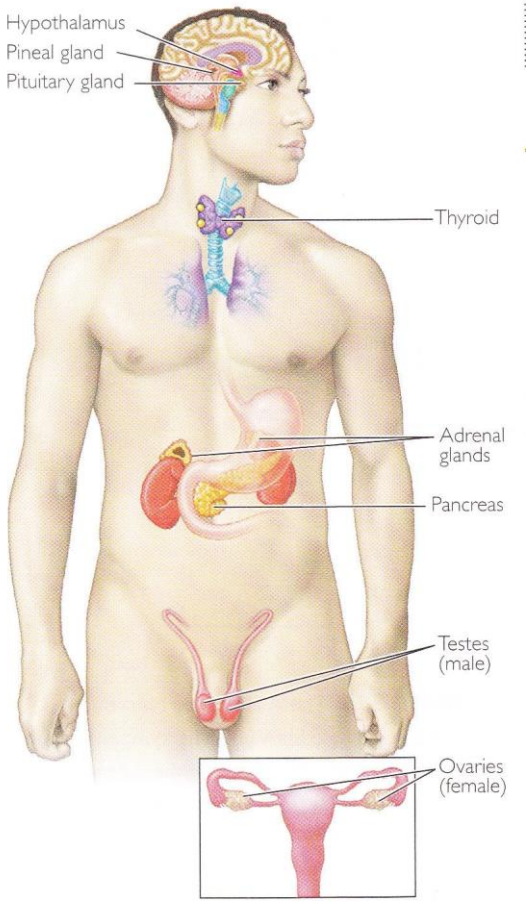


FIGURE 3.17 The Major Endocrine Glands of the Body. Endocrine glands throughout the body play specialized roles.

OUR GENETIC BLUEPRINT

Our genetic blueprint

- Humans have 46 **chromosomes** (23 from each parent) that carry our genetic "code".
- Male – XY
- Female - XX
- Our **genotype** is determined by the genes we inherit from our parents.
    - ***Dominant gene*** – masks other genes effects
    - ***Recessive gene*** – expressed in absence of dominant gene
- Our **phenotype** is how those genes manifest themselves in observable traits.
- A phenotype is not a perfect representation of genotype
- Heredity deals the cards, environment makes or breaks the hand
- Genes give possibilities, environment influences which occur

Nuclei have **chromosomes** which carry **genes** made of **DNA.**

A **genome** is all chromosomes/genes.

Nature versus nurture

- Studies of families, twins, and adoptive children help us differentiate genetic versus environmental influences.

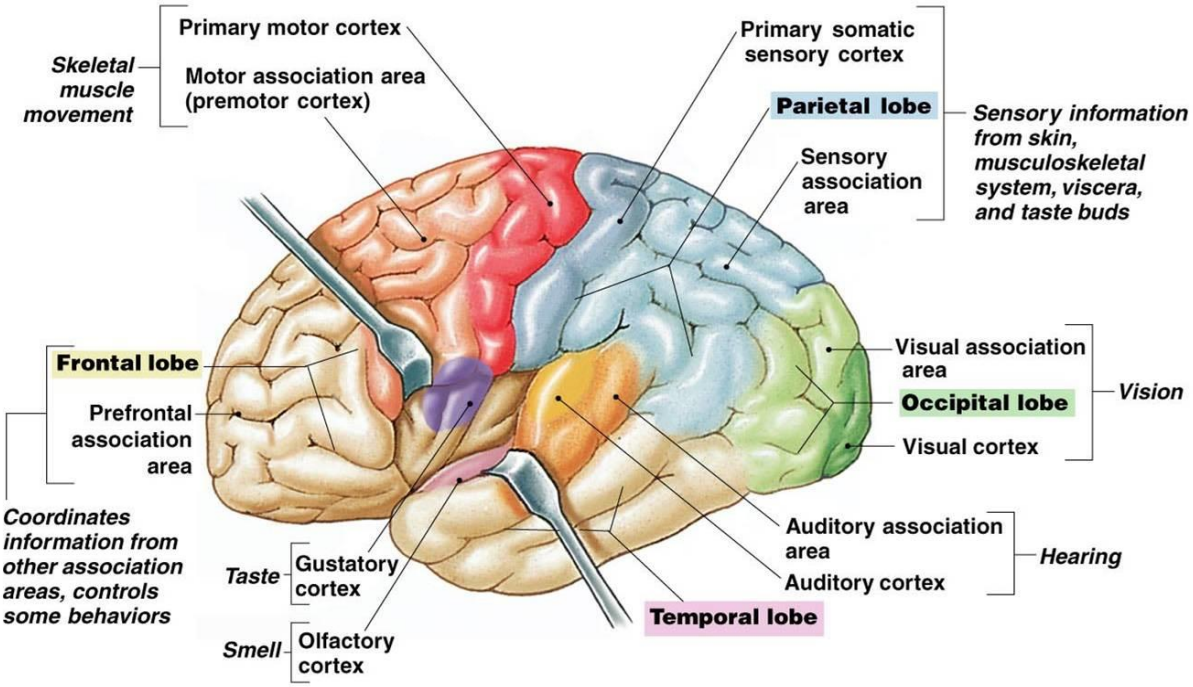
For exam:

- Bring a pencil
- Check out MyPsycLab if you have it

SENSATION

Sensation and the brain

- **The human senses:** Hearing, Sight, Smell, Taste, Touch
- Sensory receptors in the eyes, ears, tongue, nose, and skin transduce neural signals to various parts of the brain to create sensory experiences.
    - **Transduction** - sensory information is transformed into electrical signals; the bridge which links sensation and perception



Absolute Thresholds and Difference Thresholds

- Affected by individual differences, distance, etc.
- Human error increases as stimuli become weaker in magnitude
- **Absolute thresholds** – the minimum amount of *stimulation* necessary to detect a particular stimulus **50%** of the time when no other stimuli of that type are present.
    - **Can you see it or not**?
- **Difference threshold** - the minimum amount of *difference* in stimulation necessary to detect a particular stimulus **50%** of the time when no other stimuli of that type are present.
- **Just noticeable difference** (JND) – the smallest change in the intensity of a stimulus that can be detected.
    - If you're holding 2kg and 2kg is added, you'll notice the difference greatly. If you are holding 50kg and 2kg is added, you'll barely notice the change.
    - Visually, it's like a drop in the bucket.
    - **Weber's law** – the **stronger the stimulus**, the **bigger the change needed** for a change in the stimulus to **be noticeable**.

Sensory Adaptation

- Activiation is greatest when you first encounter a stimulus
- Sensitivity to stimuli can diminish as a consequence of constant stimulation.
    - Sensory receptor reacts strongly at first, then tapers off to conserve energy and attentional resources
    - For example, turn on a light in a dark room and you'll cover your eyes quickly. After 10 minutes, turn on a second light and you won't bat an eye.

Signal Detection Theory

- Developed by David Green and John Swets (1966)
- How stimuli are detected under different conditions.
    - Expectation and focus affect senses
    - We filter out background information
    - Signal-to-noise ratio
        - Too much noise, must increase signal
- **Reaction time** – our ability to quickly detect a stimulus affects our ability to react to that stimulus.
- **Response Biases** - tendencies to make one type of guess over another when in doubt about whether a weak signal is present or absent under noisy conditions
    - **True positive/hit** - say they experienced it, and something happened
    - **False positive/false alarm** - say they experienced it, but nothing happened
    - **True negative/correct rejection** - say nothing happened, and nothing happened
    - **False negative/miss** - say nothing happened, but something happened
    - The frequency of false neg/pos helps measure bias of respondents to choose yes or no

Specific Nerve Energies

- Johannes Muller 1826
- Even though there are many distinct stimulus energies, the sensation we experience is determined by the nature of the sense receptor, not the stimuli
- **Phosphenes** - sensations of light caused by pressure on receptor cells in the eye
    - Even though touch brings on the reaction in the receptor cells, they can only provide visual output

McGurk Effect

- When processing spoken language, we also integrate visual and auditory information plus calculate the most probable sound given the information from the two sources

Rubber Hand Illusion

- When a rubber hand is placed exactly where a person's hand should be then stroked with a paintbrush while their real hand is also stroked, they believe the rubber hand is their own
- May prove brain regions serve double duty

Synesthesia

- Sir Francis Galton 1880 first described
- People experience cross-modal sensations, such as hearing sounds when seeing colours or tasting colours

- **Grapheme-colour synesthesia -** Numbers are coloured
- **Lexical-taste synesthesia -** Words have tastes

PERCEPTION

- **Sensation** – **detecting** stimulus from the environment.
- **Perception** – **Selecting, organizing, and interpreting** those sensations.

Filling in - when the brain (perception) fills in gaps in our senses

We mix illusory and sensory-based information to arrive at perceptual decisions.

- Simplifies the world

Parallel Processing

- Attending to many sense modalities simultaneously
- **Bottom-Up Processing** – first we sense; then assign meaning.
    - Draw on past experiences
    - Processing in which a whole is constructed from parts
- **Top-Down Processing** – our experiences frame what we sense.
    - Expectations affect what we see
        - As in the blue bar example in class, we may never have seen anything until we were told there was something to look for
    - Conceptually-driven processing influenced by beliefs and expectancies

Perceptual Sets

- Environmental conditions, experiences, expectations, motivation, and alertness affect what we sense.
    - Top-down processing
- **Perceptual constancy**
    - We perceive objects as unchanging, even though the angle, distance, and illumination may change
    - Shape constancy
        - A door still looks like a door, even as it opens
    - Size constancy
        - While someone walking away looks smaller, we don't perceive them as really shrinking
    - Colour constancy
        - Even when light changes, the colour looks the same
- **Selective Attention** – Conscious awareness is focused only on a very limited aspect of all that you experience.
    - One channel at a time is focus
        - Controlled by reticular activating system and forebrain
    - We pay attention to what we focus on
    - Can be affected by outside influences
        - Magicians draw your eye away from their trickery
    - **Cocktail Party Effect** - hear what you are familiar with, like your name across a cocktail party

    - **Filter Theory of Attention** - attention is the bottleneck through which information passes
        - Donald Broadbent 1957
        - Studied **dichotic listening** (subjects hear 2 messages, one in each ear)
        - Anne Treisman 1960 repeated test asking subjects to repeat messages
            - **Shadowing**
            - Sometimes mixed in content from other ear if it fit what they heard
- **Inattentional blindness** – when people fail to sense objects right in front of them
    - Daniel Simons and Christopher Chabris
        - In the basketball passing video, we fail to see the moonwalking bear
- **Change blindness** – when people fail to notice changes in the environment.
    - In the card trick video, we fail to see the colour changes

Binding - Brain binds diverse pieces of information from multiple parts of the brain into a unified whole

- While we perceive the apple in different ways (look, feel, taste, smell), it's all put together so that we know it is an apple
- Any single characteristic isn't an apple or part of an apple
- Hypothesis: multiple cortexes coordinate to cause binding

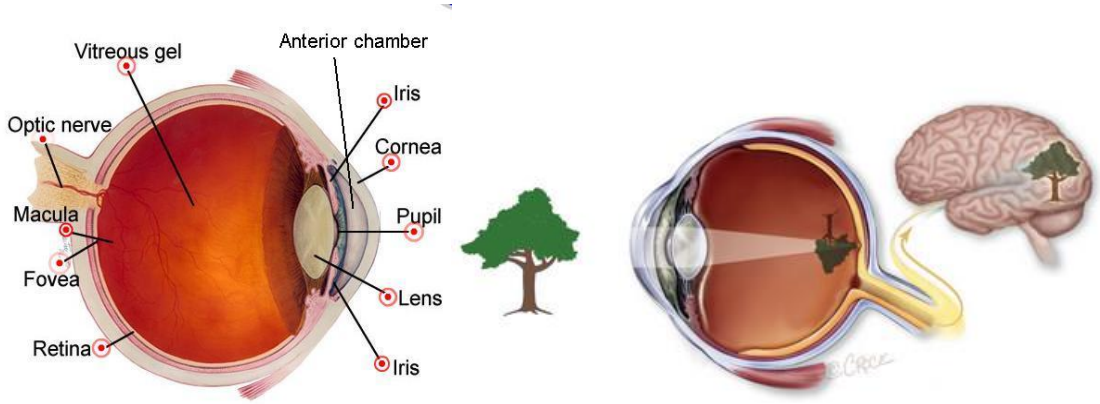
Subliminal Information Processing

- Much sensory input is processed with little to no forethought or deliberation
- **Subliminal Perception**
    - The processing of sensory information that occurs below the limen (threshold of conscious awareness)
    - **Mask** - stimulus that blocks out mental processing of a subliminal stimulus
    - If the subject can't identify the content of the stimulus at better than chance levels, then it was subliminal
    - Effects of subliminal messages often vanish when subjects either suspect or find out about the subliminal message
- **Subliminal Persuasion**
    - Subthreshold influences, typically used in marketing or even elections
    - Words like "drink" may make you more thirsty, but words like "cola" don't influence which drink you choose
    - Subliminal persuasion has little influence since we can't process its meaning in-depth, therefore doesn't influence decisions
    - **Illusory placebo effect** - while no improvement can be measured, the subject thinks they have improved

Psychophysics

- Gustav Fechner 1860
- Published landmark work on perception
- Out of his work grew psychophysics
    - Study of how we perceive sensory stimuli based on their physical characteristics

VISION



Light

- Electromagnetic energy, fluctuating electric and magnetic waves
- Visible light - wavelength in the hundreds of nanometers
- We only respond to a small visible spectrum/wavelengths of light
    - Have more vitamin A, see more infrared light
- Our experience of colour depends on brightness, hue and saturation
    - We see reflected light
    - Brightness is how much light reflects (intensity)
    - Hue is the color (a banana is yellow)
    - Saturation is how pure the colour is (vivid vs pastel)

Letting light in

- **Sclera** is just the white of the eye, while the **iris** is the coloured part (**pigments** cause colour - **melanin** [brown] and **lipochrome** [yellow-brown]).
    - Blue eyes contain very little lipochrome and no melanin
        - Appear blue and not yellow because the less pigment there is, the more blue light is reflected
    - Green and hazel eyes have some melanin
    - Brown eyes have lots of melanin
- The **pupil** of our eye allows in light, where the curved shape of the **cornea** focuses the incoming visual image on the back of the eye. The **lens** allows us to fine-tune the visual image through its curvature (which changes as necessary) and includes completely transparent cells. Through a process of **accommodation** our lenses change shape to allow us to see things far away or up close.
    - **Pupilary reflex** - bright light causes pupil to shrink
        - Happens in both eyes even if you only shine light into one
    - Pupils dilate when processing complex information or when we look at a good looking person

Shape of the eye

- Nearsightedness/myopia happens when cornea is too steep or eyeball is too long
- Farsightedness/hyperopia happens when the cornea is too flat or eyeball too short
- **Presbyopia** - Eyesight gets worse with age as lens loses flexibility

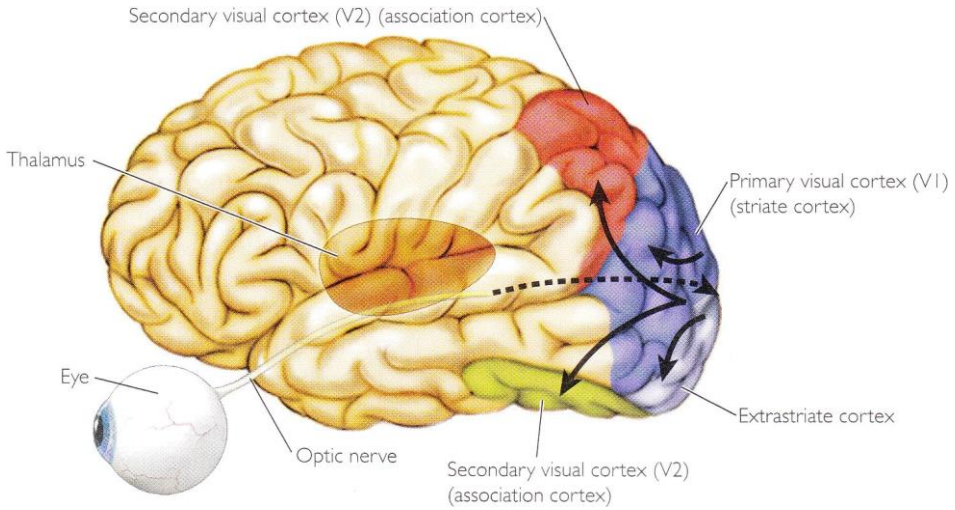
(a) Nearsighted eye (b) Farsighted eye

From light to neural activity

- Light passes through the **retina**, at the back of our eye, to two types of sense receptor cells.
  - **Rods** – enable us to see basic shapes and forms, darkness and light, and allow us to see in the dark (without color - just whether there is light or not); most plentiful
    - **Dark adaptation** - takes 30 minutes, move from bright to dark environment, how quickly we adapt
    - No rods in the fovea, which is why we see best in the dark if we tilt our heads (more rods in peripheral vision)
    - Named after shape
  - **Cones** – give us colour vision, interpret light; don't work in the dark
    - Also named after shape
  - **Photopigments** - chemicals which change following exposure to light
    - In rods, called **rhodopsin**
    - Made with vitamin A (found in carrots)
  - **Fovea** - central part of the retina which is responsible for acuity
    - Contains 100 million sense receptor cells for vision plus visual info processing cells

Transduction

- Through **transduction**, **optic nerve** sends the neural signals out of the eye and into the brain.
  - Ganglion cells bundle their axons in the optic nerve
  - **Blind spot** - where optic nerve connects to the retina
  - **Optic chiasm** - fork in the road
    - Half of axons stop here
    - Half continue past, turn into optic tracts
      - Most lead to visual part of Thalamus then on to primary visual cortex (VI)
      - The rest go to the midbrain, **superior colliculus**, to affect reflexes



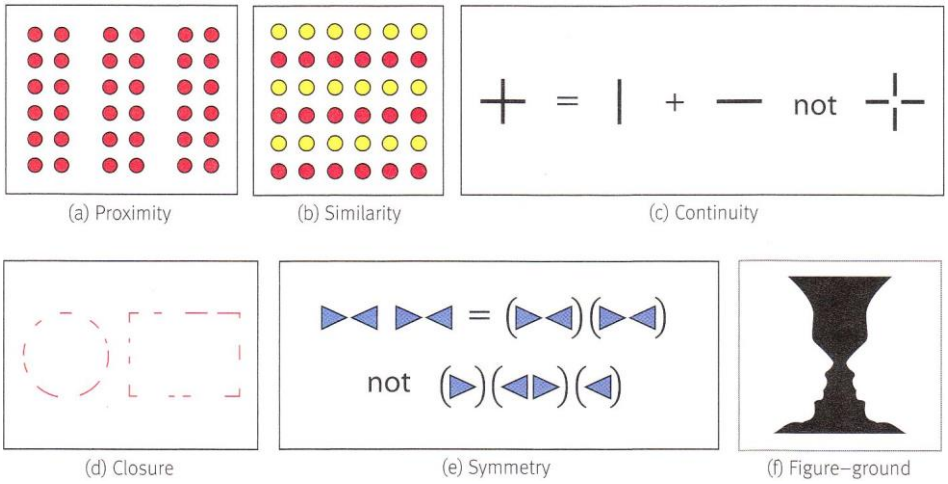
Perception

- David Hubel and Torsten Wiesel
  - Tested cats viewing visual stimuli by measuring electrical activity in visual cortexes
  - Noticed slits of light cause V1 activity
  - Found out that V1 contains cells which respond to certain orientations
    - Some vertical, some horizontal, some oblique
  - Simple cells only respond to specific orientation, stop when it moves
  - Complex cells respond in a variety of positions
- **Feature detection** - ability to use certain minimal patterns to identify objects
  - Include feature detection cells such as simple and complex cells
  - Processing gets more complicated as the information moves through levels of the brain
    - V1 → V2 (parietal lobe and temporal lobe)
- Optical illusions help psychologists understand the connection between sensation and perception.
  - Mismatch between senses and perception
- **Visual capture** – in individuals with sight; there is a tendency for visual information to dominate the other senses.
- **Perceptual set** – Our experiences, assumptions, and expectations affect what we perceive.

Perceptual Organization:

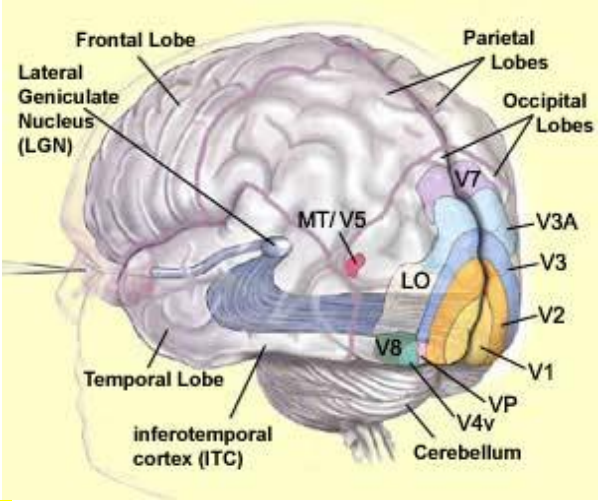
- **Gestalt principles**
  - Formulated by psychologists Max Wertheimer, Wolfgang Kohler and Kurt Koffka
  - The whole is greater than the sum of it's parts
    - An apple is an apple, not "red, with leaf, round, etc."
  - Proximity - Objects close together are perceived as a whole
  - Similarity - Same shape, colour, etc. perceived as a whole
  - Continuity - View an object as a whole even if something blocks part of it
  - Closure - Our brains fill in the gaps to create a whole
    - **Subjective contours** - brain provides missing info about outlines; rules governing how we perceive objects as wholes within their overall context
  - Symmetry - Objects arranged as a whole seems as one unit

- Figure-ground - Focus attention on what we perceive to be the central figure, ignore the background

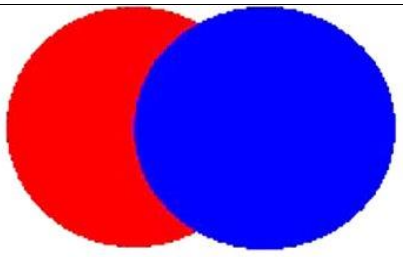


- **Face perception**
  - Central to social self
  - Don't need exact face to recognize (caricatures)
  - Response to faces is in temporal lobe & hippocampus
  - **Grandmother cell argument** - each neuron stores one memory
    - Unlikely due to activity in multiple brain regions, is multiple neurons in conjunction
- **Colour perception**
  - Sometimes we see colour which isn't there
  - **Trichromatic Theory** - colour vision is based on sensitivity to three basic colours.
    - Red, green, blue only
    - Only have 3 types of cones, each sensitive to specific wavelengths of light
  - **Colour blindness** - inability to see some or all colours, often due to the absence or reduced number of one or more types of cones.
    - **Monochromats** have only one type of cone and no colour vision - rare
    - **Dichromats** have two cones and only miss out on some colours
      - **Red-green dichromats** can't distinguish red well
    - Mostly men as the gene for producing photopigment is on the x chromosome, meaning women get 2 chances to have a good gene
    - **Trichromatic vision** increased fitness due to improved foraging ability
  - **Opponent process theory** – colours work in complementary pairs (black-white, green-red, yellow-blue). Perceiving one colour inhibits the perception of the component colour. If we fatigue the receptor sites of one colour, we can no longer inhibit the receptors of the opponent colour – resulting in an afterimage.
    - Green holds back red, gets tired from the struggle; when no longer in use, red comes barging through
- **Depth & Motion perception**
  - **Motion perception** - Neurons in **region V5** (MT in primates) respond to both the direction and speed of motion. Devoted to motion.

- The amount of motion required for a single neuron to respond = amount needed for an organism to detect motion
- **Phi phenomenon** - illusion of motion due to flashing, like marquis lights
  - For an example, visit http://en.wikipedia.org/wiki/Phi_phenomenon
- Uses **retinal disparity** - the slight difference in the two retinal images due to the angle from which each eye views an object



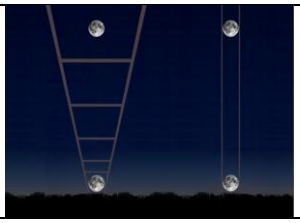
- **Depth Perception** - ability to see spatial relations in three dimensions
  - **Monocular cues** – Using ***pictorial cues***, a single eye can detect depth.

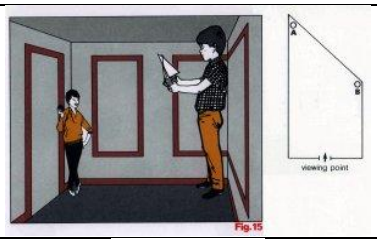
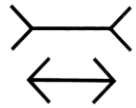
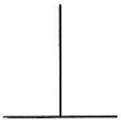
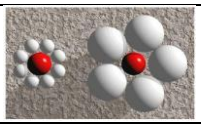
Relative size – more distant objects appear smaller	
Linear perspective – Lines appear to converge with distance **Texture gradient** – Closer objects have more detail ○ A face, pattern, etc. blurs further away ○ The grass has blades nearer, but appears as a clump further away	
Interposition – closer objects block the view of objects further away	 *Figure 2. Interposition. The blue circle is reported to be closer since it overlaps the red circle.*

Height in plane – distant objects appear higher, closer objects lower	
Light and shadow – Shadows give a sense of form ○ Big shadow, big object	

Motion parallax - the ability to judge the distance of moving objects from their speed

- **Binocular cues** – the ***binocular disparity*** (i.e., differences in the images sent to the brain from each eye) combined with ***binocular convergence*** (amount our eyes turn inward to see object) allows the brain to create three dimensional images
  - Depth perception emerges in infancy (between 2 – 14 mos old) avg 4-5 mos
  - Use the visual cliff to see if infants can determine depth

Moon Illusion ○ Moon appears larger at horizon ○ Atmosphere changes its colour, but not its size	

Ames Room Illusion ○ Adelbert Ames Jr. 1946 ○ Shape of room makes one person look gigantic	
Muller-Lyer Illusion ○ Line of two arrows is the same length, but appears different due to orientation of arrow heads	
Ponzo Illusion ○ Two shapes within converging lines, the one closest to the lines looks bigger	
Horizontal-Vertical Illusion ○ Flip a T upside down, the vertical line looks longer than horizontal as horizontal is cut in half by vertical line	
Ebbinghaus-Titchener Illusion ○ Circle appears larger when surrounded by smaller circles	

Blindness - dramatic reduction in the ability to see; presence of vision less than or equal to 20/200 on Snellen eye chart

Motion blindness - inability to string still images into perception of motion

Visual Agnosia - deficit in perceiving objects; can see colour or shape, but can't recognize object

Blindsight - cortically blind people can guess about visual appearance of things around them

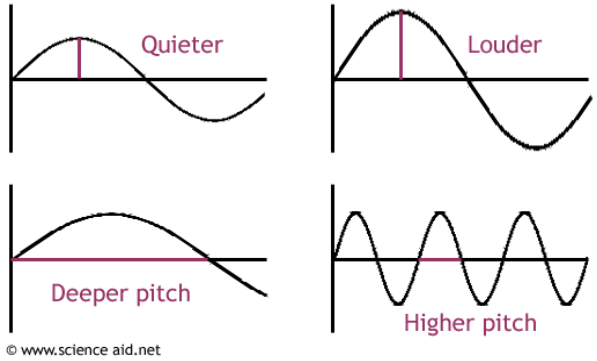
AUDITION

Sound - mechanical energy in the form of vibration traveling through a medium like air; disturbance of molecules in air causes waves

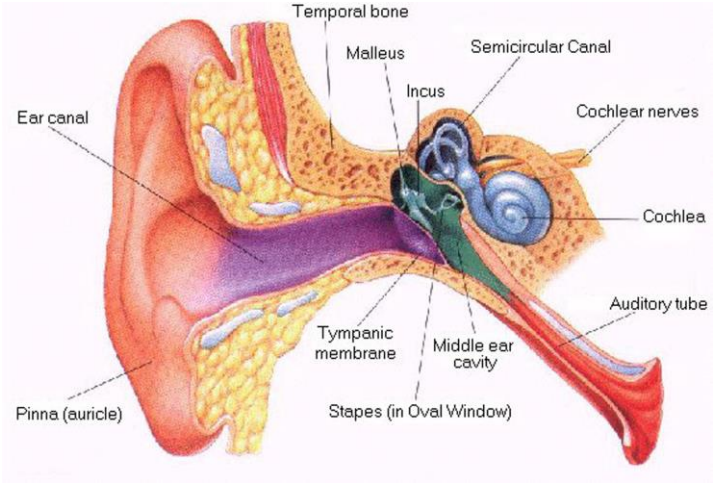
Hearing (audition)

- It's all about sound vibrations
    - **Pitch** – frequency of the sound wave
        - High or low
        - Number of vibrations per second
        - Speed of wave
        - Squished/shorter horizontally
        - Human ear can pick up 20-20,000Hz
        - Younger people are more sensitive to higher frequencies
            - Eg. Mosquito ringtones
    - **Amplitude** (volume) – height of the sound wave

- Loud or quiet
- Shorter vertically = quieter
- Affects air pressure

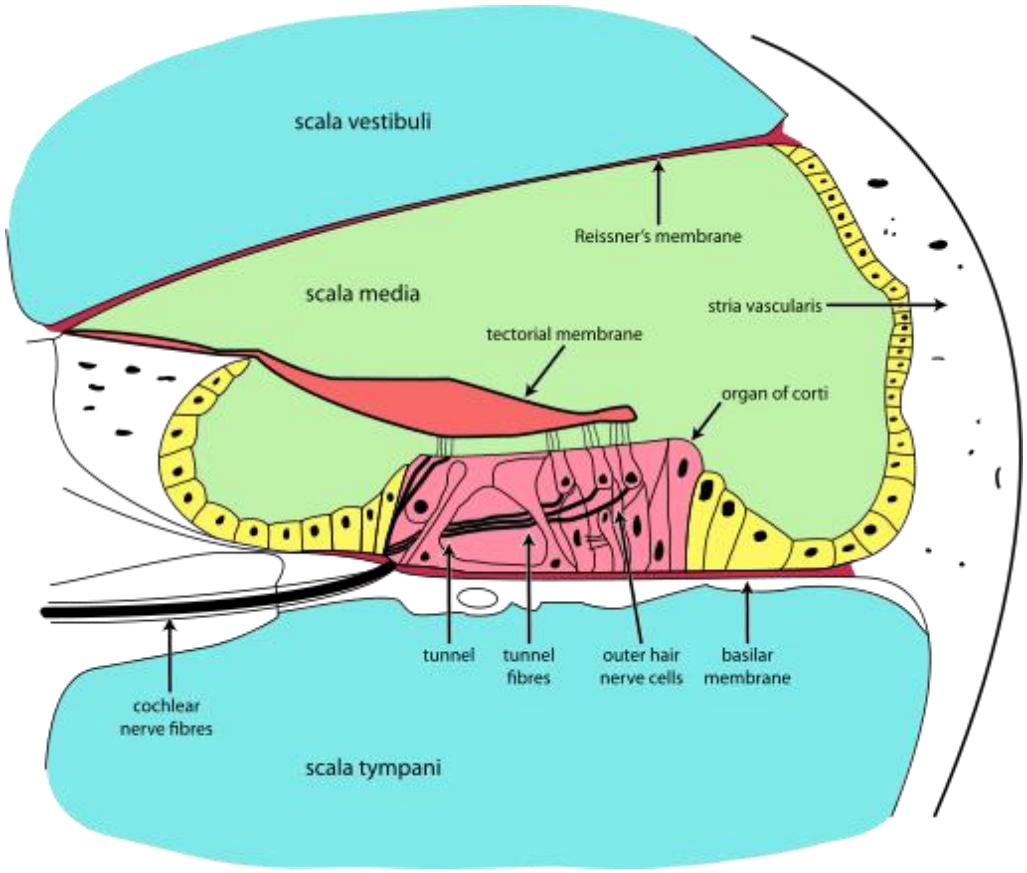


- **Timbre** – quality or complexity of the sound
  - Intonation



The Ear

- ***Outer ear***: The **ear canal** and **pinna** funnel sound into the ear.
- ***Middle ear:*** contains the three tiniest bones in the body (the ***ossicles***) which vibrate to transmit the frequency to he inner ear.
- ***Inner ear:*** The **cochlea** (from the latin "kokhlias" meaning snail or screw) converts vibration into neural activity. Bony outside with liquid on inside.
  - The cochlea also includes the **organ of Corti** and the **basilar membrane**.



- Sound waves cause ***hair cells*** in the basilar membrane to vibrate. The location of the vibrations determines the pitch.
  - Hair cells convert acoustic information into action potentials
    - Cilia protrude into cochlear fluid, the pressure of sound waves deflects the cilia, exciting the hair cells
    - Info is fed into auditory nerve which passes information to the thalamus
  - High pitch near the base, low pitch near the apex
    - **Frequency theory** - rate at which neurons fire action potentials faithfully reproduces the pitch (up to 1000Hz tones)
    - **Volley theory** - neurons fire at their highest rate but slightly out of sync to reach up to 5000Hz rates
    - **Place theory** - specific place along membrane matches specific pitch (explains high pitched, >5000Hz, tone perception)

Localization of sound

- Where auditory nerve connects to the brain stem, some axons connect with one side of the brain and some axons the other
  - Means information from both ears reaches both sides of the brain, but slightly out of sync
  - **Binaural cue** – our brain compares the auditory information from each ear (sync difference and volume difference) to detect the **source of a sound**.
    - Ear furthest away from sound is in **sound shadow**

- **Monaural cues** – a single ear can help detect sounds that are **muffled versus** those that are **clear** (which also enable us to **localize sounds**).

Echolocation - animals emit sounds & listen to echoes to determine their distance from a barrier
- Some humans can use mouth clicks to "see" even though blind

Conductive Deafness - inability to hear due to malfunctioning of the ear
Nerve deafness - damage to the auditory nerve
Noise-induced hearing loss - damage to ear hair cells due to loud sounds

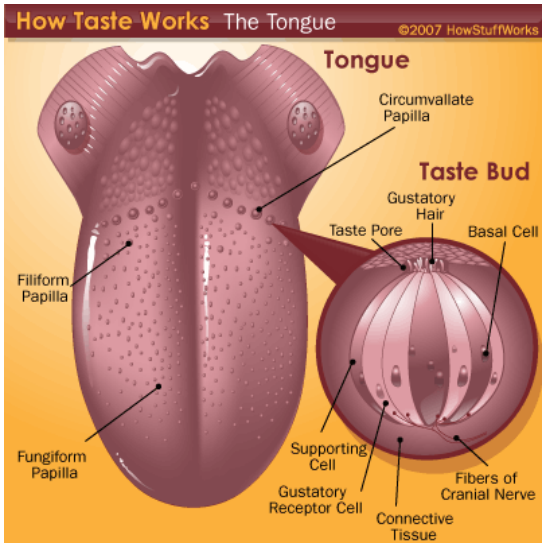
Music
- Muzak does not create change in brain activity
- Left hemisphere language/structure areas activate when listening to music
  - Same areas as active when deaf people sign
  - Therefore, area is focused on structure in general, auditory or visual
- Right hemisphere also active, but won't be if only listening to language

TASTE AND SMELL

- Critical to ensure we don't eat spoiled food

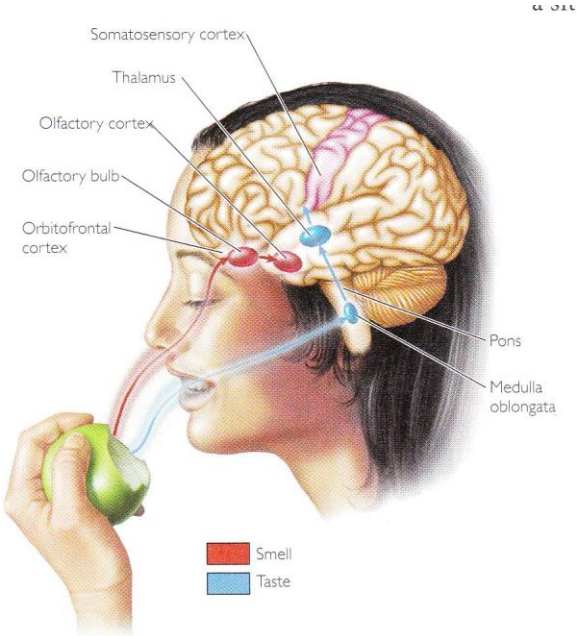
Smell (olfaction)
- **Odours** are airborne chemicals received by receptor cells in the olfactory membrane.
- Receptor sites are specialized to **recognize various odours**.
- Capable of detecting between 2000-4000 different odours

Taste (gustation)
- Less variable than smell
- Tastes are detected by taste buds detect **sweet, salty, sour, bitter, & umami** (brothy/meaty)
- Taste perception is biased strongly by our sense of smell.
- Humans have over 1000 olfactory genes, 347 coding olfactory receptors
- Olfactory neurons each have one olfactory receptor, recognizing an odorant based on shape
  - Like neurotransmitters, when odorant connects, action potential is triggered
- Tongue taste map is a myth, but there are separate **Papillae** for each taste
- There is a reaction to fat on the tongue, so may be sixth taste receptor



Smell and taste perception

- Smell and taste perception involves the **temporal lobes, limbic system, and prefrontal lobes**!



- Smell can trigger strong emotional memories.
- Smell beats out taste if they disagree
- Odours interact with sense receptors in nose, passing info to brain and to olfactory cortex/limbic system
- Tastes interact with taste buds, passing info to brain through gustatory cortex, somatosensory cortex and limbix system
- Frontal cortex is where taste and smell converge
- Amygdala helps us determine if smell is pleasant.
- Gustatory cortex does the same for taste.
- Emotional disorders can affect taste perception

    - Serotonin and norephinephrine make us more sensitive to taste
- Smell plays a role in sexual behaviour
    - **Pheromones** - odourless chemical that serves as a social signal to members of one's own species

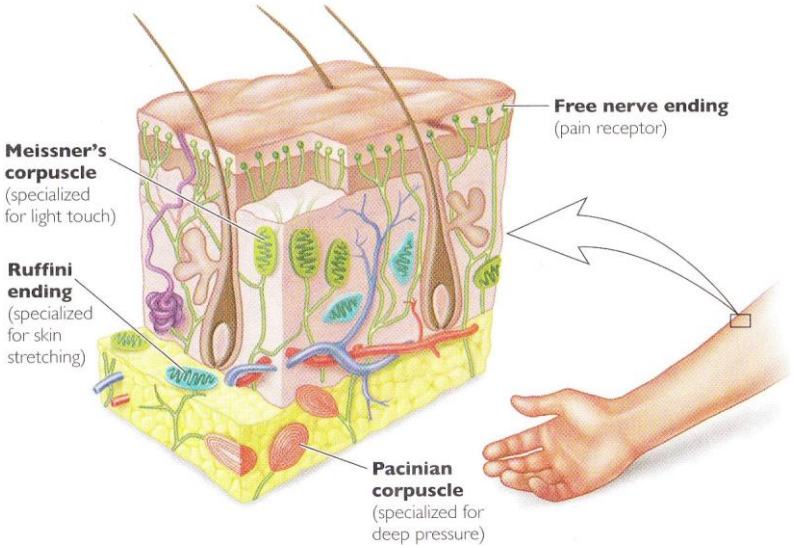
Note: Light and sound are waves; smell and taste are chemical

BODY SENSES

Body senses

- Somatosensory system: touch and pain
    - Responds to pressure (texture), temperature, and pain
    - Sense touch with **mechanoreceptors** - specialized nerve endings located on the ends of sensory nerves in the skin
        - Pacinian corpuscle, named after Filippo Pacini (1831)
        - **Free nerve endings** - sense touch, temperature and especially pain
        - Most nerve endings are found in fingertips, then lips, face, hands, feet
- Somatosensory pathway
    - Nerves →spinal cord → spinal reflexes → brain stem → thalamus → somatosensory cortex; association areas; limbic system
    - Touch info moves faster than pain info as touch is more urgent
    - **Withdrawal reflex** - body pulls away from painful stimuli automatically
- Proprioception: kinesthetic sense; helps us keep track of body position and move efficiently
    - **Proprioceptors** - sense muscle stretch and force
        - **Stretch receptors** (in muscles) and **force detectors** (in tendons)
- Vestibular sense: sense of equilibrium; enables us to sense and maintain balance
    - Inner ear contains **semicircular canals** which sense equilibrium using liquid inside
    - Information goes to brain stem where eye muscles are controlled and eye/head movement reflexes are set off
    - Also travels to cerebellum, allowing us to balance as we fall

Skin: touch and pain



- **Pain threshold** - point at which feeling goes from pressure to pain
- Can't localize pain as easily as touch
- Pain connects with emotion as it goes to somatosensory and limbic areas
- **Gate Control Model** - Ronald Melzack and Patrick Wall; pain is blocked from consciousness due to neural mechanisms in the spinal cord which control the flow of sensory input to the CNS
- Placebos may increase production of endorphins
- **Phantom pain** - pain or discomfort in a limb which is missing
- **Pain insensitivity** - impaired ability to sense pain
- The sensory cortex

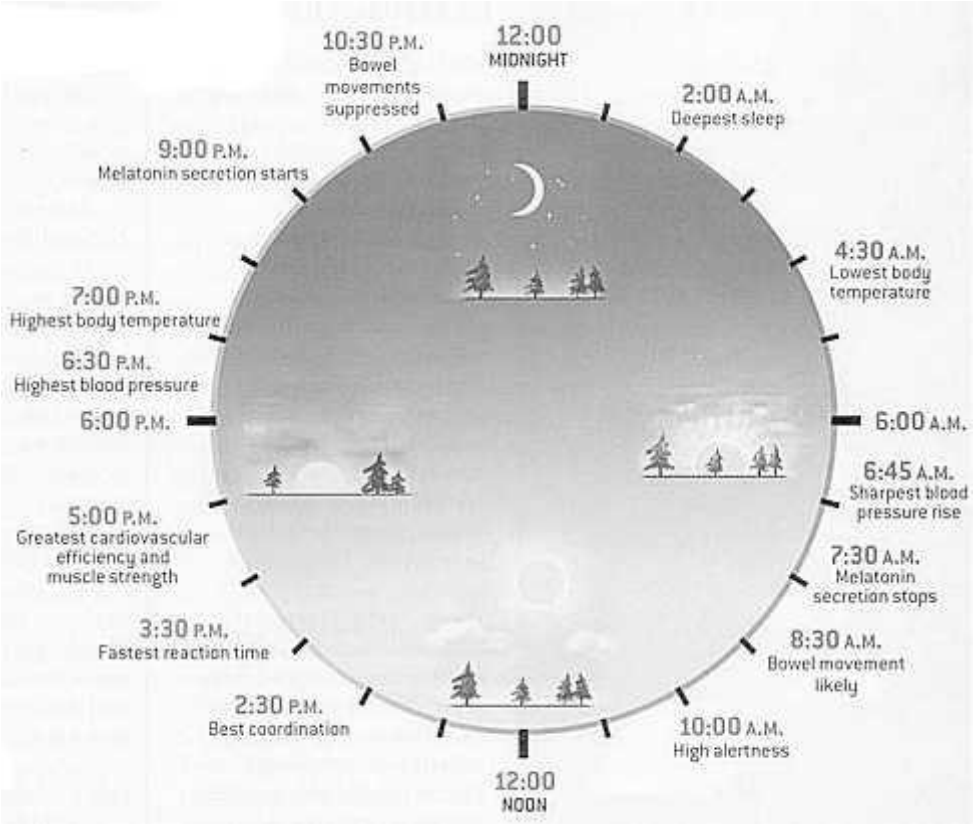
Ergonomics

- Making things more worker-friendly
- Human Factors - optimizing tech to better suit sensory/perceptual capabilities

PSY102 Week 7 Oct. 24, 2013

Consciousness - our subjective experience of the world and ourselves

CIRCADIAN RHYTHMS

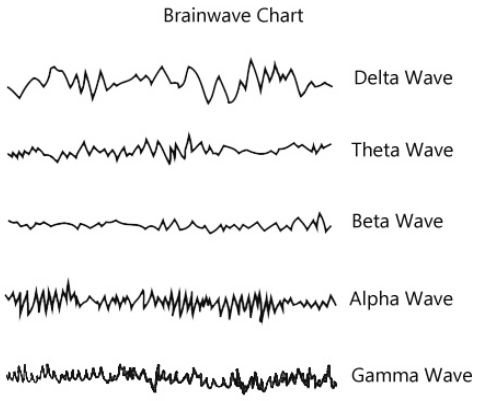


- **Circadian Rhythms** – aka **biological clock**, cyclical changes of alertness and sleepiness that occur on a roughly 24 hour basis.
- The **suprachiasmatic nucleus** (soo-pruh-kie-as-MAT-ik), *SCN*, reacts to light-dark patterns to activate the **pineal gland**, which starts and stops the secretion of the hormone ***melatonin***.
- **Sunlight** is critical for resetting our circadian rhythms.
- **FALSE**: After months on the job, people who work the night shift are able to switch their natural wake/sleep rhythm to allow for alertness at night and sleep during the day.
- **FALSE**: If one lives in complete darkness for months at a time, one's sleep-wake cycle will differ from the 24 hour cycle that occurs when exposed to light and dark.
    - Will still have a 24 hour clock, it just won't correspond with the normal sun/dark schedule
- Even an hour or two shift in sleep/wake patterns can disrupt circadian rhythms.
    - Like daylight savings time changes
- Crossing time zones can also disrupt circadian rhythms, causing jet lag.
    - It's easier to stay up later than get up earlier

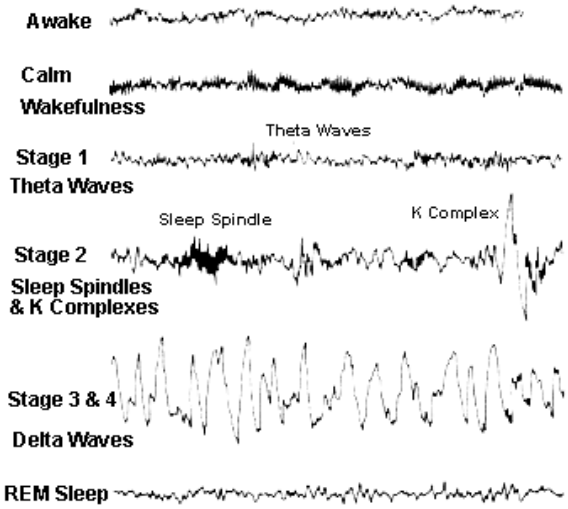
- Resetting your biological clock can take a few days.
    - Just try to follow the new time zone
    - Get outside often
    - Have your meals on the new schedule
    - Social contact
    - Physical activity
    - Can't extend your circadian rhythm past 24 hours
    - Taking melatonin 2 hours before bed to prepare circadian rhythm for earlier bedtime
        - Can work in one dose
        - Phase advance
    - Taking melatonin in the morning to try to extend sleep (less effective)
        - Phase delay
        - Requires multiple doses
- **FALSE:** Taking Melatonin before bed can help an individual sleep more soundly.
    - Melatonin is an on or off situation, not more or less
    - Already have enough in your system
- **FALSE:** "Early to bed, early to rise makes a person happy, healthy, and wise."
    - Elderly and women work best on this schedule
    - Get better grades if on this schedule
    - Evening people tend to be more extroverted

SLEEP CYLCES

- **TRUE:** ~~All people~~ Most adults need 7 to 8 hours of sleep at night to feel rested.
    - Babies need as much as 16 hours
    - Adults with a mutation in the DEC2 gene can sleep six hours only
    - Not getting enough sleep leads to depression, learning difficulties, attention deficits, slowed reaction times; if long-term, hallucinations appear
    - Over time, leads to weight gain, increased risk for high blood pressure, diabetes and heart problems, reduced immune response
- Measuring sleep: eye movement, EMG, EEG
    - Scientific study of biological indicators
    - EEG - brain waves
        - Measures average of inhibitory and excitatory potential
        - Shows states of consciousness
    - EMG - relaxed muscles
    - Eye movement - REM sleep, dreaming
    - Gamma - active
    - Beta - alert (awake), 13+ cycles per second
    - Alpha - relaxed (calm wakefulness), 8-12 cycles per second
    - Theta - drowsy (stage 1) , 4-7 cycles per second
        - 50% less activity than alpha waves
    - Delpha - sleep (stage 3&4), 1-2 cycles per second



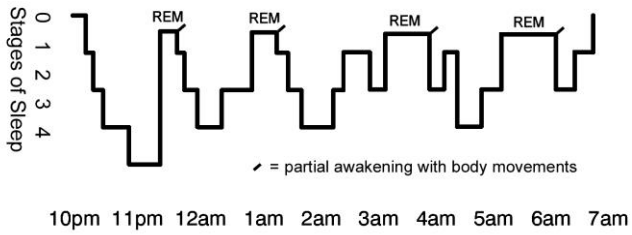
- **FALSE:** The brain rests during sleep so that you can feel refreshed the next day.



- Kleitman and Dement discovered 5 stages 1957
- Each cycle lasts ~90 minutes each
- **Stage 1 (theta waves)**
  - Light sleep lasting about 5 to 10 minutes.
  - **Hypnagogic imagery** – dreamlike images / hallucinations.
  - **Myoclonic jerks** of the limbs.
  - Falling or weightless sensation.
- **Stage 2**
  - Relaxed, deep sleep characterized by irregular brain waves lasting 5-20 minutes
  - **Sleep spindles** as the thalamus communicates with the cortex.
    - Allows for response to external environment
    - Prepares for sensory cut-off
    - Rapid up and down waves
  - **K complexes** occur only when we're asleep and seem to react to external stimuli (loud noises).
    - Bran still capable of responding to senses

- Heart rate slows, body temperature decreases, muscles relax, eye movements cease.
- Adults spend ~ **65% of sleep time in Stage 2 sleep**.

- **Stages 3 & 4 (slow wave/delta wave sleep)**
  - Delta brain waves 20-50% (stage 3) or 50%+ (stage 4) of the time, **hard to awaken**.
  - Alcohol suppresses delta sleep
  - Needed to feel fully rested the next day.
  - Adults spend about **25% of sleep in slow wave sleep** (children about 40%).
  - **Sleep talking, sleep walking, tossing/ turning, bed wetting** happen at this stage
- **REM Sleep**
  - Discovered by Aserinsky in 1951, confirmed in 1953 with Kleitman
  - All other stages = NREM (non-REM) sleep
  - Starts after ~15-30 minutes of delta sleep, stage 4 goes to stage 2 then REM
  - Lasts up to 45 minutes per night, typically 10-20 minutes - amount increases as night goes on, return to REM 5-6 times per night
  - Process learning
  - Brain waves rapid, but **body is paralyzed**.
    - ∴ no sleep walking possible
    - **Sleep paralysis -** being unable to move immediately after falling sleep or upon waking up
  - Heart rate rises, breathing rapid, eyes dart, genitals aroused.
  - Dreaming is most common in REM sleep (but can occur in other stages, as well).
  - **REM rebound**: if sleep deprived, will fall into REM sleep immediately upon falling asleep
  - **Middle ear muscle activity**: muscle activity in the middle ear much like rapid eye movements
  - **REM behaviour disorder** - people aren't paralyzed during REM sleep
- **Sleep Cycles**
  - Sleep cycles occur about every 90 minutes.
  - As night progresses, **less** Stage 3 & 4 and **more** REM



- Total sleep deprivation = death

SLEEP DISORDERS

- **Insomnia** - trouble falling asleep, waking too early, waking up and not being able to fall back asleep
  - 9-15% of people report insomnia
  - Common in people with depression, pain, other medical conditions, stress, medications, illness, shift work, jet lag, relationship problems, caffeine, napping, anxiety over not being able to sleep
  - To combat, hide clocks, cool room, sleeping on a schedule, avoiding caffeine, naps, reading or watching tv or using a computer in bed

    - **Rebound insomnia** - insomnia gets worse after taking sleeping pills
- **Narcolepsy** - random episodes of sleeping from a few seconds to minutes or an hour
    - **Cataplexy** - complete loss of muscle tone
    - Affected by hormone **orexin** (not enough brain cells creating it)
- **Sleep apnea** - blockage of the airway during sleep
    - Can lead to night sweats, weight gain, fatigue, hearing loss, irregular heartbeat
- **Night terrors** - screaming, perspiring, confusion episodes
- **Sleepwalking** - somnambulism, walking while fully asleep
    -

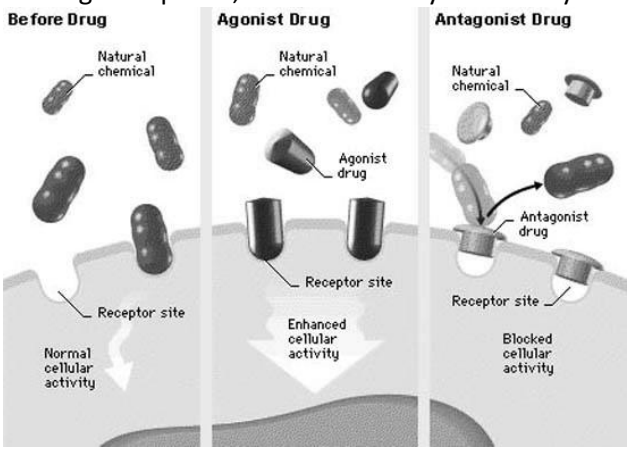
DREAMS

- Process emotional memories, integrating experience with established memories
- Reorganize memories
- Learning new strategies, coping with threats through simulations
- **FALSE:** People who sleep walk are acting out their dreams.
- **TRUE:** Dream sleep is needed for biological and learning functions and without it people can become severely disabled and even die.
- **Lucid dreaming -** the ability to become conscious of a dream while dreaming
- **Freud's *The Interpretation of Dreams***
    - Dreams are the protector of sleep
    - The ego can't keep sexual and aggressive instincts at bay
    - Dreams allow them to be acted out, ensuring they don't bubble and disturb sleep
    - **Wish fulfillment** - how we wish things could be
    - **Manifest content** - details of a dream
    - **Latent content** - hidden meaning
    - These theories have been rejected by today's scientists since not everyone dreams, most dreams aren't positive or sexual, dreams aren't disguised
- **Activation-synthesis theory**
    - Hobson and McCarley, 1960-1970s
    - Dreams reflect brain activation in sleep, as opposed to a repressed unconscious wish
    - Dreams are just the brain making sense of random and internally generated neural signals during REM sleep
    - ACh surges turn on REM sleep, serotonin and NE are shut down
        - Reflective thought, reasoning, attention, memory decreases
        - Pons is activated, sends incomplete signals to lateral geniculate nucleus of the thalamus (relays sensory info to lang/visual areas of forebrain) which tries to assemble them into a meaningful story
    - Amygdala is active, adding fear, anxiety, anger, sadness, elation
    - This all leads to dreams
- **Solms** surveyed those with brain injuries
    - Damage to deep frontal white matter (connects cortex to lower brain) and parietal lobes leads to complete loss of dreaming
    - ∴ brain stem doesn't exclusively create dreams, must include forebrain
- **Neurocognitive theory**
    - There is more to the story

- Dreams are a product of our cognitive capacities, which then shape the dreams
- Parallel gradual development of visual imagination and advanced cognitive abilities

PSYCHOACTIVE DRUGS

- **Psychoactive drugs** – chemicals that interact with neural processes to change perceptions and moods.
- **Remember the neuron**? Different neurotransmitters relay different messages
  - **Excitatory neurotransmitters** → **increase** activity.
  - **Inhibitory neurotransmitters** → **decrease** activity.
- **Drugs interact with neurotransmitters**
  - **Agonists** – mimic neurotransmitters
  - **Antagonists** – decrease receptor site activity
  - **Reuptake inhibitors** – prevent the reuptake of neurotransmitters
    - Causes a longer response, either inhibitory or excitory



DEPRESSANTS – **reduce neural activity** and **slow body functions**. (Do not confuse depressants with anti-depressants!). Examples include **alcohol, barbiturates, Quaaludes, Valium**.

  - Slow brain activity, decrease CNS activity
  - **Sedative** - calming; **Hypnotic** - sleep inducing
- **Alcohol**
  - Why is alcohol a *depressant* if it produces *euphoria* and *energy*?
  - Information to brain slows, less activity
    - No excitatory PLUS more inhibitory activity
  - Alcohol *depresses* brain activity by acting as:
    - An **antagonist** that decreases the transmission of **glutamate** preventing excitatory transmissions.
    - An **agonist** that increases the transmission of **GABA** increasing inhibitory transmissions.
  - Alcohol produces a "lively drunk" because it **inhibits** judgments and impulse control. (It also **inhibits** memory and motor functions).
  - A **balanced placebo design** can be used to tease apart physiological versus psychological effects of alcohol.

- World wide, alcohol is the most widely abused drug. Young adults are at a particularly high risk for alcohol abuse!
- Check out Ryerson's Health Promotion Webpage: ryerson.ca/studentservices/healthpromotion/drugs/
- If people think they're drinking, they'll still be aggressive, flirty, humourous and relaxed
- They will not experience physiological effects
  - Motor coordination, reaction times, driving ability, perceptual activity
- Both groups, drunk and not, will have reduced judgment capabilities
- Setting affects effects, including drinking with others or alone
- BAC cut off: 0.08, some 0.05; 0.2-0.3: sedation occurs; 0.4-0.5: unconsciousness; 0.5+ can lead to death
- Body metabolizes alcohol at one shot (30mL) of whisky per hour
- No one knows how many brain cells are killed off by drinking, but brain damage and memory problems do occur with long-term abuse
- Coordination can be affected 10-12 hours after drinking
- 80% of traffic accidents are caused by binge drinking
- Acetaminophen increases toxicity of alcohol in the liver
- Your judgment is impaired before you seem intoxicated
- Blackout is losing memory while drunk, passing out is unconsciousness

- **Sedative hypnotics**
  - Sleeping pills/anxiety drugs (**barbiturates, Quaaludes (nonbarbiturates), Valium (benzodiazapines))**
  - Overdose is often fatal

Antidepressants increase NE or serotonin, or inhibit dopamine

Psychopharmacological drugs treat mental illness

STIMULANTS – **excite neural activity** and **speed up body functions**. Examples include **caffeine, cocaine, amphetamines, methamphetamines, and tobacco**.

- Increase CNS activity, speed up brain activity
- **Caffeine** acts as an **antagonist** that decreases **adenosine**, an **inhibitory neurotransmitter** that makes people **sleepy**. Blocks sleep.
  - With repeat doses, the body loses control of adenosine production, causing sleep issues - **tolerance**
- **Cocaine**, **amphetamines**, and **methamphetamine** produce a **euphoric rush** by affecting the **reuptake** and **presence** of **dopamine**. Affects dopamine transporters.
  - Overstimulation of reward centre and voluntary movements (motor functions)
  - **Cocaine:** Enhanced mental and physical capacity, stimulation, decrease in hunger, indifference to pain, sense of well-being, diminished fatigue
    - Comes from erythroxylum coca
    - Creates intense drive to use it

    - **Amphetamines**: using it occasionally doesn't create abuse when used to prevent fatigue or elevate mood
    - Using it off-prescription creates dependence and can lead to withdrawal depression, paranoia, etc.
  - **Methamphetamines speed up body functions**, which **boosts energy and mood**, but with devastating effects.
    - Extra dopamine spits out of the axon terminal, not reuptaken as meth fills vesicle spots
    - Speeds up bodily functions including aging
    - Stops the production of dopamine, leads to dependence
- **Tobacco/nicotine** acts as a **stimulant** by **activating receptors sensitive to** the neurotransmitter **acetylcholine** (AcH), producing a sensation of **relaxation** and **alertness**.
    - Kills 33 out of every 100 people who smoke

OPIATES (narcotics) are derived from the opium poppy. These narcotics **relieve pain, induce sleepiness**, and lead to a **sense of euphoria**. They are highly addictive. Examples include **heroin, morphine, and codeine**.

- **Heroin withdrawal syndrome:** Withdrawal painful as body stops producing natural opiates, cravings, nausea, chills, sweating, yawning, cramping
- Inhibit dopamine
- Tolerance builds quickly to the point that the high is never attained again, use is to avoid withdrawal
- Oxycontin is another opiate, can be lethal if mixed with alcohol and other drugs

PSYCHEDELIC DRUGS - are **hallucinogens** that **distort perceptions** and **evoke sensory images** in the **absence of sensory input**. Examples include **marijuana, mescaline, PCP, LSD, and Ecstasy**

- Both excitatory and inhibitory
- **Marijuana** is the **most frequently used** illegal drug in Canada. It acts on natural **cannabinoid receptors** in the brain (called **anandamide**) that **inhibit some functions and excite others**.
- **LSD** is an **agonist** that **binds to serotonin receptors** and may also **interact** with the **neurotransmission** of **dopamine**. LSD can promote **rich sensory experiences** but can also produce **paranoid delusions, panic, depression, and occasionally drug flashbacks**.
- **Ecstasy** (MDMA) mimics **serotonin** in the **reuptake** process, resulting in an "overflow" of serotonin in the synapse. Ecstasy acts as a **stimulant** and a **hallucinogenic** and has addictive properties.

Category	Examples	Action	Neurotrans.	Neuronal Effects	Effects
Depressants	Alcohol	Agonist	GABA	Increases inhibitory transmissions	Depresses brain activity, inhibits judgment and impulse control, inhibits memory and motor functions
		Antagonist	Glutamate	Prevents excitatory transmissions	

Stimulants	Caffeine	Antagonist	Adenosine	Decreases inhibitory transmissions	Stops sleepiness
	Cocaine, ampheta-mines	Reuptake inhibitor	Dopamine	Increase production of, block reuptake of	Euphoric rush
	Metham-phetamin e	Reuptake inhibitor	Dopamine	Blocks spots in vesicles so dopamine isn't reuptaken, instead flows out of neuron	Speeds up bodily functions, boosts energy and mood
	Tobacco	Agonist	ACh	Activates receptors sensitive to ACh	Stimulant, relaxes, increases alertness
Opiates	Heroin, morphine , codeine	Agonist	Endorphin	Increases inhibitory transmissions	Relieve pain, induce sleepiness, lead to a sense of euphoria; highly addictive
Psychedelics	Marijuana	Agonist	Ananda-mide	Increases inhibitory and excitatory transmissions, increases levels of dopamine and NE	Appetite/sensation/libido/heart rate increase, muscle relaxation, euphoria, alters sense of time, feelings of well-being, pain & nausea relief, glaucoma symptom relief; impaired memory & cognition (reversible), habit forming, psychotic episodes, anxiety & paranoia, poor grades & legal troubles, lung cancer, schitzophrenia
	LSD	Agonist	Serotonin, dopamine	Increases inhibitory transmissions	Rich sensory experiences, paranoia, panic, depression, drug flashbacks, confusion, bodily discomfort
	Ecstasy	Reuptake inhibitor	Serotonin	Blocks spots in vesicles so serotonin isn't reuptaken, instead flows out of neuron	Stimulant, hallucinogenic; addictive, high blood pressure, depression, nausea, blurred vision, liver problems, sleep disturbance, memory loss, damage to serotonin-reliant neurons

Common Neurotransmitters

- Glutamate (excitatory) - Participates in relay of sensory info and hearing

- Gamma-aminobutyric acid (GABA) (inhibitory) - Main inhibitory neurotransmitter
- Acetylcholine (ACh) (excitatory) - Muscle contractions in the PNS, cortical arousal in the CNS
- Norephinephrine (NE) (excitatory) - Brain arousal; Mood, hunger, anti-sleep
- Dopamine (inhibitory) - Motor function and reward
- Serotonin (inhibitory) - Mood and temperature regulation, aggression and sleep cycles
- Endorphins (inhibitory) - Pain reduction
- Anandamide (both inhibitory and excitatory) - cannibinoid; synthesized within lipid bilayer of neuronal membrane; pain reduction, increase in appetite

ADDICTION

- **Addiction** – compulsive drug **craving** and **use**.
  - **Action → pleasure → neural paths created → desire to repeat**
  - Using a drug once outside of prescribed used = drug abuser, not addict
- **Tolerance** – with **repeated** use, larger and **larger doses** are **needed** to experience a **drug's effect**.
  - Receptor cells are shut down, less neurotransmitters are created in the dopamine pathway
  - Drugs flood reward pathways with dopamine →
  - Brain becomes overwhelmed and shuts down receptor cells →
  - Higher and higher doses are needed to produce the same effect.
- **Drug dependence** – when a person becomes **dependent** on a drug for **normal functioning**.
  - **Psychoactive drugs** can **drastically alter** the **neurochemical balance** in the brain, **decreasing** the brain's **ability** to **produce** and **act** on its **own natural neurotransmitters**.
  - When the drug is withdrawn this can cause severe negative consequences (called **withdrawal symptoms**).
    - Can be deadly
    - **Physical dependence** - taking a drug to avoid withdrawal symptoms
    - **Psychological dependence** - taking a drug to avoid cravings
- Factors which affect addiction/drug tolerance
  - Exposure to drug/amount used
  - Expectations (positive or negative effect)
  - Personality/impulse control/sociability/propensity for negative emotions
  - Social conditions (friends, family)
  - Sociocultural influences (especially drinking)
  - Genetic predisposition
    - Strong physical response to alcohol decreases risk of alcoholism (ALDH2 mutation mainly found in people of Asian decent)
    - Gene on chromosome 15 leads to weak response to alcohol which is a predictor of later alcoholism (have to drink more to feel effects)
  - Age at time of use (prefrontal development, neural plasticity)
    - Younger = more likely to become addicted
  - Environmental stresses/trauma - brain is vulnerable
  - **Tension reduction hypothesis** - people consume drugs to reduce anxiety
- Is addiction a disease? Some argue that saying "yes" is giving addicts an excuse

OTHER ALTERATIONS OF CONSCIOUSNESS AND UNUSUAL EXPERIENCES

- **Hallucinations** - realistic perceptual experiences in the absence of external stimuli
    - Can affect any sense (hearing, sight, touch, etc.)
    - Can occur due to oxygen/sensory deprivation
    - Fantasy-prone people can hallucinate sometimes
- **Out-of-Body Experiences**
    - Not as uncommon as you'd think - 10-25%
    - Sense of self isn't locked to body
    - Often report other unusual experiences
    - Can be caused by medication, drugs, migraines, seizures, relaxation or stress
    - Ehrrson experiment - goggles show video of participant being touched as they're being touched, report OBE
- **Near-Death Experiences**
    - Often have an OBE
    - 6-33% of people report NDEs
    - Seem to represent beliefs of what death is
    - Peaceful feeling may be a release of endorphins
    - Sounds may be due to oxygen-starved brain
    - Typically occur when death ISN'T imminent
        - Electrical stimulation of brain's temporal lobes
        - Lack of oxygen in rapid acceleration during fighter pilot training
        - Psychedelic and anesthetic drug use
- **Deja Vu Experiences**
    - You've been there or done that before
    - 75% of people report this phenomena
    - Most reported by people who remember dreams, travel frequently, are young, have liberal political and religious believes, a postsecondary education, and a high income
    - Decreases with age
    - Excess dopamine in temporal lobes may trigger this experience
    - Seizures in right temporal lobe lead to feelings of DV
    - Resemblance between current and previous experience can trigger DV
- **Mystical Experiences**
    - Sense of unity or oneness with the world, transcendence of time and space, feeling of wonder and awe
    - Merging with God's presence, bliss, selfless peace
    - fMRI shows 12 distinct areas of the brain become active, including emotion, perception, cognition
    - Study had participants ingest psilocybin, a hallucinogenic drug which affects serotonin receptors, part of "sacred mushroom" used in religious ceremonies
        - Over half had mystical experience, claimed most meaningful/significant of life, reported life satisfaction (also extreme fears, paranoia)
- **Hypnosis**
    - A set of techniques which provide people with suggestions for alterations in their perceptions, thoughts, feelings, behaviours, typically to enhance calmness and relaxation
    - It is currently being scientifically measured
    - 15-20% are lowly or highly suggestible, while the rest are medium

- Can be used to aid cognitive-behavioural and psychodynamic psychotherapies, to treat pain, medical conditions and habit disorders (smoking, addictions)
- Whether benefits are from relaxation or hypnosis isn't known
- Stage shows and movies show false representations of hypnosis
    - Suggestions can be opposed at will when hypnotized
- Some suggestions alone work as well as when hypnotized
- No markers of being hypnotized have been discovered yet
- Brain activity varies by suggestion given
- Hypnosis does not resemble sleep, do not lose touch with surroundings, forget what happened while under hypnosis
- Memory is not enhanced by hypnosis, instead causes us to recall more inaccurate information, increases eyewitness confidence erroneously
- **Sociocognitive theory** - people's attitudes, beliefs, motivations and expectations about hypnosis, as well as their ability to respond to waking imaginative suggestions, shape their responses to hypnosis
- **Dissociation Theory**- separation between personality functions that are normally well integrated
    - **Hidden observer**- part of the consciousness is "unhypnotized"
    - Could just be further suggestion, therefore **flexible observer** shaped by expectations and beliefs
    - Bypasses ordinary sense of control we exert over our behaviours, so suggestions bring about responses with no effort or conscious control
- **Past-Life Regression Therapy** - therapeutic approach that hypnotizes and supposedly age-regresses patients to a previous life to identify the source of present day problems
    - Events are product of imagination

CHAPTER 6 LECTURE GUIDE

- **Learning** is relatively permanent change in an organism's behavior due to experience.
  - Cues (chlorine brings out competitive physical feelings in Dr. B)
- **Association** is when our minds naturally connect events that occur in sequence.
  - Sound of can opener (cats know food is coming)
- **Habituation -** process which allows us to respond less strongly to stimuli over time
  - Progressive decrease in release of serotonin
  - Evolution: allows us to keep focus on more important things, and only safe things can be habituated
- **Sensitization** - reacting more strongly to a stimulus over repeated exposures

- British Associationists
  - John Stuart Mill
  - Believe that almost all knowledge is acquired through conditioning
- Ivan Pavlov (1849-1936)
  - Russian scientist
  - Made an accidental discovery while studying the digestive system of dogs, labeled it classical conditioning
- **Classical Conditioning**
  - The **FOOD** is an **unconditioned stimulus (UCS),**
    - Already exists, reflexive; external
  - because it naturally elicits an **unconditioned response (UCR),** **SALIVATING**.
    - Whatever you want the CS to elicit
  - Classical Conditioning
  - The **TONE** starts out as a **neutral stimulus** **(NS)**
    - Focus of intent
  - because it does not naturally elicit the response.
  - During the **acquisition phase**, the **neutral stimulus** (**NS**), the **TONE**, is paired with the **unconditioned stimulus** (**UCS**), the **FOOD**…
  - **Classical conditioning** occurs when the **neutral stimulus** (**NS**), the **TONE**, becomes a **conditioned stimulus** (**CS**)
    - Triggers
  - that elicits a **conditioned response** (**CR**), **SALIVATING**.
    - Learned; typically weaker than UCR; may be opposite of UCR

UCS	UCR	NS/CS	Acq. Phase	CR
Food	Salivation	Tone	Tone + Food	Salivation
Altoids	Hand out	Shutting down sound	Sound + Altoid	Hand out
Loud Noise	Fear	Rat	Rat + Loud Noise	Fear
Drugs/Release of dopamine	Euphoria	Triggers (friends, stress, time, etc.)	Friends + doing drugs, etc.	Need for drugs to create euphoria
Dog treat	Desire for treat	Say "sit"	Say "sit" + treat	Sit on command

- **Higher order conditioning** – developing a conditioned response (salivating) to a conditioned stimulus (tone) by virtue of its association with another conditioned stimulus (assistant's footsteps = dog starts salivating).
  - Tone will elicit strongest response, assistant showing up lesser response, etc.
  - Second order conditioning
- John Watson (1878-1958)

    - American Psychologist
    - Examined the development of fear
    - Watson's Little Albert study
        - Since only one child, case study, little external validity
- **Stimulus Generalization** – similar stimuli elicits response.
    - Any small white animal will cause fear (bunny, etc.)
    - Get bitten by a dog, scared of ALL dogs (stimulus generalization)
- **Biological preparedness** – conditioning is most likely to occur when it benefits survival.
    - Hot things burn you, so you learn not to touch them
    - **John Garcia** - taste aversion: if it makes you sick, you will fear eating it again
        - Rats connect water bottles with radiation sickness
        - All animals typically connect being sick with ingesting something bad
- Applications: Phobias (repeat exposure to dogs without being bitten → desensitization), Advertising, Addiction (release of dopamine (CS) creates CR)
- **Indistinctive drift -** tendency for animals to return to innate behaviours following repeated reinforcement

- **Law of effect** – a behavior that **results in reward** will be **more likely to occur again** in the future.
    - Punishment has the opposite effect
    - Reward or punishment doesn't have to be intentional
        - If child wants attention and gets it (yelling), considered reward
        - If child is given something they don't want (broccoli), considered punishment
- **Operant Conditioning** - Learning that occurs when a behavior is followed by a reinforcement or a punishment.
    - Learning controlled by the consequences of behaviour
    - Behaviour = **operant**

	Classical	**Operant**
Target behaviour:	Automatic, trained	Voluntary, emitted
Behaviour is a function of:	Stimuli which precede behaviour	Consequences which follow
Behaviour depends primarily on:	Autonomic nervous system	Skeletal muscles
Reward/punishment is:	Independent of reaction (reward/punishment happens regardless of reaction)	Contingent on behaviour (no behaviour, no reward/consequence)

- **Positive** ***ADDS*** something and **Negative** ***REMOVES*** something.
- **Reinforcement** ***INCREASES*** behavior and **Punishment** ***DECREASES*** behavior.
    - Positive (add) Reinforcement (increase likelihood of behaviour) (add something pleasant)
        - Get good grades, be given $100, continue to get more good grades
        - Any reward
    - Negative (remove) Reinforcement (increase likelihood of behaviour) (remove something unpleasant)
        - Get good grades, have your curfew taken away, continue to get good grades
        - Academic probation removed
        - Add Aspirin, remove headache, likely to take Aspirin again
    - Positive (add) Punishment (decrease likelihood of behavior) (add something unpleasant)
        - Get bad grades, be forced to do more studying, work to not get bad grades
        - Extra chores, add yelling
    - Negative (remove) Punishment (decrease likelihood of behavior) (remove something pleasant)
        - Get bad grades, not be allowed to go to a party, work to not get bad grades
        - Take away phone, computer, etc.

- **Primary reinforcer** – objects or events that are naturally reinforcing.
    - Donut, candy, things that ensure survival
- **Secondary reinforcer** – an initially neutral object that becomes associated with other reinforcers.
    - Anything that you can use to get a primary reinforcer (money, good grades, etc.)
    - Socially constructed
- **Discriminative stimulus (S^d)** – stimulus that indicates the potential for reinforcement or punishment.
    - A cue that indicates the kind of consequence that's likely to occur after a response
    - Pull out a bag of candy → students know doing their work will get them a reward
    - "If you don't put on your shoes in 5 seconds, you'll be in trouble" signals potential punishment
    - Saying "sit" signals to a dog they have the potential to get a reward
- **Skinner Box -** electronically records and animal's responses and prints out a cumulative record of their activity

Intrinsic vs Extrinsic

- Works for reinforcements or punishments
- Intrinsic: do it for "me"
    - Get good grades because success feels good
    - More sustaining
- Extrinsic: do it for external reasons
    - Get good grades to make my parents happy, for money, etc.
    - Less likely to motivate

- **Acquisition** – a behaviour (NS) is paired with a consequence (UCS).
- **Extinction** – if the behaviour (CS) is no longer paired with the consequence (UCS), the response may end.
- **Spontaneous recovery** –the behaviour and consequence are remembered and may spontaneously appear.
- **Renewal effect** - effect goes extinct in a different environment, but returns when subject goes back to where CR was acquired
- **Stimulus generalization** – responding in the presence of stimuli similar to the original S^d.
    - Training a dog to sit by saying "sit" and using hand command
    - Soon enough, just "sit" or just hand command work
    - If we see a blank red hexagon, we still stop
- **Stimulus discrimination** – displaying a less pronounced response to CS that differ from the original S^d.
    - Tendency for a response to happen only when a particular stimulus is present
    - Weaker response to related CS, strong response to original CS
    - Raising your voice at someone else no longer causes a fear reaction in your child
- **Latent inhibition** - when one has experiences a stimulus alone many times, it is hard to condition it to another stimulus
- **Conditioned compensatory response** - cue-dependent tolerance to a drug (body balances effects of the drug when it knows that it's getting the drug - tolerance)
- Fetishes are likely conditioned sexual responses
- Disgust reactions are acquired with ease

SCHEDULES OF REINFORCEMENT

- Pattern of delivering reinforcement
    - **Continuous** - every time it happens
    - **Partial** - intermittent reinforcement

    - **Humphrey's paradox** - partial reinforcement after continuous reinforcement leads to less extinction
    - **Consistency of administering reinforcement**: fixed vs variable
    - **Basis of administering reinforcement**: ratio vs interval
- **Fixed** → predictable
    - Produce a pause after each reinforcer (FI Scallop)
- **Variable** → random
    - More consistent results, highest rates of response
- **Interval** → time
- **Ratio** → response
    - Higher rate of response
    - **Fixed interval –** reinforced after a set amount of time
        - Birthday gifts happen every 365 days
    - **Fixed ratio –** reinforced after a set number of responses
        - If you sell a bracelet, you get $9.99 every time
        - Multiple choice test
    - **Variable interval –** reinforced after a variable amount of time
        - If you check your phone for ?? minutes, you'll find a text message
    - **Variable ratio –** reinforced after a variable amount of responses
        - If you check your phone ?? times, you'll find a text message
- Fixed schedules lead to faster learning.
    - Dog gets a treat every time he sits
- Variable schedules are more resistant to extinction and lead to more consistent responding.
    - After a while, dog gets a treat every # time he sits
- Ratio schedules produce higher rates of responding than interval schedules.
    - If paid by the hour, workers won't work as fast as if paid a lump sum
- Fixed interval tends to produce a “pause” after each reinforcement.
    - As exam approaches, studying increases; once exam over, studying drops
- For best results, variable schedule
    - Include pop quizzes to increase studying
- Best uses of operant training:
    - Animal training
    - Overcoming procrastination
- Superstitious behaviours can be caused by operative learning
- Punishment:
    - Can be effective in the short term, BUT
    - Often indicates what *not* to do, not what *to do*.
    - Can create anxiety.
    - May encourage sneaky behaviour.
    - May model aggressive behaviour.
- **Shaping** – progressively enforce behaviours that come closer and closer to the target.
    - AKA shaping by successive approximations
    - First, force dog to sit, say "sit", give treat
    - Then, move to voice and hand motion
    - Then just hand motion
    - Then give reward less often
    - **Fading** - decreasing the frequency of reinforcements
    - **Chaining** - linking interrelated behaviours to form a series

- **Premack principles** – reinforce less desired behaviours with more desired behaviours.
  - Bargaining
- **Token economy** – Reward tokens for desired behaviours. The tokens can be traded in for rewards.
  - Gold star (secondary reinforcement) for good behaviour, 5 gold stars = candy (primary reinforcement)
- **Two-Process Theory** - both classical and operant conditioning are needed to explain the persistence of anxiety disorders
  - Classic learning teaches them to fear a dog after a bite
  - Operant learning causes them to avoid dogs, not allowing extinction
  - Negative reinforcement - anxiety subsides, causes them to repeat avoidance behaviour

Fiction	Fact
Skinner believed that genes played no role in human behaviour	Genes affect the ease with which people learn habits, but emphasis must be on study of environmental influences
Didn't believe in thinking or emotion	Believed that intelligent animals think and emote, but both are unobservable behaviours
Favoured the use of punishment as a behavioural technique	Opposed punishment for shaping human behaviours, believed in reinforcement instead
Any human behaviour can be conditioned	Didn't argue this ever
Denied the uniqueness of individuals	Acknowledges that all individuals are unique, product of unique genetic predispositions and unique learning histories
Devoid of morality	Advocated society in which people would be reinforced for ethical and co-operative behaviour

- **Behaviourism**: classical conditioning and operant conditioning are stimulus → response (S → R) models
  - Problem: we're not mindless, we have a choice (we know drugs are bad, but we do them anyway)
- **Cognitivism**: S → Organism → R models recognize the role of the organism in thinking about and interpreting stimuli.
  - Neither reward nor consequence are enough to motivate us either way
  - **Learning history** - training to react
  - Intepretation of stimuli also matters
- **Cognitive conditioning** – our interpretation of the situation greatly affects conditioning.
  - If told shocks will stop, sweating will end
  - Classical conditioning can only occur of the CS regularly predicts the UCS, creating expectations
- Tolman & Monzik study - we're always learning, we just choose when to exhibit behaviours based on reinforcement - it is our choice to perform
- **Latent learning** – we can learn in the absence of directly observable behaviours.
  - **Competence** - what we know
  - **Performance** - showing what we know
  - If nothing to gain, won't perform
- **Cognitive maps** – Mental representations of how a physical space is organized.

- **Radical behaviourism:** Skinner believed that observable behaviour, thinking and emotion are all governed by classical and operant conditioning - thinking and emotion are behaviours

- **Observational Learning** – learning by observing others.
    - Watch a cooking show
- **Social Learning Theory** – 4 conditions must be present for people to learn through observation:
    - The person must first **pay attention** to the model.
    - The person must be able to **remember** the behavior.
    - The person must have the **ability to replicate** the behavior.
        - Saying something to a baby won't work, they can't talk
    - The person must have the **motivation to demonstrate** what they have learned.
        - Get reward, avoid consequence
- Application: TV Violence, Aggression, and Fear
- Children who watch violence = more aggressive
- Correlational study
    - Controlled setting (internal validity)
    - Longitudinal study (external validity)
        - Established temporal order
    - Field study (external validity)
    - Factors: weakens inhibitions (everything is OK on TV), inspires aggression and new moves, primes feeling of anger/aggressive response (empathy for characters), reduces sensitivity/sympathy for victim, increases perception of danger/anxiety, watching violence activates endorphins/gives thrill/seek more
    - We feel fear when scary things happen to others (mirror neurons make it like it's happening to us)
        - Ordinary event + violence incites fear when we are in ordinary event ourselves
            - Subway, school, etc.
    - Operant - seek out scary movies
    - Observational - see others feeling fear
    - Classical - ordinary event + violence = fear

- **Insight Learning**
    - Wolfgang Kohler
    - Sudden understanding of the solution to a problem

Classical vs Operant Conditioning

- **Classical**
    - Response is automatic
    - Stimulus precedes response and elicits it
    - Learning results from automatic association
- **Operant**
    - Response is voluntary
    - Stimulus follows response and elicits it
    - Learning results from knowledge of consequences
- **Examples**
    - Dog chewing on shoe (bad behaviour)
    - **Operant**
        - Fixed ratio: shoe being chewed (predictable events)
        - Spray dog with water (positive punishment - add water, reduce bad behaviour)
        - Dog voluntarily avoids shoe
        - **Problems:** dog fears shoe, dog fears water, dog fears bottles
    - **Classical**

UCS	UCR	NS/CS	Acq. Phase	CR	Problems
Yucky spray	Disgust	Shoe	Shoe + spray	Disgust at shoe	- Could chew on something else = give a chew toy instead and reinforce that behaviour - Dog fears shoe

- Bedwetting
- **Operant**
  - Fixed ratio: bed wet (predictable events)
  - Give sticker, 5 stickers = candy (positive reinforcement - add sticker, increase good behaviour)
  - If bed peed, make child change sheets (positive punishment - add chore, reduce bad behaviour)
    - Child voluntarily doesn't pee the bed
    - **Problem**: kids don't usually have the ability to not wet the bed or they wouldn't anyway, children can't give consent/volunteer to do anything
- **Classical**

UCS	UCR	NS/CS	Acq. Phase	CR	Problems
Electrical alarm	Wake up	Full bladder/wet bed	Bedwetting + Alarm	Waking up to pee	May fear/pee when hears alarm sound

- When choosing between operant and classical, the ability to voluntarily do anything is important (animals, kids)

- Phobias are preparedness: evolutionarily predisposed to fear certain stimuli more than others, those which posed a threat to early ancestors
- Leads to illusory correlations (statistical mirage) between fear-provoking stimuli and negative consequences
- Evidence for this isn't totally consistent - as we have few exposures to these things, they may be more easily classically conditioned
- Could also be genetic predisposition

Sleep-Assisted Learning
- Listening to what you want to learn while you sleep

Accelerated Learning
- Mixes techniques to make learning faster

Discovery Learning
- Given an experiment, determine scientific principles on your own
- Direct learning more effective

Learning Styles
- Analytical, holistic, verbal, spatial

No evidence for effectiveness of any of these techniques

CHAPTER 7 LECTURE GUIDE

- **Memory** – the retention of information over time.
  - Sensory memory, short term memory, long term memory
  - Learned associations, knowledge
  - **Paradox of memory**: it's really good sometimes, and really bad other times
    - Mechanisms which serve us well an hinder us in other situations
- **Infantile autism** - lower than average intelligent, incredible memory (Kim Peek)
- Rajan Mahadevan - normal emotionally, exceptional memory - can remember 38,000 numbers of pi, but can not remember how to find the bathroom
- **Memory illusion** - false but subjectively compelling memory due to brain's general adaptive tendency to go beyond the information available to it
- **Encoding** – getting information into our memories.
  - Did not get the gorilla information into our memory in basketball passing example
  - Must be paying attention - if you are preoccupied, you will not remember
  - If we do not encode, the memory is lost forever
- **Storage** – keeping information in our memories.
- **Retrieval** –reconstructing our experiences from memory.
  - Name recall, taking an exam
  - When recalling, we **actively reconstruct** memories, we do not **passively reproduce** them
  - **Field memory** - viewing through your field of vision in a memory
  - **Observer memory** - view ourselves in a memory from a distance, proof that at least some memories are reconstructive

THREE SYSTEMS OF MEMORY

- Vary based on **span** - amount of information held - and **duration** - length of time memory lasts
- People believe there may be more than three
- **Sensory Memory** – automatically formed; holds information long enough to be processed for basic physical characteristics; raw materials of experiences
  - **Iconic Memory** - visual information (< 1 second) EYE-con, visual
    - **Eidetic imagery** - photographic memory, extended recall of iconic memory
  - **Echoic Memory** - auditory information (< 5 – 10 seconds) ECHO, audio
- **Short term memory** – a second memory system that can hold information for up to 20 seconds; work space for raw materials of sensory memory
- **Magic number**: 7 ± 2 (5-9 things can be remembered at one time without chunking), may be only 4
- Why so limited?
  - **Decay** over time
    - Birth of new neurons in hippocampus leads to decay there
  - **Interference** of new information
    - Number list study shows this is major factor in forgetting
- **Serial position curve:** recall accuracy varies as a function of an item's position within a study list
  - **Primacy effect**: remember items at the beginning.
  - **Recency effect**: remember items at the end.
- **von Restorff effect:** remember items that are distinctive.

ENCODING

- **Active encoding strategies** - short term memory operates as "working memory", can then hold more than 7 ± 2 for more than 20 seconds and then move it to long term
- **Working memory** - ability to hold on to information we are currently thinking about, attending to, or processing actively
- **Chunking** – organize items into meaningful groupings.
  - PAO / IT / DNCS / ML / BERU

- **Rehearsal** – repeating the information
  - ***Maintenance rehearsal*** – simply repeating information
  - ***Elaborative rehearsal*** – elaborate and link to meaning, connect new knowledge to old knowledge
- **Mnemonic [nih-MON-iks] –** any learning technique that aids information retention
  - Never Eat Shredded Wheat - north, east, south, west
  - My Very Educated Mother Just Served Us Nectarines - planets
  - **Acronym** - an abbreviation formed from the initial components in a phrase or a word
    - OCEAN - personality theory, big 5 personality traits; Openness, conscientiousness, extrovert, agreeable, neuroticism
    - HOMES - Huron, Ontario, Michigan, Erie, Superior - great lakes
    - ROY G. BIV - colours of the rainbow
  - **Pegword method** – associates a number rhyme with the information that you want to remember.
    - For example, want to remember apple, dog, house, beer in that order
    - Rhyme: One is a bun, two is a shoe…
    - Associate "bun" with the first thing to remember, apple = apple bun
    - Associate "shoe" with the second thing, shoe = dog with a shoe on, etc.
  - **Method of loci** – associates locations along a path with the information that you want to remember.
    - If you have numbered something, such as the aisles in a grocery store, you can relate numbers to those aisles. For example, cereal = 1, baking = 2, household = 3, pet food = 4. If you want to remember 4-1-2-3 you could remember pet food, cereal, baking, household
    - If you have a list of things, you just imagine them along a path you know well, such as walking around your house
  - **Keyword method** – think of a similar sounding work that helps you remember the target word.
    - Create a picture of a woman driving a car with a vulture on the hood to remember in French a car is "la voiture" - woman + vulture within a car
- **Levels of Processing** - depth of transforming information, which influences how well we remember it
  - Write things in your own words to more easily learn them
  - Visual processing
    - In example, is it all in capitals?
    - Worst way to remember something
  - Phonological (acoustic) processing
    - In example, does it rhyme?
  - Semantic processing: meaning
    - Connect to a hobby, something you know
    - Best way to remember something
    - In example, does it relate to the summer?
- **Long-term memory** – relatively enduring retention of information (lasting anywhere from minutes to years).
  - **Explicit** – can be known/declared (semantic [knowledge, left frontal cortex], episodic [events, right frontal cortex])
    - Knowledge, "know what", memory of an event, 1+1=2
    - Memories can go from here
  - **Implicit** - process/skills (procedural [motor skills & habits], priming [can identify something faster when we have seen something similar recently], conditioning [automatic], habituation [repeat exposure])
    - To here

        - Tough to articulate, automatic, "know how", tying a shoe, learning new vocabulary
- Differences between long-term and short-term memory
    - Short term holds much less and for a much shorter time
    - Short-term mistakes will be based on sound, we will remember "noodle" instead of "poodle"
    - Long-term mistakes are based on semantics, such as "terrier" instead of "poodle"
- **Storage** – Memories do not leave a physical trace (i.e., *engram*), instead they are maintained by stable and permanent changes in neural connections (i.e., *assemblies*) spread throughout the brain.
    - **Long term potentiation** – memories are associated with the gradual strengthening of neural connections in the hippocampus, frontal cortex, and amygdala.
    - Glutamate may play a particularly important role in long term potentiation.
        - LTP causes more glutamate to be released, activates postsynaptic receptors for NMDA and AMPA
    - Factual knowledge is processed in the hippocampus (esp. newer memories) and prefrontal lobes (esp. older explicit memories).
    - Emotional memories are processed in the amygdala.
    - The cerebellum and basal ganglia seem to be involved in the forming and storage of implicit memories.
    - Loftus & Ketchum - Memories are more a spiritual than physical reality. Touch them and they turn to mist.

RETRIEVAL

- **Retrieval cues** - hints that make it easier to recall information
- **Recall** – *retrieve* information learned earlier (fill-in-the blank exam)
    - Name of grade 3 teacher
- **Recognition** – *identify* items previously learned (multiple-choice exam)
    - Given a list of names, pick your grade 3 teacher out of the list
- **Relearning** – time is saved when learning material a second time (comprehensive exam)
    - **Distributive versus massed practice** - spread out learning works better than cramming (Ebbinghaus)
    - **Testing effect** - testing produces long-term learning
- **Tip-of-the-tongue phenomenon** - know the answer to a question but can not come up with it
- **Encoding specificity** - (Tulving) will have an easier time remembering something if we are in the same conditions we learned it in
    - **Context-Dependent Learning** - external context of original memories matches retrieval context makes recall easier
    - **State-Dependent Learning** - same physiological/psychological state for retrieval as for encoding makes recall easier
        - **Mood-Dependent Learning** - same mood for encoding/retrieval makes recall easier
        - **Retrospective bias** - current emotional state can distort memories
- **Memory Construction** – Our memories are constructed based on previous experiences – our brain fills in the holes and gaps in our memories to create a comprehensive picture.
- The storage and retrieval of memories depends on our *interpretation and expectations*.
    - Do you really remember paying for your groceries, or do you just assume you did since you always do?
    - **Priming** – increased sensitivity to certain stimuli due to prior experience
        - Unconcious, implicit memory
        - When you are exposed to something enough, it rises to the top of our consciousness
        - Constant exposure reinforces neural pathways for that memory/knowledge
        - When you research a new car, you'll find yourself seeing it more often than before
    - **Schema** – cognitive framework or concept that helps organize and interpret information.
        - Why we thought of "sleep" in example with rest, bed, etc.
        - A child can have a schema for a horse - four legs, tail, mane, short coarse hair

        - Then sees a cow - thinks it's a horse as a result
        - Duplicates horse schema only with additions for cow features
        - **Script** - how things go according to experience
    - Loftus false memories experiment - video of a car accident shown, term used for crash ("hit" vs" smashed) affected estimated speed of cars by 6km
- **Misinformation effect** – providing people with misleading information after an event can lead to fictitious memories.
    - Repeat questioning leads to creating false memories

CHAPTER 7 LECTURE GUIDE

- **Eyewitness testimony**
  - Juries believe eyewitnesses, especially if confidence
    - Confidence isn't always a sign of accuracy
      - Impairment
      - Kids are especially vulnerable, easily influenced
  - Hard to identify people of different races, when one is impaired (too dark, too noisy, etc.), when they talk to other witnesses first, when they only glimpse criminal, or when under stress
  - Sometimes use availability heuristic, remember someone they saw just before/after the crime
  - Weapon focus - focus on gun, not criminal
  - Police often influence witnesses, give false confidence
    - Witness wants to pick someone, even if they recognize no one
    -
- **Forgetting** can occur at any stage in the process:
  - Lack of attention – we don't process the details.
  - Encoding failure – information never enters our long-term memories.
  - Storage Decay – We tend to "prune" information over time: "**use it or lose it**"
  - Retrieval failure – failure to retrieve the information from long-term memory
    - **Interference** –Learning some items may interfere with retrieving others.
    - **Proactive interference** – earlier learning disrupts newer learning (stroop effect).
      - If you know how to play tennis and try to play racquetball, you'll find that you have to unlearn your tennis swing
      - PRO - new
      - **Stroop effect** - meaning of the word interferes with retrieving the colour in the coloured word example
    - **Retroactive interference** – new information makes it harder to remember information learned earlier.
      - If you know Spanish and learn Italian, you may say things in Italian when speaking Spanish
      - RETRO - issues with OLD memories/learning
  - **Amnesia** – severe loss of memory
    - **Retrograde amnesia** – difficulty remembering events prior to trauma.
      - RETRO - issues with OLD memories/learning
    - **Anterograde** – difficulty forming new memories from the time of the trauma on (more common).
    - Memory loss may be temporary or permanent. In the case of temporary memory loss memories typically reoccur gradually.
    - May affect explicit versus implicit memories differently.
      - Can LEARN new things, remember HOW to do things (implicit)
    - Clive Wearing has total amnesia, but implicit "how" memories remain like playing the piano
      - Procedural/muscle memory OK
      - Stored in the cerebellum and processed by the basilar membrane

        - Hippocampus deals with explicit memories, must have been damaged
- Memory over time
    - Memory changes as we age, but shows the same basic processes throughout life
    - Children's memories increase in sophistication with conceptual understanding and as they develop **meta-memory skills**.
        - **Meta-Memory Skills** - recognize, reflect on memories
        - Need to be able to create schematic connections
        - Infantile amnesia - hippocampus not developed fully
            - No self vs other, recognition of self until age 3
        - Young children over-estimate their memories
    - Memory span increases with age (until about age 12).
    - For some (but not all), memory begins to decrease starting at about age 65.
    - Amygdala provides emotion to memories, especially fear
    - Emotional memories last longer than non-emotional

Alzheimer's Disease

- **Alzheimer's disease** is the most frequent cause of **dementia** (50-60% of cases).
- Alzheimer's disease is associated with memory and language losses, consistent with cortical loss (esp. in neurons linked to acetylcholine, ACh).
    - Senile plaques, neurofibrillary tangles, loss of synapses, degeneration and death of Ach neurons
- Treatments for Alzheimer's disease:
    - Boost acetylcholine (ACh).
    - Some drugs block glutamate (which can be toxic in high doses)
    - Future: gene therapies that enable ACh neurons to survive.
- Correlates of reduced risk include:
    - Physical activity
    - Higher education and intellect
    - "Use it or lose it"
    - Correlation is not causation, is there a third variable?
    - Temporal order not determined

- Repressed memories?
    - Abuse happens
    - Forgetting happens
    - Theoretically possible to recover forgotten information
    - BUT hypnosis, drug state, dream analysis are not reliable
    - Memories before age 3 are not reliable
    - Stress ENHANCES the memory process normally
- **Flashbulb memories** - emotional memories that seem so vivid that people seem able to recount htem in remarkable, even photographic, detail
- **Phantom flashbulb memories** - false memories, even though they seem real
- **Source monitoring confusion** - lack of clarity about the origin of a memory
    - We try to identify the origins of our memories by seeking cues about how we encoded them
- **Cryptomnesia** - forget that an idea we think is novel came from someone else
- **Destination memory** - remembering to whom we have provided information
- **Suggestive memory techniques** - procedures which strongly encourage people to recall memories

- **Seven Sins of Memory**:
  - Suggestibility - misleading information, leading questions, explicit information and suggestions increase the change of our believing that fictitious events occurred
  - Misattribution - suggestions are effective as they lead us to misattribute memories to incorrect sources
  - Bias - schemas bias memories
  - Transience - memories fade with time
  - Persistence - Strong memories can reappear frequently
  - Blocking - temporary inability to access information
  - Absentmindedness - forgetting things

IMPROVE YOUR MEMORY

- In what ways can you use memory theory to improve your own memory and studying techniques?
  - Over-learn (practice)
  - Rehearse (elaborative)
  - Personalize
  - Use mnemonics
  - Study in exam-like situations
  - Test yourself
  - Look things up
  - Minimize interference
  - Sleep and dream

CHAPTER 8 LECTURE GUIDE

WHAT IS LANGUAGE?

- **Language –** a largely arbitrary system of communication that combines symbols (such as words or gestures) in rule-based ways to create meaning.
  - Communicate information
  - Express thoughts
  - Convey emotions
  - Maintaining relationships
- Language is highly practiced and automatic (you do not have to think much about using or interpreting language), but does not start out that way
- **Sound Symbolism** - the fact that certain word sounds seem to have intrinsic meanings
- Language develops early but comprehension precedes production

  - **__Pregnancy_____**: Begin to hear mother's native language(s)
  - **__At birth_____**: Prefer speech to non speech, recognize native language(s).
  - **__4 months_____**: **Babbling** (intentional vocalization that lacks specific meaning) of many speech sounds begin.
  - **__6 months_____**: Recognize own name and simple words (mommy, daddy)

- **__10 months_____**: Babbling resembles household language(s).
- **__12 months_____**: First meaningful words (**one word stage**)
- **__12 months +___**: Develop 20 to 100 word vocabulary
- **__2 years_____**: Combine words into meaningful phrases (more juice)
- **__2 years +_____**: Vocabulary includes several hundred words
- **__5 years_____**: Vocabulary includes several thousand words

- **Overextension** - using a word in a broader sense than adults do (all men are daddy)
- **Underextension** - using a word in a narrower sense than adults do (cat means only MY cat)
- Language involves five areas of the cortex!
  - Visual cortex, angular gyrus, motor cortex, Broca's area, Wernicke's area
- Language involves four levels of analysis:
  - **Phonemes** – the sounds of our language, sounds produced by elements of our vocal tract
    - ~ 100 phonemes across the world (~ 40-45 in English)
    - Babies < 10 months share same basic phoneme category
    - Babies > 10 months phonemes resembles native language
    - Fockers vs Fuckers
  - **Morphemes** – the smallest units of meaning (semantics), smallest meaningful unit of speech
    - A word
    - **Free morph**: ball, ear
    - **Bound morph**: re-, dis-, -ion, -ance
    - **Semantics** – meaning derived from words and sentences.
    - Babies can be measured as understanding morphemes starting ~ 6 months of age.
    - Babies produce first morphemes ~ 12 months of age.
  - **Syntax** – grammatical rules, grammatical rules that govern how words are composed into meaningful strings
    - Let's eat Grandpa. Vs Let's eat, Grandpa.
    - ***Morphological markers*** – grammatical elements that modify words by adding sounds that change meaning (- ed, past tense).
  - **Extralinguistic information** – context & interpretation, elements of communication that aren't part of the content of language but are critical to interpreting its meaning. (like syntax)
    - **Pragmatics** – one can infer what words and sentences mean from context, experience, assumptions, and social interactions. (adyl = blue)
    - **Dialects** – language variations used by a group of people who share geographic proximity or ethnic background.
    - Used for identifying insiders and outsiders
    - Informal and hard to learn

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BILINGUALISM

- The earlier the better! Before 7 in order to master pronunciation and grammar, dialect
- Usually one language is dominant (usually home language).
- Stages of language development the same, but syntax slowed.
    - Better meta-linguistic insight (awareness of language structure).
    - Enhanced executive control.
    - Boosts cognitive abilities, decision making
    - Enhanced executive control processes
    - Offsets some cognitive deficits that accompany aging
- Same brain areas used if second language is learned early, but different areas used if learned later in development.

SIGN LANGUAGE

- Sign language is a language developed by members of a deaf community that uses visual rather than auditory communication.
    - Involves own phonemes, words, syntax, and extralinguistic information.
    - Involves the same brain areas as spoken languages.
    - Involves the same developmental trajectory as spoken languages.
    - Babies will even babble in sign

CRITICAL PERIODS OF LANGUAGE

- Children deprived of language exposure (such as Genie) often develop only rudimentary language skills.
- Ages **one to seven** seem to be a sensitive period for language acquisition.
- The younger that you learn a new language, the better.
- **Sensitive period** - a period during which people are more receptive to learning and can acquire new knowledge more easily
- Newport's less is more hypothesis - children have more limited information processing abilities, fewer analytic skills, less specific knowledge about how language works than adults, so they learn it more naturalistically and gradually from the ground up, while adults try to impose organization, structure on their learning

THEORIES OF LANGUAGE

- Children often do not begin formal schooling until 5+ years of age and yet they show remarkable ability for language acquisition and understanding of syntax. *How?*

IMITATION ACCOUNT

- Language is *learned* through **association, imitation, and reinforcement** (e.g., we learn the language to which we are exposed).
    - Loss of phonemes supports this theory
    - Against this theory: kids overregulate, which adults do not do
        - Language is **generative** - it is a system which allows us to create an infinite number of sentences, producing things never uttered before
        - Kids and adults should learn a new language at the same rate
        - People are able to create new words ("internet", "thot", etc.)
        - Is it imitation or reinforcement through cheering when a baby says a recognizable sound?

NATIVIST ACCOUNT

- Children are born with a **mechanism for learning language**.
    - Language is **generative** - it is a system which allows us to create an infinite number of sentences, producing things never uttered before
        - Ability to create sentences we have not heard before
    - **Language acquisition device** - something in the brain preprogrammed with the rules of universal grammar
    - Children make ***overregulation errors*** ("run-ned" instead of ran) suggesting that children follow syntactic rules rather than imitating what they hear.
    - Human beings have evolved a capability for spoken language that has not developed in other animal species.
        - They have communication, but not range of language
    - Ability of babies to hear phonemes from birth supports this theory

SOCIAL PRAGMATIC ACCOUNT

- Children **infer** what words and sentences mean **from context and social interactions**.
    - Syntax, grammar are learned, but we understand grammatically incorrect sentences based on context
- Against: children would have to know a lot about the thoughts of others, there are simpler explanations

GENERAL COGNITIVE ACCOUNT

- Language is learned from **general skills** that children apply across a variety of activities (such as the ability to **perceive, learn, and recognize patterns**).
    - The ability to perceive language patterns exceeds other patterns
    - Teach one group words, other group no words - it makes the job of thinking easier, but thinking does not stop

LANGUAGE AND THOUGHT

- **Linguistic determinism** – all thought is represented verbally and that our language therefore defines our thinking
    - Hellen Keller says that she did not think as deeply before words
    - Compare language with 1 word for something to language with many words for it
        - Just use adjectives to make word more descriptive
        - Conclusion does not support LD

    - Against: language areas are not always active when thinking, and paralysing oneself does not stop thought
- **Linguistic relativity** – view that characteristics of language shape our thought processes (Sapir-Whorf hypothesis)

READING

- Like language, reading becomes an automatic process
- We often cannot turn it off, even if we want to:
    - Remember the Stroop test? We read coloured words, can not see their colour
- Learning to read:
    - Realize that writing is meaningful.
    - Writing moves in a specific direction. Left to right
    - Learn to recognize letters of the alphabet.
    - Learn that printed letters correspond with sounds. A is for apple
    - Whole word recognition (**sight words**).
    - Phonetic decomposition (sounding out words, **phonics**).
        - Words often not pronounced as they read
        - We need both to learn reading best
- *There is a speed-accuracy trade-off (speed reading is a myth)*
    - As long as you're under 400 words per minute, comprehension should still be good

THINKING AND REASONING

- Humans are not computers! Unlike computers, humans have the ability to *explore* and *interact* with the world, learn from *experience*, and to ***adapt***.
- Given the complexity of thinking our brains are ***cognitive misers*** – using shortcuts that help streamline the thinking process…
    - **Heuristics** are mental shortcuts that help us streamline our thinking (e.g., representative and availability heuristic).
        - Bias, sexual appeal, etc.
    - ***Top-down processing*** (Chapter 4) and ***schemas*** (Chapter 7) help us to quickly organize the world around us.
    - **Concepts** - our knowledge and ideas about a set of objects, actions and characteristics that share core properties (all dogs pant, all walls are sturdy)
        - **Schemas** - concepts about how things are related (how to wait for the doctor)

DECISION MAKING

- **Decision making** – process of selecting among a set of possible alternatives.
- Wilson et al. (2002) art appreciation study
    - When a decision is **emotional, thinking can get in the way** (especially when the decision is emotionally complex).
        - Fight or flight, driving a car, flying a plane, etc.

    - Yet, when a decision is **informational** (such as when making scientific decisions), making an **intuitive decision can be biased**.
        - Hiring decisions are very open to bias
    - Study shows going with your gut is better
    - Gut = implicit, list of pros/cons = explicit
- **Framing** – how we formulate the question that we need to decide.
    - Typically describing political, media practices
    - Inevitable process of selective influence over the individual's perception of the meanings attributed to words or phrases
    - Heuristically appealing - 50% win vs 50% lose

PROBLEM-SOLVING

- **Problem-solving** is **generating a cognitive strategy** to accomplish goals.
    - Algorithms versus heuristic?
    - **Algorithm** - step-by-step learned procedure used to solve a problem
    - Is it bias or based on fact/processes?
- **Salience** – how **attention grabbing** something is.
    - Image then information for a car based on looks; info then image for a car based on facts
- **Mental sets** - inhibited by our inability to generate alternatives.
    - Can not connect the dots as we do not think beyond the square
- **Functional fixedness** – difficultly conceptualizing that an object typically used for one purpose can be used for another purpose
    - Drill with scissors instead of hand mixer