- **<u>Week 1 – Fundamental concepts & Main approaches,</u>**

Cognitive processes and especially cognitive biases play a big role in the development and treatment of mental disorders

These processes include attention, memory, language perception, learning, problems solving and reasoning

<u>Cognitive psychology precursors</u>

Prior to psychology being known as a science, philosophers tried to understand perception, what was the position of the mind in the brain, sensations effect on perception & how humans interacted with the environment.

- From the 1920s - 1950s, American psychology was dominated by behaviorism.
- Historically, cognitive psychology was unified by a common approach based on an analogy between the mind and computer.
- The information processing approach viewed the mind as a general purpose, symbol processing system of limited capacity.
- Trying to understand the mind goes back to philosophers Plato and Aristotle trying to explain the nature of human knowledge.
- The study of mind remained philosophical until the nineteenth century, when experimental psychology developed.
- **Wilhelm Wundt** and his students initiated laboratory methods for studying mental operations more systematically.
- Decades later experimental psychology became dominated by <u>Behaviourism</u>, a view that denied the existence of mind.
- *Behaviorist J. B. Watson*, said psychology should restrict itself to examining the relation between observable stimuli and observable behavioral responses and consciousness and mental representations was banished from respectable scientific discussion.
- In 1956 **George Miller** summarized numerous studies showing the capacity of human thinking is limited, with short-term memory limited to around seven items:
    - memory limitations can be overcome by recoding information into chunks, mental representations that require mental procedures for encoding and decoding the information.
- **John McCarthy, Marvin Minsky, Allen Newell, and Herbert Simon** were founding the field of <u>artificial intelligence</u>.
- **Noam Chomsky** rejected behaviorist assumptions about language as a learned habit and proposed to explain language comprehension in terms of mental grammars consisting of rules.

<u>The evolution of contemporary cognitive psychology</u>

Today there are FOUR main approaches to cognitive psychology: **experimental cognitive psychology, cognitive neuropsychology, computational cognitive science & cognitive neuroscience (brain imaging).** Information from behaviour and brain activity are integrated and this approach is referred to cognitive neuroscience in a broad sense.

Cognition

- the ways our brains process information
- It includes mental processes such as attention, memory, learning, understanding language, problem solving and decision making is the way our brain processes information.
- Historically cognitive scientists have used the information-processing approach.
- Human cognition involves a mixture of top down & bottom up processing.
- *<u>There are two types of visual receptor cells in the retina: cones and rods.</u>*
- There are 6 million cones, mostly in the fovea, which are specialized for colour vision and sharpness.

- There are 125 million rods, which are specialized for vision in dim light and for movement detection:
- Impulses leave the eye via the optic nerve.
- The main pathway between eye and cortex is the retina-geniculate-striate pathway.
- Two stimuli adjacent to each other in the retinal image will also be adjacent to each other at higher levels within that system (retinopy).
- Signals proceed along two optic tracts within the brain.
- One tract contains information from the left half of each eye and the other tract from the right half.
- Nerves reach the primary visual cortex (V1) within the occipital lobe before spreading to secondary visual areas. There are two relatively independent channels within this system:

<u>Visual systems in the brain</u>

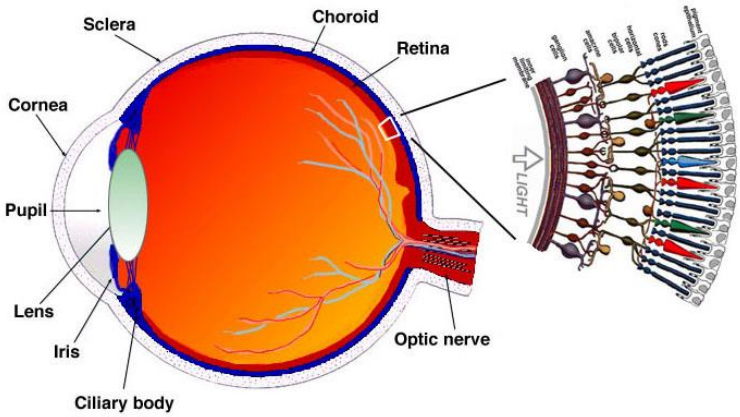


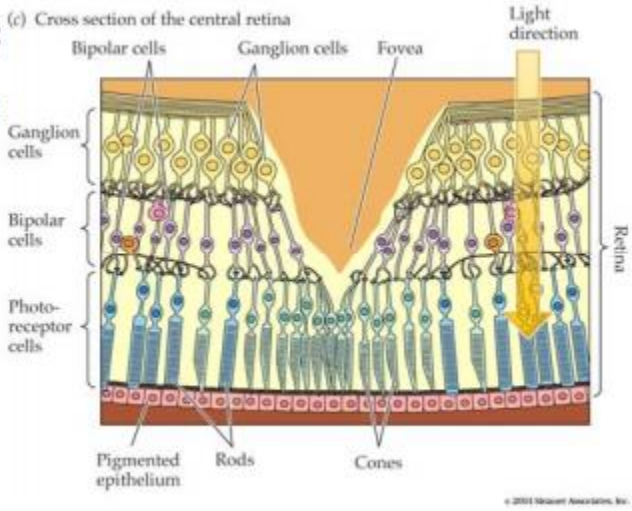
Fig. 1.1. A drawing of a section through the human eye with a schematic enlargement of the retina.

<u>Processing in the retina</u>

- Light waves enter the cornea & pass to the iris, with the iris' pupil dilating & contracting to let light in and keeping bright light out
- The lens focuses light onto the back of the eye & enters layers of the retina
- Photoreceptors (rods & cones) detect the light (millions of photoreceptors)
- **Rods** detect dim **light** but **no colour**, **cones** detect **colour** under **normal light**.
- The light goes through the **fovea**, which has **no rods** but **many cones**,
- When Light hits the photoreceptors & interacts with a molecule called photo pigment which starts a new reaction to propagate the signal which is transmitted to the bipolar cells
- Rods & cones make horizontal synapses with horizontal cells & bipolar cells
- The horizontal cells make inhibitory contact onto the bipolar cells which turn them into amacrine cells connecting the photoceptors to ganglion cells.
- The axons of the ganglion cells for the optic nerve that leaves the retina & travels along the lower surface of the brain
- cells pass the signal to the ganglion cells which is passed onto the optic disc (which cannot process visual information)
- The optic disc creates a natural blind spot but we don't notice this because information from the other eye & the brain fills in the gaps of information of the images that are processed by the retina.
- The main pathway bilaterally is the retina geniculate striate pathway which meets at the optic chiasma
- From the optic chiasma where the information from the nasal hemi-retina (nasal side of retina) of each eye crosses contralaterally
- The information from the temporal hemi-retina (temporal side of retina) is sent ipsilateral
- Most ganglion cell axons go to the lateral geniculate nucleus (part of the thalamus)

- A small number of axons go to the superior colliculus & part of the hypothalamus
- The axons that go to the lateral geniculate nucleus sends axons to other parts of the thalamus & the visual cortex.
- The cortex returns many parts of the thalamus, so the thalamus & cortex constantly send information back & forth

- photoreceptors;
- horizontal cells;
- bipolar cells;
- amacrine cells;
- ganglion cells;
- optic nerve...



Rods
Predominate in the periphery of the eye.
Sensitive to **motion**.
Coarse detail and **no color** information.
Dim light
Cones:
Concentrated in the center of the retina (especially fovea.)
Sensitive to **color** and fine detail (high resolution).
Normal light