Why what you see is what you think you see: **Analysis of visual information**

**Visual Pathway**

Lateralization: Not about eye... it’s about visual field. Right visual field goes to left hemisphere.

**Mapping**

Visual Field: Eyes>>>LGN>>>V1

LGN: Hypothalamus (circadian rhythms) time of day
Tectum
Superior Colliculus (e.g. eye movements accommodation)

**6 Layers of Neurons**... in 3 groups

*Parvocellular* (3, 4, 5, 6): red + green cones, high resolution, slow

*Magnocellular* (1, 2): low spatial resolution, fast

*Koniocellular* groups (in between): blue cones, low resolution

**Primary Visual Cortex: V1**

Striate Cortex (=V1)...6 Layers

At least 3 types of cells: Simple, Complex, Hypercomplex: Feature selectivity

Orientations columns

Spatial frequency & disparity

V1 module: Blobs & Interblobs

Descartes' Principle of Philosophy 1596-1650
**Striate Cortex (V1)**

>6 parallel layers of neurons running along brain

>Information enters @ layer 4 in the middle, processed across all layers, exits in upper layer - out to V2

Response of V1 cells

Orientation selectivity:

**Simple cells:**

Sensitive to the orientation of bars of light

*Nobel Prize Won for this discovery...it was made by mistake: glass slipped on microscope-went from little to no response from dot, to neurons rapidly firing at the sight of the straight edge of glass that had slipped under the microscope= discovery of sensitivity to the strait line!

**In V1...not about dots but about lines!**

Sensitivity is dependant on early life experience. Exposure to rich visual environment.

- Elongated receptive field
- Inhibitory surround
- Edge detector

**Hypercomplex cells:**

- Elongated receptive field
- Inhibitory Flank
- 'Line-end' detectors
Visual Angle, Spatial Frequency

Low spatial frequency = less details
High spatial frequency = more details

Used in perceiving textures

Most cells in VI are also sensitive to ‘spatial frequencies’
i.e. the amount of details in their receptive fields

Hubel insists everything is about lines.

Another researcher says you can’t reduce water to just lines
E.g. sunshine on water - light
   Impressionists - color & light

---Debate is still unsettled.
Retinal Disparity: Perception of Depth

Far cells & near cells are maximally active when stimuli are on non-corresponding parts of the retina (retinal disparity)

We use many other cues to perceive depth (shape, angles)

Our brains make assumptions about angles.
Perception is information from our previous knowledge.

Putting it together:

**Module of V1**

**Blobs:**
Low spatial frequency
Color
Binocular

**Interblobs:**
Orientation
High spatial frequency
Motion
Disparity (depth)
Binocular
Beyond V1: \textbf{Extrastriate cortex}

*The visual system is complicated!!!

2 Visual pathways (two streams)

2 streams of info leave V1
The dorsal (on top) ‘Where’ (in motion) pathway---Posterior Parietal Lobe
The ventral (on bottom) ‘What’ pathway---Inferior Temporal Cortex

\textbf{Ventral Pathway} processes \textit{shape information} in 2 hemispheres

\textbf{Dorsal Pathway} processes \textit{location information} in 2 hemispheres.

The further the information goes along Ventral Pathway (temporal lobe) the more selective the cells for specific objects or visual features.

\textbf{Ventral: Perception of Color}

CO (cytochrome oxidase) blobs>>>V4....V8

V4: Color constancy

Perception of color depends on ‘context’

\textbf{Cerebral Achromatopsia} (damage to V8)

>Loss of color vision with no loss of acuity.

>Deficiency in perception of color

>Some patients can recognize colors, but not shapes.

\textbf{Ventral: Perception of form: Face cells}

Cells selective to faces, emotional expressions, identity

----In humans, face cells are located in the fusiform face area

Inverted faces- we cant detect details because we only encounter upright faces
-Monkeys are sensitive to inverted faces because it is not unusual for them to encounter faces upside down.
We are sensitive to changes:
Configuration—distance between eyes, nose ect...
Different contour
Different features

Ventral Stream—‘What’ pathway

- Respond to complex 3D objects, colors & forms
- Large receptive fields

Faces & bodies are special:
  - Faces= Fusiform Face Area
  - Bodies= Extrastriate Body Area
  - Objects= Lateral occipital complex
  - Scenes= Parahippocampal place area (PPA)

Damage to ventral stream: Visual Agnosia (‘failure to know’)

- Deficit in perception of object. Good recognition.
- Deficit in associating a shape with a name. Good perception.

*Usually together with a language deficit.
**Prosopagnosia:** deficit in the perception of faces (fusiform face area)

*Objects and faces are processed differently....e.g. lady can see fine---but can’t put it all together.*

**Dorsal Stream:** motion information

**Magnocellular**

Compute optic flow: center of expansion. One goal is to separate objects from each other & from background.

Inferring form from motion....e.g. body with lights attached to joints.

**Akinetopsia:** selective deficit in motion perception, not form.

**Blindsight:** seeing motion only-Collicular

You only need 1/10th of a second to infer shape from motion.