VISION (Class 9)

The Primary Visual Cortex

- Striated cortex (V1) – 6 layers
- At least 3 types of cells: simple, complex and hyper-complex (feature complexity)
- Orientation columns
- Spatial frequency and disparity
- V1 module- blobs and inter-blobs

[Image: Visual Cortices]

https://manumissio.wikispaces.com/Association+Visual+Cortex

Striated Cortex (V1) [figure 6.12]

Visual cortex has 6 parallel layers of neuron running along the brain surface
LGN: konio (II, III); parvo and magno (IVb and IVc)
Most visual information enters through layer 4 and is processed across all layers and leaves from layer 1-2.
**Response of V1 cells**

**Orientation selectivity – Simple Cells**

- Sensitive to the orientation of bars of light (as the bars rotate, the AP of the neurons changes) and different neurons response to different orientation (horizontal/vertical)
- Experiments: movement of edges → trigger AP
- Innate or Nurture: kitten expose to only horizontal strips, response to only horizontal movement of sticks, and vice versa (reversible in 2-3 days)
- Edge detector: Elongated receptive field and inhibitory surround
- Motion detector: Elongated receptive field (no inhibitory surround)
  - COMPLEX cells
  - Less precise. Response to movement in particular direction

**Hyper-complex cells**

- elongated receptive field
- Inhibitory flanks
- “Line-end” detectors: very specific as the AP is maximum when the stimulus lies before the inhibitory end (stimulus outside of receptive field or those on the inhibitory end of the receptive field produce no response)
Visual Angle and Spatial Frequency
- most cells in V1 are also sensitive to special frequencies: the amount of details in their receptive fields
- used for the perception of texture

Retinal Disparity: Perception of Depth (figure 6.20)
- Far cells and Near cells are maximally active when stimuli are on non-corresponding parts of the retina (retinal disparity)
- Fixation point of the object determines where the object (light) falls in the retina (further object would fall more central than closer object)
- Other cues: shapes, angles (visual illusion: our perception assumption)

Putting it all together: Module of V1 (figure 6.17, 6.18, 6.19)
- Blobs – low spatial frequencies, color, binocular
- Inter-blobs – orientation, high special frequency, motion, disparity (depth), binocular

2 Visual Pathways (2 streams of information leave V1)
- Dorsal: ‘Where’ pathway, in the posterior parietal lobe
- Ventral: ‘What’ pathway, in the inferior temporal cortex

Shape/Form and Location

Ventral pathway – shape information in the two hemispheres
Dorsal pathway – location information in the two hemispheres

The further the information goes along the ventral pathway, the more selective the cells for specific object or visual features

Ventral: Perception of Color
- CO blobs: V4 → V8
- V4: color constancy
- Perception of color depends on context
- Cerebral Achromatopsia (damage to V8). Loss of color vision with no loss of acuity
- Some patients can recognize color but not shapes

Ventral – Perception of Form

Face cells: cells selective to faces, emotional response, identity (in Human, face cells are located in the ‘fusiform face area’). The neurons are specific to certain angle and are not distorted.

Face processing: What matters
- Features, Contour, Configuration (figure 6.26)
- Autism: deficit in recognizing faces
- Williams Syndrome: increase interest in faces

Ventral Stream
- Respond to complex 3D objects, color, and forms
- Large receptive field
- Faces and bodies are special
  - Face: Fusiform face area
  - Bodies: Extra-striated Body Area
  - Objects: Lateral Occipital Complex
  - Scenes: Parahippocampal place area
- Damage to ventral stream: Visual Agnosia
  - Deficit in perception of object. Good recognition.
  - Deficit in associating shape with a name. Good perception – can read.
    Can name the object using other senses e.g. touch and smell. (Usually with language deficit)
  - Prosopagnosia: deficit in the perception of faces (fusiform face area) – notice the faces features, but can’t name the people they see

Dorsal Stream
- Magnocellular $\rightarrow$ Area MT (V5) + MST
- Compute optic flow (movement): center of expansion. One goal is to separate objects from each other and from background
- Inferring form/shape from motion
- Akinetopsia: selective deficit in motion perception (not form)
- Blindsight: seeing motion only- Collicular pathway (use superior colliculus)