

Condensed study notes PYB 204

Week 1: Intro

What is cognitive psychology?

- Cognitive psychology = how the mind is organised to produce intelligent thought and how it is realised in the brain
 - Intelligent thought = how we think, reason, solve problems, remember things
 - Realised in the brain = how neurons carry out those mental processes
- Human information processing

Why do we study cognitive psychology?

- So, we can understand mechanisms governing human thought, which is useful for studying:
 - Why thought malfunctions occur (clinical psychology)
 - How people behave with others (social psychology)
 - How financial decisions are made (business and economics)
 - False memory and eyewitness testimony
 - Spatial navigation and design of automatic robots/cars
 - Understanding brain disorders = navigation systems and Williams Syndrome

Williams syndrome

- Loss of 26-28 genes, which affects navigation and processing visuospatial information
- Spatial navigation not entirely impaired, can still learn repeated routes
- Response-based system is affected

Cognitive revolution

- During World War II, research on human performance was intensively conducted leading to shortcomings of behaviourism (not useful for solving practical issues)
- Allowed development of other scientific fields (linguistics, computers, information theory)

Week 2: Vision

Light (wave lengths)

- Light is called electromagnetic radiation, generated when an atom emits a photon
- Measured by energy of photon = wavelength
- The human eye can only detect light within a narrow range of wavelengths
- Different wavelengths = creates the perception of different colours e.g., short wave lengths = ultraviolet

Eye movements (saccades)

- If an image stays in the same spot on retina, photoreceptors stop sending signals and image appears to fade even though it is still there
- We all have a stationary blind spot where the optic nerve enters the eye, we are unaware of it because our brain fills in the missing details

Accommodation

- The eyes lens changes shape to focus on objects at different distances
- Lense round/thicker/more curved = focusing on near objects, ciliary muscles contract
- Lense flat/thinner/less curved = focusing on far away objects, ciliary muscles relax

Vergence and Stereopsis – how our eyes work together to perceive depth and 3D shape

- Vergence = the simultaneous movement of both eyes in opposite directions to maintain single vision when focusing on an object
- Stereopsis = each eye has a slightly different view (binocular disparity), the brain combines the images to judge depth and distance

Cones vs rods = purpose: to detect light and convert it into signals the brain can interpret

- Cones = colour vision, fine detail, works best in daylight
- Rods = black and white, blurrier, and nighttime

Functional organisation

- Photoreceptors = detect raw light and colour (input)
 - Convert light into electrical signals for the next layer of retinal neurons
- Ganglion cells = combine input from multiple photoreceptors to produce a sharpened, informative signal to the brain

- Retina = converts light into signals
- Visual cortex = interprets information into shapes, colours, and motion

Key terms

- Lateral Inhibition = edges and contrasts stand out as nearby photoreceptors suppress each other's activity
- Lateral Geniculate Nucleus (LGN) = relays visual information from the retina to the cortex and fine-tunes signals using feedback from the brain
- The Tectopulvinar System = localisation of objects in space, guidance of eye movements, and gross pattern perception

Schneider's hamster experiment

- When LGN was removed = hamster could not recognise patterns (LGN critical for identifying objects)
- When superior colliculi removed = hamsters could not move accurately towards patterns (Colliculi critical for locating objects)

2 separate visual pathways

- Focal system = "what", involves LGN, responsible for recognising and identifying objects
- Ambient system = "where/how" system, involves superior colliculi, responsible for localisation, movement, guiding action towards objects
- Blindsight = some people with damage to the focal system cannot consciously see objects, can still react to them

Receptive fields

- Receptive fields let ganglion cells detect light patterns over a small area of the retina
- Good at detecting edges, contrast, and shapes
- If light hits this area, the ganglion cells firing rate changes (increases or decreases)

Key terms

- Feature detectors in the primary visual cortex = there are special neurons that respond to specific aspects of a visual scene
- After V1, visual signal travels along 2 separate pathways = dorsal and ventral
- Adaptation = visual system adjusts to constant or repeated stimuli = stop noticing
- Constancy = even when sensory input changes, we perceive objects as stable

Week 3: Hearing

The nature of sound

- Sound is caused by changes in air pressure
- These pressure waves are characterised by:
 - Amplitude = loudness
 - Frequency = pitch
 - Phase = position within cycle
- Human hearing range = 20-20000 Hz
- Complex sounds = built from sine waves of varying amplitude, frequency, and phase
- Fourier analysis = used to decompose complex sounds into sine wave components
- Fundamental = the lowest frequency component of a complex sound

The outer ear

- Pinna = increases sound amplitude, helps determine direction of sound
- External auditory canal = provides protection, increases the sound amplitude
- Eardrum (tympanic membrane) = vibrates in response to sound waves, moves bones in the middle ear

The middle ear

- Ossicles (smallest bones)
- They transmit the vibration of the eardrum into the cochlea
- Provides protection against high amplitude sounds

The inner ear

- Cochlea = contains auditory sensory receptors, filled with a watery liquid, that turns sound vibrations into electrical signals, which are then sent to the brain through the auditory nerve, allowing us to hear

Central auditory pathways = how sound travels to the brain

- Sound starts in the cochlea (inner ear), where vibrations are turned into nerve signals
- These signals travel along nerve fibres and make stops at several key points before reaching the auditory cortex (where sound is processed)
- The auditory cortex deals with more complex auditory tasks

Key terms

- Frequency coding = different parts of the cochlea and auditory system respond to specific frequencies, allowing us to perceive pitch
- Pitch perception = binaural pitch encoding -> both ears work together to help the brain understand pitch
- Loudness perception = how loud something seems depends on how strongly and how many neurons in the auditory system fire
 - Overall firing rate = faster the firing, louder sound
 - Range of firing = louder sound, more neurons activated
 - Sound duration and frequency affect loudness perception
- The McGurk effect = shows that what we see can override what we hear

The human auditory system uses three main cues to determine the location of a sound

- Interaural time difference (ITD) = difference in arrival time of a sound at the two ears
- Interaural level differences (ILD) = difference in sound intensity/loudness between the ears
- Pinna spectral cues = shape of the outer ear (pinna) modifies the sound depending on its vertical location (up/down) and front/back location