Two (cortical) visual systems

Human visual cortex

Lateral Occipital Complex (LOC)
A Model of Object Recognition
A Model of Object Recognition (cont.)

Four broad stages:

1. Early visual processing (color, motion, edges etc.)
2. Grouping of visual elements (Gestalt principles, figure–ground segmentation)
3. Matching grouped visual description onto a representation of the object stored in the brain (called structural descriptions)
4. Attaching meaning to the object (retrieved from semantic memory)

Combining Parts into Wholes: Gestalt Grouping

• Constitutes the second stage of the model of object recognition

Seeing Parts But Not Wholes: Integrative Agnosia (cont.)

• Disorders in object recognition are called agnosia
• Many different types of agnosia that can broadly be divided into disorders of perception (apperceptive agnosia) or meaning (associative agnosias)
• Integrative agnosia is a type of apperceptive agnosia in which grouping principles are disrupted
• This prevents stored knowledge of objects being accessed, but does not prevent the patient from seeing basic visual elements (computed in stage 1)
**Routes to Object Constancy**

- Object constancy achieved by mapping a potentially infinite number of visual depictions on to a **finite set of stored descriptions** of the structure of objects.
- One suggestion is that the brain stores objects in a single viewpoint (the canonical viewpoint that contains the principal axis).
- In this account, object recognition involves view normalization from the seen viewpoint to the stored viewpoint (mental rotation).
- Another suggestion is that stored structural descriptions are accessed by matching feature-by-feature.

**Neural Substrates of Object Constancy**

- Monkey cells in IT (inferotemporal) cortex respond to very particular object attributes (e.g. corners, shapes) but are less concerned with where they are located in space (Gross, 1992).
- These are ideal conditions for computing object constancy.
- fMRI in humans shows that inferotemporal regions respond to the same object presented in different sizes – left region is insensitive to viewpoint but right region is viewpoint sensitive.
- This is consistent with two different routes to object constancy.

**The Problem with Faces**

- Face recognition is a within-category discrimination (all faces look the same), whereas other object recognition is between category (e.g. distinguishing a pen from a cup).
- Maybe faces require different types of processing to other objects?
- Maybe faces are so important from a social/evolutionary perspective that they have a mechanism all to themselves? = domain-specificity.

**Different Aspects of Face Processing:**

Bruce and Young (1986)
Are Faces Special?: Fusiform Face Area

- Responds to faces more than other types of objects in functional imaging experiments (Kanwisher)
- But this may be a relative difference between faces and objects rather than an absolute difference

Are Faces Special?: Prosopagnosia

- Prosopagnosia = impairments of face processing that do not reflect difficulties in early visual analysis
  - also used specifically to refer to difficulty in recognizing previously familiar faces
- De Renzi (1986) – patient failed to recognize his own family but could do so by voice, clothes “are you...? [wife’s name] I guess you are my wife because there are no other women at home, but I want to be reassured”
- Could match different views of faces and name other objects

Why Are Faces Special?

1. Task difficulty?
2. Holistic/configural processing?
3. Visual expertise?
4. Domain-specificity?
Task Difficulty?

- Farah et al. (1995) devised a task involving faces and spectacles that was equally difficult for controls (both 85% correct)
- Prosopagnosic patient, LH, was normal on spectacles (92%) but impaired on faces (62%)
- Other patients are reported who are bad at recognizing familiar objects but not faces (so faces are not always hard)

Holistic/Configural Processing?

- Farah (1990) – all visual recognition lies on a continuum between recognition by parts and recognition by wholes
- Faces may lie at one end of the continuum (holistic), words may lie at the other end (part-based) and objects are intermediate
- She presents evidence that face and word recognition impairments always affect object recognition
Holistic/Configural Processing? (cont.)

- Subsequent researchers have argued that faces, visual words, and objects can be independently impaired.
- This may suggest separate stores rather than a single continuum.

Visual Expertise? (cont.)

- BUT: do Greebles look like faces?
- BUT: not all prosopagnosic patients impaired on within-category discrimination.
- Patient WJ – owned a flock of sheep and could distinguish between them.
- Patient RM – could distinguish between his collection of 5000 miniature cars.

Domain-Specificity?

- It is the default hypothesis when all else fails.
- Strongest evidence for this comes from prosopagnosic patients who can make within-category discriminations.
- Even in this instance, it is debatable that the tasks are matched (e.g. 36 sheep versus huge numbers of faces).
- Problem for proving this hypothesis is that it is hard to find stimuli that are just like faces (in terms of processing, difficulty, etc.) but that are not faces.

Visual Expertise?

- Gauthier and colleagues suggest that faces are special because we have become experts at within-category discriminations.
- Claims that becoming an expert at "Greeble" discrimination involves the fusiform face area, as do other types of within-category discrimination (e.g. model car collectors).
Visual Imagery

- Imagery = perception in reverse?
- But how low does it go? Kosslyn argues V1 is important but ‘how low it goes’ may depend on the content of vision (e.g. whether it is faces, colors or lines)