Chapter 1

Thinking Critically With Psychological Science

Psychology is a science, it is the study of how we think, feel, and behave.
Every aspect of human life relates to psychology.

A - The Need For Psychological Science

1. **Limits intuition**

Intuition has values and sometimes we should listen to them, but we can't use them to study psychology because it can be unreliable.

2. **Limits of common sense**

Common sense doesn't generate new knowledge, it's the result of already learning or experiencing something.
Hindsight Bias (I knew it all along phenomenon) - thinking we can predict something which we actually can't, because we need all the facts to predict something (9/11 people stayed in a burning building).

3. **Overconfidence**

We tend to think we know more than we do.
We are ignorant about how ignorant we are (going on moons, building planes)

4. **Illusory correlation**

We perceive a relationship between two things that don't actually have a relationship. This affects how we think, feel, behave, and what we pay attention to (friday the 13th, black cats being bad luck).

5. **Perceiving order in random events**

Making an order when there is no order to feel better.

B - The Scientific Attitude

To be a better thinker, we need to be curious and open-minded.
Be skeptical: don't be too gullible that you're gullible, be aware.
Be humble: we all make mistakes, others have something to offer too.
Caution: science is always evolving.

C - The Scientific Method

What makes a field of research a science is if it follows the scientific method.
In science, everything begins with **observation**. What starts with casual must become problematic.
After observation, move on to **theory**.
Theory is an attempt to explain observations. It organizes and summarizes explanations.
After theory, move on to **hypothesis testing**. Your theory isn't always true.
Hypothesis testing is when you extract an idea from your theory and test it using rigorous scientific methodology.

One scientific rule when testing hypothesis is to **operationally define variables** (state with clarity and precision how you measured your variables).
Always be **optimistic**.
After hypothesis testing, **repeat test** with different subjects. If you get similar results, you become more confident in your study.
After repeating tests, use **results to generate or refine new theories** and process starts all over again.

Types Of Research Studies

A - Descriptive Research
The purpose is to observe and describe what you observe.

1. **Case study**

An in depth investigation of either one person or a small group of people.
Researcher gathers any piece of information that is relevant.
Advantages: **1)** this is the most in depth research you can do. **2)** it can be an excellent first step, especially for something we don't know much about. **3)** it allows us to document and preserve information about rare cases before it's lost. **4)** it allows us to have a glimpse into human nature and learn about humans.
Disadvantages: **1)** the sample is too small and you can't generalize. **2)** the researcher can be biased and can filter results through his own beliefs.

2. **Survey**

Asking a large sample of people a question that interests the researcher.
It is impossible to survey every single person, therefore we generalize.
In order for the survey results to be viable, we must have a **representative sample** (characteristics of sample must match characteristics of population).
We achieve **representative sample** by using **random sampling** (no choosing subjects).
Random sampling is when only chance determines who will be apart of sample, and when every person in the population has an equal chance of participating.
Advantages: **1)** super easy to do. **2)** cheap. **3)** we can reach a large number of people, and include people who aren't usually included (illiterate). **4)** sometimes, the only way to find out is by asking.
Disadvantages: **1)** people can lie intentionally and unintentionally. **2)** surveys are very sensitive to the words used. Also, if a guy is asking girls about abortion, it can cause different answers.

3. **Naturalistic observation**

The researcher does research in the real world.
The number one rule is that the researcher must never interfere, only observe.
Advantages: **1)** doesn't get more real than this (real world, real behaviours). **2)** allows researchers to discover things we may never discover in labs.
Disadvantages: **1)** researcher bias. **2)** even if the researcher doesn't interfere, just his presence can be an affect (has to blend in).

B - Correlational Research

The purpose is to allow us to observe, describe and make predictions. It also allows us to find out if there is a relationship between two variables.

Three major questions

1. **Do the variables covary?**
2. **In what direction do they covary?**

Could be positive or negative.

Positive correlation: when one changes, the other changes and they both change in the same direction (attendance goes up, grades go up).

Negative correlation: when one changes, the other changes and they boh change in opposite directions (attendance goes up, fails go down).

3. **To what extent is the relationship between the variables?**

How strong or weak is the relationship.

Correlation coefficient: **r** (varies between -1 and +1).

R = 0 = no relationship

R = -1 = perfect negative correlation

R = +1 = perfect positive correlation

Ex. 0.13 = weak and positive. 0.88 = strong and positive. -0.88 = strong and negative.

Advantages: **1)** excellent first step to see if a relationship exists. **2)** sometimes it's the only way, other methods would be unethical (won't make a pregnant woman drink to see if dangerous). **3)** describe and predict. Once you know there is a correlation between two variables, having information on one allows us to make predictions about the second.

Disadvantages: **1)** you cannot say A changes B (eating ice cream causes drowning).

C - Experimental Research

We observe, describe, predict, and infer.

This is the **only** type of research where we can talk about **cause and effect** (A affects B) because in experimental research, the researcher will measure the variable of interest, and because the researcher is going to control all other independent variables which can affect his results.

Independent variable: affects another variable, this is the variable the researcher will control.

Dependant variable: the variable being affected by IV, this is the variable the researcher will measure.

To **manipulate the IV**, the researcher must create two groups of IV.

Group 1: experimental group (subject is exposed to IV).

Group 2: control group (subject is not exposed to IV).

The researcher sees if there were changes between the ones exposed and not exposed to IV.

The researcher must **control all other IV's**, which are IV's he's not interested in but can still affect results.

If he doesn't, then he won't know what changed the DV (if we want to see if milk makes bones stronger, we have to make sure the subject isn't weight-lifting).

If he doesn't control all other IV's, they become **confounding variables** and he won't know what caused what.
There is no way to know everything about something, but we still have to control IV's by doing **random assignment**, which is when chance determines which subject is in group 1 or 2, and it's also when every subject has an equal chance of being in either group.
When doing research to test the effectiveness of a drug, we must control for the **Placebo effect.**
Placebo: a fake treatment that has no therapeutic value.
Placebo effect: giving a placebo to a person unknowingly and they believe they are getting better. They can actually get better based on **belief only** (prozac/placebo study).
Blind procedures are when the subjects are kept in the dark of the study to control **subject bias**, if the subject knows what you're doing it can change how he acts which ruins results.
Double act procedure is when you keep the subject and research blind to prevent subject and researcher bias (giving two types of treatment to researcher to give to patients unknowingly).

Statistical Reasoning

Stats are math tools which help researchers describe data.
Two types of stats.

A - Descriptive stats
Allows researchers to organize, summarize, and describe their data in an understandable way (bar graph, %).
Measures of central tendency in descriptive stats is when the researcher has an idea about the typical score in his distribution of scores.

Mean

The math average of scores. **Caution**, extreme scores can inflate/deflate scores distorting it.

Median

Ranging a distribution of scores from highest to lowest, the median is the middle number of the distribution. **Caution**, although it is not affected by extreme scores, it is only based off one number so we lose lots of our data.

Mode

The most frequently occurring score in a distribution. **Caution**, the most frequently does not mean the most typical.
Measures of variability is that scores in a distribution of scores will differ. It allows researchers to have an idea of the typical difference between scores.

- **Range** is the gap between the lowest and highest scores. It limits a lot since it only takes two scores and misses a lot of information which could distort information.
- **The standard deviation** is a much better way of measuring than range. It takes into consideration every score, and looks at the difference between every score and the mean. It gives averages between the score and the mean. When scores are clustered around the mean, the variability is lowered and the SD will be smaller. If scores are widespread around mean, variability is higher and the SD is larger.

B - Inferential Stats

Inference: a conclusion reached from evidence and reasoning.

It allows the researcher to make inferences from his data, and allows him to generalize it. It also allows the researcher to determine if the results are statistically significant to draw conclusions.

When results are statistically significant, they are not likely to be due to randomness. Instead, they are more likely to reflect real differences or relationships between data.

The results are considered to be statistically significant when **p is = or less than 0.05.**

Chapter 2

The Nervous System

Breaks down into the **Central NS** (brain and spinal cord) and **Peripheral NS** (rest).
The NS is a communication network. It receives information from the environment, organizes the information, uses the information in order to send out messages to muscles and glands. The NS also controls emotions, behaviours, etc. and is responsible for your conscious experiment.

Neurons

A - Neurons Are The Basic Unit Of Communication In NS
The neurons main job is to receive and deliver.
Three types of neurons

1. **Sensory neurons**

Receives information from the environment and transmits it to the brain (from eyes/ears).

2. **Interneurons**

Found only in CNS. They create neural circuits to enable communication between sensory neurons and motor neurons, and they also organize information.

3. **Motor neurons**

Receives information from the CNS and transmit to muscles.
Cell body/soma is where you find DNA. It manufactures everything neurons need to function.
Dendrites receive information from other neurons.
Axon is where the information is passed to, which is then turned into an electrical impulse (action potential). The axon carries the AP away from the cell body to the terminal branches.
Terminal branches release the information (NTs) to other neurons by forming junctions with other neurons.
Myelin sheath is a white fatty substance covering the axon. It insulates the axon and also speeds up APs. healthy myelin sheath are important to staying healthy.
Synapse is where neurons meet to communicate.
Synaptic cleft is a tiny space between two neurons at the synapse.
Presynaptic neuron is a neuron that sends out the message.
Postsynaptic neuron is a neuron that receives the message.

B - Communication

When a neuron decides to communicate, it fires an AP which travels all the way down the axon and releases NTs.

This is an **electrochemical process**.

Our brain is 8% water and has dissolved Na+, Cl-, and K+ ions. These are found inside and outside neurons in different concentrations. The concentrations differ depending on what goes on with the neurons.

When the **neuron is at rest**, it is not sending messages. It also has more negative ions inside, therefore it is more negatively charged inside the neuron. There are more positive ions outside, therefore it is more positively charged outside the neuron. At rest, the neuron is at -70mV. At rest, the membrane is polarized.

At rest, the neuron still receives messages.

Two types of messages

1. **Inhibitory**

Instructs the neuron not to fire, and they change the concentration of ions making the inside of the neuron more negative (-70mV to -75mV). The neuron is less likely to fire. The membrane is hyperpolarized.

2. **Excitatory**

Instructs the neuron to fire, and they change the concentration of ions making the inside of the neuron less negative (-70mV to -65mV). The neuron is more likely to fire. The membrane is depolarized.

The neuron fires when neuron is -50mV to -55mV, known as **threshold of excitation**.

AP is an all or none phenomenon, when it fires, it fires. APs have same strength from beginning to end. APs travel down the axon in a domino-like manner.

Between the two neurons, the presynaptic neuron fires. In terminal buttons, we have **synaptic vesicles**.

Synaptic vesicles are little bags which hold the NTs. they attach to the membrane, burst open, and release NTs. the NTs end up in the synaptic gap, where they cross the gap and attach themselves to receptor sites and deliver messages to the neuron.

Once the message is transferred, the NT deactivates.

It can deactivate with **reuptake** which is when the NT is reabsorbed by the first neuron and is repackaged and reused. Another way is with **degradation** which is when an enzyme comes and breaks down the NT. a third way is **diffusion**, when the NTs simply drift away.

The NT has to be deactivated because if not, it'll keep delivering the same message over and over again, which will overexcite or overinhibit the NS.

Neurotransmitters are chemicals that neurons use to deliver messages to other neurons. Healthy levels of NTs are needed for healthy functioning, physically and mentally. An imbalance of NTs can be unhealthy (dopamine makes us happy. Too much dopamine can make us hallucinate. Too little dopamine can make us depressed).

You can balance your dopamine by running, etc.

Acetylcholine - enables muscle action, learning, memory. With Alzheimer's, ACh producing neurons become worse.
Dopamine - influences movement, learning, attention, emotions. Too much is linked to schizophrenia, too little is linked to tremors and loss of motor control in Parkinson's disease.
Serotonin - affects mood, hunger, sleep, arousal. Too little is linked to depression, there are drugs which raise serotonin levels to treat depression.
Norepinephrine - control alertness, arousal. Too little can depress mood.
GABA - a major inhibitory NT. too little linked to seizures, tremors, insomnia.
Glutamate - a major excitatory NT, involved in memory. Too much can overstimulate the brain which causes migraines or seizures (in MSG in food).

C - Drugs And The Brain
Drugs reach the brain and affect you at the synapse.
Drugs interfere with the communication of neurons.
Three levels of interference

1. **Presynaptic neurons**

Could increase, decrease, or prevent the release of NT.

2. **Activity in the cleft/gap**

Could interfere with degradation or reuptake by enhancing, decreasing or blocking it.

3. **Postsynaptic neurons**

a) Drug molecules could **lock** on receptor sites and **mimic** NTs.
b) Drug molecules could **lock** on receptor sites and **block** them, so they won't deliver but NTs won't deliver either.
c) Drug molecules could **lock** on receptor sites in a way that allows NTs to attach as well, but the drug will enhance or weaken the message.

Two types of drugs

1. **Agonists**: enhance, increase activity of NT.
2. **Antagonists**: block, decrease activity of NT.

Brain

The brain is 2% of our body weight but it uses 20-25% of the glucose in our body.

A - Tools Of Discovery

Clinical observation is the oldest method and at one point was the only method. It is still being used today.

We systematically observe people with brain damage/tumors and we systematically describe what we observe.

Brain manipulation is when the researcher intentionally interferes with the functioning of the brain then systematically describes the results of his manipulations.

Brain manipulation methods include

1. **Surgery** (removing part of the brain, removing neurons, etc.)
2. **Adding chemicals**
3. **Electrical** (implant electrodes)
4. **Magnetic field** (exposing brain to magnetic field)

EEG allows us to see the brain in action. Electrodes pick up electrical activity and show how the brain works, responds, etc. This method is safe.

Four neuroimaging techniques

1. **CT scan**

Uses X-ray technology to take multiple pictures of brain from different angles. It doesn't allow us to see the brain in action, we can only see the structure of the brain (tumors, strokes).

2. **MRI**

It doesn't allow us to see the brain in action. We can see the structure of the brain (tumors, strokes). MRI exposes the brain to high magnetic fields, which causes tissues to release electromagnetic signals, which are used to create detailed pictures of the brain.

3. **PET scan**

You are injected with radioactive glucose which is tracked by a machine. The more active an area of the brain is, the more glucose it consumes. The picture is colourful, which lets us know which part of the brain is in action more.

4. **FMRI**

It allows us to see the brain in action. It is safe. You are exposed to powerful magnetic fields, and a machine tracks the flood flow to the brain. The more active an area of the brain is, the more blood flow to it. It also produces a colorful image.

B - Tour Of The Brain

Lower brain structures

- **Brain stem** starts where the spinal cord ends. All information coming/leaving the brain goes through the brain stem. Researchers believe analysis of research starts in the brain stem. It's the crossover point (information on right crosses to left). It is considered the life centre of the brain because it contains structures that control vital functions, like **medulla** (controls heartbeat, breathing, swallowing, vomiting) and **reticular formation** (linked with arousal, waking/sleeping, cases of coma).
- **Thalamus** is on top of our brain stem. All information collected by sense (except smell) go to the thalamus, which sends it to different parts of the brain. All information from higher brain areas go through thalamus which relays it to lower brain areas. It filters important information and controls arousal, motivation, attention.
- **Cerebellum** is known as the little brain. It controls muscle tone, balance, posture, movements. It is associated with learning motor skills which become automatic (writing). Only 1/10 brain volume but over half of the brain neurons are in the cerebellum. Neurons in cerebellum have 20x more synapses. It is involved in cognitive functions (learning, memory, creativity, language, creation of human culture). When you drink, your cerebellum is drunk.
- **Limbic system** has multiple structures. It is linked with learning, memory, emotions, motivation. **Amygdala** is linked with aggression, emotions (mainly fear), perception of emotions, formation of emotional memories, stress response, can detect threats. **Hypothalamus** sits under the thalamus and is the size of a pea but is powerful. It is known as the brain within a brain. It controls drug, hunger, thirst, sex. Responsible for maintaining homeostasis and controls autonomic system and endocrine system. **Reward deficiency syndrome** is where people have low levels of dopamine activity, and they seek drugs, food, gambling to pump up pleasure pathways.

Cerebral cortex is the youngest part of the brain but also the most complex part of the brain. Humans have the most complex cerebral cortex. Is it responsible for higher function. ⅓ of the cortex is visible, the rest is hiding in valves and grooves. It has **glial cells**, which are considered to be the nanny of neurons because they provide neurons with structural support and produce myelin. Glial cells outnumber neurons. Glial cells are more than just nannies, they are involved in giving neurons nutrients, providing structural support, building myelin sheaths, cleaning after neurons, disposing of dead neurons, information processing, mental functioning (learning, memory, creativity, intelligence). It is divided into **two hemispheres**, which are connected by the **corpus callosum** (a bundle of nerve fibers that the two hemispheres use to communicate). **Primary areas** are found in each lobe and are linked with the processing of either motor or sensory information.
Primary visual cortex is located in the **occipital lobes** and process visual information.
Primary auditory cortex is located in the **temporal lobes** and process auditory information.

Primary sensory cortex is located in the **parietal lobes** and arches from one ear to the next. It receives information from the skin, muscles, joints, and process information relating to touch, pain, temperature. It is also known as **primary somatosensory cortex**.
The right part of the parietal lobe receives information from the left side of the body, and the left parietal lobe receives information from the right side of the body.
The size of a body part has nothing to do with the size of the area the brain devotes to it.
Primary motor cortex is located in the **frontal lobes** and arches from one ear to the next. It controls voluntary movement.
Association areas are found in each lobe and are linked with more complex mental functioning. The association areas are also involved in the processing of complex motor or sensory information.
Frontal lobe: attention, planning, thinking, impulse control, decision-making, emotions.
Temporal lobe: language, music, memory.
Parietal lobe: nonverbal thinking, sense of space.
Occipital lobe: processing visual information.

Brain Reorganization
Researchers believed and taught that once human brains matured, it stayed the same unless diseases, injuries, or ageing. They were wrong.
Researchers discovered that the brain is plastic, and it changes with experience, even if old.
Plasticity is that an area of the brain can increase or decrease in function by experience. A healthy area can take over for the functions of a damaged area. An area of the brain can be larger and have more synapses, or can be smaller with less synapses due to experience.
Neurogenesis is the ability of the brain to produce new neurons even in old age.

C - Our Divided Brain
Functional asymmetry. Two hemispheres carry out functions, but each hemisphere has its own expertise and its own things to do.
Both hemispheres work together to produce behaviours, emotions.
LH more linked with language. RH more linked with music. Still active in both though.
Split brain patients suffered from epilepsy and doctors cut their corpus callosum.
Information flashed to **right visual field** goes to LH, and information flashed to **LVF** goes to RH.
Normal brain - flash to RH, LH still knows.
Split brain - flash to RH, LH doesn't know.

Spinal Cord (CNS)
A highway for information, all information the body sends to the brain or brain sends to the body goes through the spinal cord.
Pattern generators are controlled by the brain and produce rhythmic movement (walk, swim).
Spinal cord controls **spinal reflexes** (unlearned behaviours) which is good for survival.

Peripheral NS

Connects the body to the CNS, and its main job is to carry information between the 2 NSs.
PNS consists of all the nerves in our body other than CNS.

Two main divisions

1. **Somatic NS**

Has two main functions, **sensory functions** (information collected by sense sent to CNS by sensory neurons) and **motor functions** (motor information sent from CNS to skeletal muscles by motor neurons).

2. **Autonomic NS**

Controls glands, organs, visceral muscles.
Breaks into two divisions

a) **Sympathetic**: energizes the body, prepares the body for fight/flight, linked with stress response.
b) **Parasympathetic**: conserves body energy, calms body, helps body repair itself.

Endocrine System

A major communication network which consists of all the glands in your body. These glands release **hormones** into the bloodstream.
Hormones are chemical messengers which carry messages from the endocrine system to the body and brain.
Examples of hormones are **homeostasis** hormones, **reproductive** hormones, **stress** hormones.
Keep in mind that short-term stress is good for us.

NS And Endocrine System

Distinct systems which influence each other.
ES affects the brain and body with hormones, however, the brain controls the ES.

Pituitary Gland

Master gland, controls all other glands in the ES.
It is controlled by the hypothalamus.
Hormones influence thoughts, behaviours, emotions.

Chapter 6

Sensation And Perception

A - Basics of Sensation

Three musts

1. **Detection**

We must be able to detect physical energy in the environment.
Humans can't detect everything (dog whistle).

2. **Transduction**

The physical energy detected must be transduced (translated to a message the brain understands). The brain doesn't understand physical energy, it understands electrochemical messages (APs and NTs).

3. **Transmission**

The translated message must be transmitted to the brain for further processing.
Sensory receptors are highly specialized receptors found in sensory organs. They detect, transduce, transmit.
Bottom-up processing is applied in sensation. It starts with basic elements then builds up.

B - Measuring The Senses

1. **Psychophysics**

The scientific study of the interaction between the physical characteristics of the world and our psychological experience of them.

2. **Absolute threshold**

The minimum amount of energy that must be there to detect it 50% of the time.
It's not enough to just detect something, it has to be strong enough to detect it.

3. **Difference threshold**

The minimum difference in stimulation that must take place to detect it 50% of the time.
The DT can vary from one person to another, because maybe one can detect it but others can't.
It is not enough to detect physical energy, it is essential for survival to detect changes in physical energy.
Weber's Law states that for an average person to perceive a difference, two stimuli must differ by a constant minimum percentage.

4. **Signal detection theory**

Our ability to detect physical energy doesn't only depend on strengths, other factors influence it as well (knowledge, past experiences, emotions, motivation, expectations) (detecting bombs in an airport)

5. **Subliminal persuasion**

Persuading someone in a way without them being aware of what's going on.

C - Sensory Adaptation

With repeated exposure to unchanging and unharmful stimulus, senses reduce or stop responding.
This is valuable because

1. The world is filled with stimulation, if the stimulation is not harmful, it is important to tune it out or our nerves can become hyperstimulated which is not good.
2. Our attentional resources are limited, we tune out stimuli that are not important to focus on stimuli that are important (some which could be dangerous - important for survival).

Circumventing SA is when SA does not occur. When in **intense pain**, SA doesn't occur because pain means something is wrong, and tuning out pain can lead to trouble. SA also does not occur in **eyes**, because if it did, small objects would disappear which could be dangerous.

Basics of Perception

Sensory information is sent to the brain. The brain processes, analyzes, organizes, integrates, and interprets information in a meaningful way.
Perception is a **top-down process**, which is when the brain uses past experiences, beliefs, values, expectations to analyze information (when shown half a face, we fill the other half).
It is possible to **have sensation but no perception** (prosopagnosia - eyes work but can't recognize people. Recognize voices but not faces)
It is possible to **have perception but no sense** (seeing a fire but there is no fire).

Influences On Perception

1. **Perceptual set**

A mental predisposition to perceive life and its events in a specific way (comes from our parents, religion, culture).

2. **Context effects**

Context is important because it controls how we perceive life and events.

3. **States of being**

Mood, emotions, health, motivation will affect how we perceive life and events.

Vision

A - Stimulus

In order to see, there must be **light**.
Light is a form of electromagnetic radiation and travels in a wave. It is a part of the electromagnetic spectrum.
We call it visible light because we can detect it (400-700nm).
Wavelength is the distance between two peaks. It is a physical characteristic that is translated to colour or hue. Colour is perceived by the brain.
Red is a **long WL**, **green** is a **medium WL**, **blue** is a **short WL**.
Amplitude is the height of a wave. It translates into the psychological experience of brightness. Brightness is perceived by the brain.
Long WL = low freq, short WL = high freq, great amp = bright colours, small amp = dull colours.
http://notebro.com/forum/viewtopic.php?f=2&t=323
http://www.blackwellpublishing.com/intropsych/lecturer/testbankqs.html
https://www.cram.com/flashcards/psychology-1101-final-exam-7963601
http://notebro.com/viewer.php?url=http%3A%2F%2Fnotebro.com%2Fforum%2Fdownload%2Ffile.php%3Fid%3D54833
https://quizlet.com/11704258/psych-1101-final-exam-flash-cards/
https://quizlet.com/40937517/psychology-1101-final-exam-flash-cards/

B - Eye

Light must focus on the **retina**.
Retina is at the back of the eye.
From the innermost layer, **rods** and **cones** are connected to **bipolar cells** which are connected to **ganglion cells**. The axon of ganglion cells bunch up together to form the optic nerve which carries information to the brain.
Blindspot is where there are no sensory receptors so when light hits that spot we see nothing.
Fovea is the centre of the retina and is responsible for visual acuity (seeing clearly).
Rods and cones detect, transduce and transmit light to the brain. They are known as **photoreceptors** and differ in shape, number (rods>cones), function, location.

Rods: super sensitive to light, only a little amount of light needed to activate, allows us to see black, white, grey. Is involved in peripheral vision.
Cones: need a lot of light to activate, used during the day, allows us to see colours and details. Cones in the fovea, no rods in the fovea. Rods in the periphery, no cones in the periphery. Several rods connect to a **bipolar cell**, while only one cone connects to a **bipolar cell**.

C - Visual Information Processing
In order of increasing complexity

1. **Retina**

Processing of visual information starts in the retina. Ganglion cells start processing the information. The information reaches the **visual cortex**.

2. **Visual cortex**

There are **feature detectors**, which are highly specialized cells that respond only to specific stimuli (vertical/horizontal line). The information reaches **Parietal and temporal lobes**.

3. **Parietal and temporal lobes**

Parietal - where pathway: allows us to locate an object in space and track its movements.
Temporal - what pathway: allows us to identify what exactly we look at.

4. **Parallel processing**

We have a duel mind (**conscious**, **unconscious**) and they process information differently.
Serial process is done by the conscious mind and is processed one step at a time.
Parallel process is done by the unconscious mind and is much faster. The brain does multiple steps at a time. Each task is handled by different neurons. Groups of neurons work separately but simultaneously. When finished, they share information, brain integrates it and we learn something meaningful (process colour, movement, shape, texture, depth).

D - Colour Vision
At the time, people knew we had three primary light colours (RGB) and by combining them, millions of colours were made.
Young-Helmholtz Theory (trichromatic theory) proposes that in the retina, there must be three different types of cones (RGB). while each type of cone responds to a variety of colours, it is responsive to 1 light colour (R cone = R light).
The brain monitors the three cones to see which are activated in which combination to which degree. (all 3 max active = white, all 3 min active = black, ½ R ½ G small blue = yellow).
Opponent-Process Theory was developed by Hering. He accepted TT but thought it was not sufficient alone to explain colour theory.
Afterimage: still seeing an object after you aren't looking at it anymore.
Complementary afterimage: seeing R after staring at G, or Y after staring at B, vice versa.
OPT states that there are four primary light colours (RGBY).
We have **three antagonist colour systems** - RG, BY, BW.
When one of these are activated, the neurons in the system respond oppositely.
Brain monitors all three to see what's excited, inhibited, in which combinations and to which degree and brain determines colour based on this.

Bottom line, both theories are supported by modern research. In the retina, we do have three types of cone which follow TT, and ganglion cells in the retina follow OPT as well as other neurons in the brain.

Organization and Interpretation

Gestalt Psychology is a school of psychology that doesn't exist anymore but their work is still valuable today. The brain organizes sensory information into a Gestalt (a unified whole), and the whole may exceed the sum of its parts.

The perceiving brain doesn't perceive reality as it is. It actively constructs reality using experience, knowledge, expectations, beliefs.

A - Form Perception (all Gestalt rules)

1. **Figure and ground**

It could apply to all senses, we are talking about vision though.

The brain organizes stuff into **figure** and **ground**. The **figure** is the object we are paying attention to, and the **ground** is everything else in the background that isn't important. Figure and ground can constantly switch.

Because of figure and ground, the same stimulus can be perceived in different ways. This is not a characteristic of the physical world, it is a psychological experience created by the brain.

2. **Grouping**

Proximity: elements in a scene that are physically close to each other are perceived as a single unit (family of 5).

Similarity: elements that are similar to each other are perceived as a single unit (two types of candies).

Continuity: elements that follow the same direction or pattern are perceived as a single unit (highways).

Connectedness: elements in a scene that are connected to each other are perceived as a single unit (ladder, not sticks).

Closure: when elements in a scene are missing, the brain will use its knowledge to fill in the blanks (sketch of house has missing parts).

B - Depth Perception

1. **Binocular depth cues**

Brain uses information from both eyes to determine depth.

Two types

a) **Convergence**

The degree to which our eyes turn inward. The more inward turned, the closer objects appear.

b) **Retinal Disparity**

There is a distance between the eyes therefore each eye has a slightly different view of the object. A larger retinal display results in the object appearing closer.

2. **Monocular cues**

The brain only needs information from one eye to determine depth.
Relative size is when objects in a scene are known to be roughly the same size, larger one appears closer (eggs in a picture).
Interposition is when an object that means to block another object appears closer.
Relative clarity is when the clearer an object is, the closer is appears (mountain is clear, background is blurry).
Texture gradient is the rougher an object is, the closer is appears (sidewalk).
Relative height is when objects higher up in our field of vision appear further, lower in our field of vision appear closer (students sitting closer/further).
Relative motion (motion parallax) is perceiving depth while moving (on a bus). When moving, objects close to us appear to move fast and in the opposite direction. Objects far from us appear to move slowly and in the same direction.
Linear perspective is when objects near two parallel lines that appear to merge in the distance appear further away (road).
Well **lit** objects appear closer. Objects which cast a **shadow** on another object appears further.

C - Motion Perception

Research believes the brain makes **assumptions** when perceiving motion.

- If the image on the retina gets bigger, the brain assumes the object comes toward us.
- If the image on the retina gets smaller, the brain assumes the object moves further away.

Stroboscopic movement is movement when watching TV. there is no actual movement on the screen (24fps).
Phi Phenomenon is when there is no motion, but motion is created by the brain (xmas lights).

D - Perceptual Constancy

Allows us to have a constant perception of the world. Our tendency to perceive shape, colour, size, remains the same in spite of physical stimulation, retinal images, lighting conditions.
Relative luminance is when the brain determines the colour of an object, it considers the light being reflected off the other objects in the environment.
Size-distance relation is that the brain uses size to determine distance, and uses distance to determine size.

E - Perceptual Adaptation

The brain is perceptually adapting and adjusting to a world that has been artificially manipulated.

F - Sensory Deprivation

Research says if we were deprived of vision, colour perception would be okay, motion perception would be somewhat okay, but shape, depth, face recognition would not be okay.

Critical periods are certain periods during development where we must be exposed to certain experiences otherwise we won't develop properly. The critical period for vision is 0-6 years old.