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Week 4: Visual Attention

Lecture

Structure of Attention

What is Attention?

- Assists us to process important information without getting weighed down by unimportant information
- *Attention...*
 - o Filters
 - o Finds
 - Spotlight and binding
 - o Favours
 - Weighting and bias

Eye Movement and Attention

- A strong relationship between eye-movement and attention – however not perfect correlation
 - o Attention often occurs before eye movement
- Tracking eye movement
 - o *Saccades*: Small, rapid eye movements
 - o *Fixations*: Pauses in eye movement. Approx. 3 fixations per second

Covert Attention

- We can usually track 4 items without moving our eyes
- Seeing something is not the same as attending to it

Attentional & Visual Resolution

- **Attentional Resolution**: The point at which we can differentiate between individual objects in our peripheral vision
- **Visual Resolution**: The finest spacing at which visual detail can still be seen

Attentional Biases

- Inherent bias to attend to information that aids our survival (sudden movements/sounds) (bottom-up)
- We can direct our attention (top-down)
- **Shifting Attention**:
 - o **Endogenous**: Intentional, goal directed

- Posner's endogenous cueing task: (Posner, Snyder, & Davidson, 1980)
 - Two locations. Endogenous cue (i.e. arrow). Target flashed. Participant asked to identify target.
 - Two types of cues: Valid cue (target appears in location arrow points to); invalid cue (target appears in location arrow does not point to)
 - Findings: Persons are slower to identify target when cue is invalid
 - **Exogenous:** Reflexive, involuntary shift of attention
 - Posner's exogenous cueing task:
 - Two locations. Exogenous cue (e.g. flash of red in location). Target flashed.
 - Valid and invalid cues
 - Findings: Persons slower to identify target with invalid cues
 - **Posner's Summary:**
 - Exogenous shifts are rapid, compared to endogenous shifts (around 300ms slower than exogenous)
 - Inhibition of Return: We are slower to direct our attention to things that we have recently attended to
- **What attention can select:**
 - *Spatial locations*
 - Attention is directed in spaces across a visual field. Spotlight attention metaphor
 - Spotlight can scale in size
 - *Features*
 - Attention can be directed towards features
 - What features?
 - Colours
 - Angles/orientations
 - *Objects*
 - Attention directed towards an entire object (colour, shape, *all* features)
 - Task (Egley et al., 1994)
 - Two cubes, 2 locations in each cube. Visual cue in either 4 locations. Target flashes in either 4 locations
 - Findings: Attention spreads better within cubes than between cubes
 - Neural evidence
 - Two overlaid objects in same location (house and face). Attended image is processed more (activation in facial processing brain area vs. scene processing brain area)

Spatial Visual Attention

- *Visual Search Paradigm*
 - Number of items to search for on screen varied
 - 50% of time there was target present
 - Participants needed to decide whether target was present or not
- *Feature-search:* Items will 'Pop Out' - refers to items that pop out because they have a distinguishing feature from other items
- *Conjunction-search:* If target shares features with other items, it takes longer to find
 - **Treisman & Gelade, 1980:**

- Conjunction-searches are serial (look at items separately) and self-terminating
 - RT increases linearly as set size increases
- Features that **Pop-Out**
 - Colour, orientation, curvature, size, motion, shape (some), depth, gloss
- **Attention Binding**: Attention binds features together into objects
 - The Binding Problem: Different bound objects are processed separately in different areas of the brain. How do features get bound in the brain? Feature Integration Theory answers this
- **Feature Integration Theory (Treisman)**
 - Basic features processed in parallel
 - Pre-attentive stage where features are 'free-floating' and unorganised
 - Attentive stage where features are combined to form objects
 - Prediction: Attention failures lead to illusory conjunctions (features become associated with incorrect features)
 - **Experiment**: Treisman & Schmidt (1982)
 - Display (4 shapes flanked by 2 numbers) flashed followed by mask
 - Subjects were to report numbers followed by shapes at four locations
 - Findings: Incorrect associations made 18% of the time (e.g. seeing a yellow triangle, when there was actually a blue triangle and a yellow circle). Asking participants to focus on target objects eliminated this effect

Face & Object Recognition

Constancy Across Viewpoints

- We are able to recognise objects from different angles. How?
- **Marr's Theory of Vision**: Bottom-Up & Hierarchical
 - Observers gradually create more detailed representations of objects
 - Input image; Primal sketch; 2 ½-D sketch; 3-D model representation
- **Biederman's Recognition-by-Components Theory**
 - There are 36 basic shapes that we combine to create representations of objects
 - Geons/Object Primitives: Sets of our 36 basic shapes
 - Viewpoint invariance: Allows us to recognise objects regardless of viewpoint
 - Once we have a representation in our mind, constructed of geons, it is easy to flip and twist that image to match it to other objects