Perception

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Perception

• Last week we talked about sensation
• How information from the world is received and encoded by special organs and receptors
• It is converted into electrical impulses
• Then it is sent via pathways to brain areas for processing
• Perception is that processing, and how the information is interpreted
• Perception is the development of an internal representation of the outside world
Outline

- Organisation
- Perceptual parsing
- Gestalt Principles
- Perceptual drive
- Models of Perception
- Parallel processing
- Perceptual complexity
  - Size
  - Depth
  - Motion
Organisation

• Perception must be flexible
  – So much information
    • What is important?
• We are however very good, even when viewing things at different angles
  – Remember feature detectors
• Consider a scene...
• How much detail do you need to recognise?
Perceptual Parsing

- Take recognition as an example
- Information such as features are encoded
- This sensory information must be organised
- Perception must determine
  - What features belong to an object
  - What features are relevant
- Based on what we know
  - A reference, construct, or memory
- This perceptual process can enable recognition
Gestalt Principles

• Gestalt Psychologists (1920s)
  – Perception is clever
  – But it is not always accurate

• Gestalt laws of Organisation:
  – Proximity, Similarity, Common Fate, Good Continuation, Symmetry, Familiarity

• Laws work independently, together and may interfere with each other
Proximity

• Things that are close together group together. Even when the elements are dissimilar.

• But... really strong grouping cues, like colour, can overcome the power of the proximity cue
Common Fate

- Things moving in the same direction appear to be grouped together.
Good Continuation

- Figure and ground will be organised so that there are as few changes or interruptions to straight or smoothly curving lines.
Closure

- Because we are biased to perceiving structures, we see a compete triangle.
Simplicity

• We tend to perceive objects based on simple constructs.
Figure & Ground

• Perception has to separate the object from its background
  – Discriminate between figure (object) and ground (background)

• Reversible figures sow that perception is I the eye of the beholder

• Perception requires subjective interpretation
Perceptual Drive

DATA ➔ PERCEPTION ➔ KNOWLEDGE

Stimuli from external environment

BOTTOM UP PROCESSING
(DATA DRIVEN PROCESSING)

Existing Knowledge

TOP DOWN PROCESSING
(KNOWLEDGE DRIVEN PROCESSING)
Bottom up

- James Gibson (1966)
- Perception is **direct**
  - bottom up
- Argued that the raw sensory data contains all the necessary information for perception
- e.g. Optic flow for pilots
According to research at an English university, it doesn’t matter in what order the letters in a word are, the only important thing is that the first and last letter is at the right place. The rest can be a total mess and you can still read it without problem. This is because we do not read every letter by itself but the word as a whole.
Top Down

• Richard Gregory (1970)
• Perception is **indirect**
  – Top down
• Perception involves making inferences
  – Making a ‘best guess’ or hypothesis
    • Prior knowledge and experience are crucial
• e.g. Necker cube
Models of Perception

• **Feature Nets**
• Proposed ‘cognitive’ process
• Recognition of patterns involving a network of detectors
  – Features detectors integral to this process
  – Hierarchically structured
• Visual search paradigm
  – Evidence that single features detected swiftly
  – More difficult with a combination of features
• Data driven – bottom up process
Feature Net

Diagram showing a network labeled 'CLOCK' with branches leading to various components labeled 'Word detector', 'Letter detectors', and 'Feature detectors'. The network includes symbols representing letters and features.
Feature Nets cont.

- More likely to include top down
- Communication can be bidirectional
  - Nodes could be excited or inhibited
  - e.g. Topic of animals
    - Cat activates rat
    - but inhibits mat
Geons

• How feature nets might work in 3D
• Irving Biederman (1986)
• Recognition by components
• Objects can be made up of combined shapes
  – Geons - Geometric icons
• Proposed early step in perceptual process
• Problem – maybe too simple
  – Think of a complex real world scene
Geons cont.
Visual Processing

- Visual Processing involves various stages starting from the retina to higher visual areas.

- The retina contains ganglion cells which connect to the lateral geniculate nucleus (LGN).

- The parvocellular pathway is color-selective, slow, and has low contrast sensitivity but high resolution.

- The magnocellular pathway is color-blind, fast, and has high contrast sensitivity but low resolution.

- The MT area is responsible for movement detection.

- V4 area is associated with color vision.

- Higher visual areas process form, color, and movement information progressively.
Dual System
Parallel Processing

- Specialised cells
- Specialised areas
- Different routes
- All processed in parallel
  - How does it all come together?
- **Binding problem**
- Neural synchrony
  - Neurons that fire together are perceptually linked
Size

• *Perceptual constancy*
• Perception of constant properties
  – Despite sensory changes
    • e.g. a door stays the same shape even when opened
• *Unconscious inference*
• Make unconscious inferences based on distal object
• Relationship between size and distance
• Incorporating any changes
• *Illusions*
• Can be caused when taking into account distal cues
  – Can be misleading
Ames Room
Distance

- **Monocular**
  - Depth cues inherent in visual scene
    - Pictorial cues
    - Interposition
- **Binocular**
  - We have 2 eyes
  - Provide different views
    - Binocular disparity
  - Less disparity, the closer the object
  - Stereoscopes create depth in 2D
    - Providing 2 images from corresponding views
    - Gives the impression of depth
Distance cont.

• Depth can also be determined through motion

• Linear perspective
  – Lines get closer, the further away

• Motion parallax
  – Objects further away move slower as we move pass them
Movement

• Apparent movement
  – Perception of movement when object changes retinal location

• Eye movements
  – Your eyes are constantly moving, jittering

• Visual saccades
  – Occur between fixations
  – Very small amount of time (milliseconds)
Induced Motion
Correspondence Problem
Happy Days

• Only a few weeks left 😞
• A lot still to cover!!
• If you have not already, you must read..
• ...and revise if you are going to do well
• Ask me or email with any queries or issues
• I am preparing a practise exam for you
  – Be prepared
  – You have been warned