The Visual Cortex

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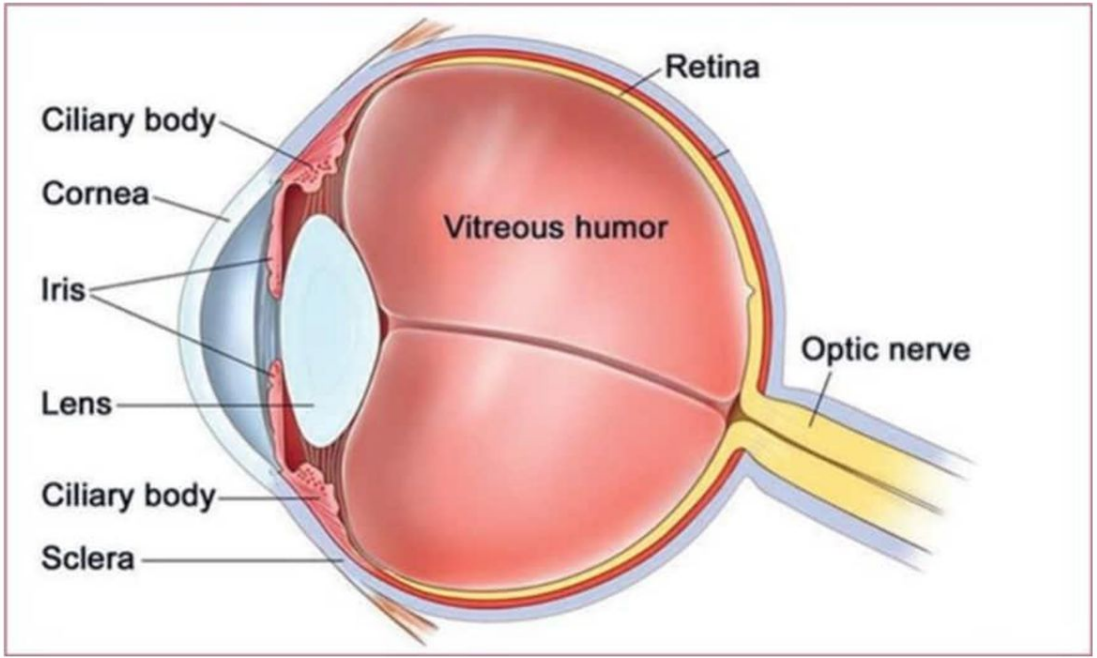
General Overview

- The main function of the visual cortex is to receive and process visual information
- The visual cortex is located in the occipital lobe at back of the brain.

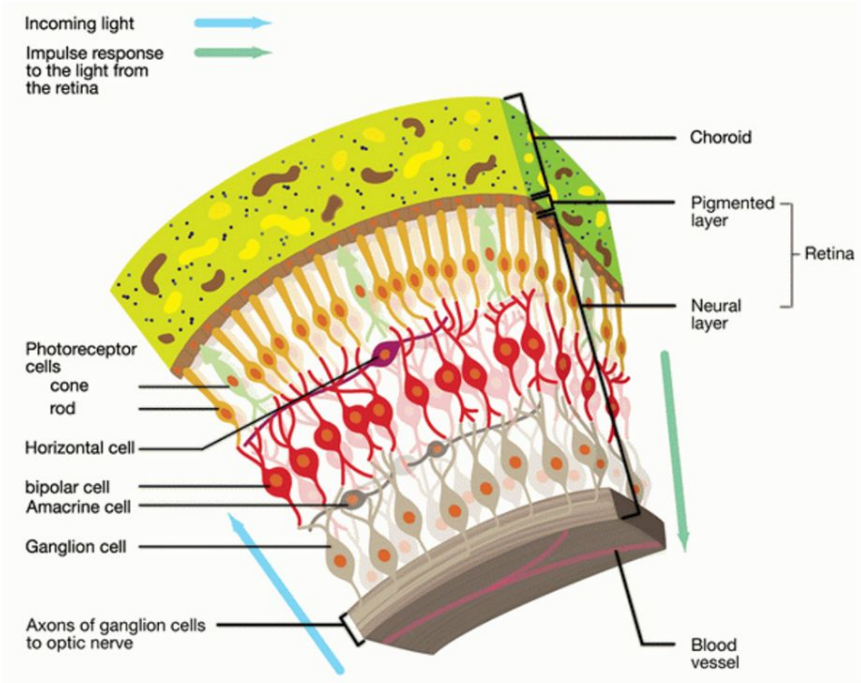
The Eye

- Light passes through the cornea and goes on through the pupil.
- The iris, which are pigmented fibers, controls how much light goes in.
  - It does this by changing shape.
  - Pupil is smaller in bright light and larger in dimmer lights
- Afterwards, the lights goes through the lens and they refract the light so that it reaches the retina



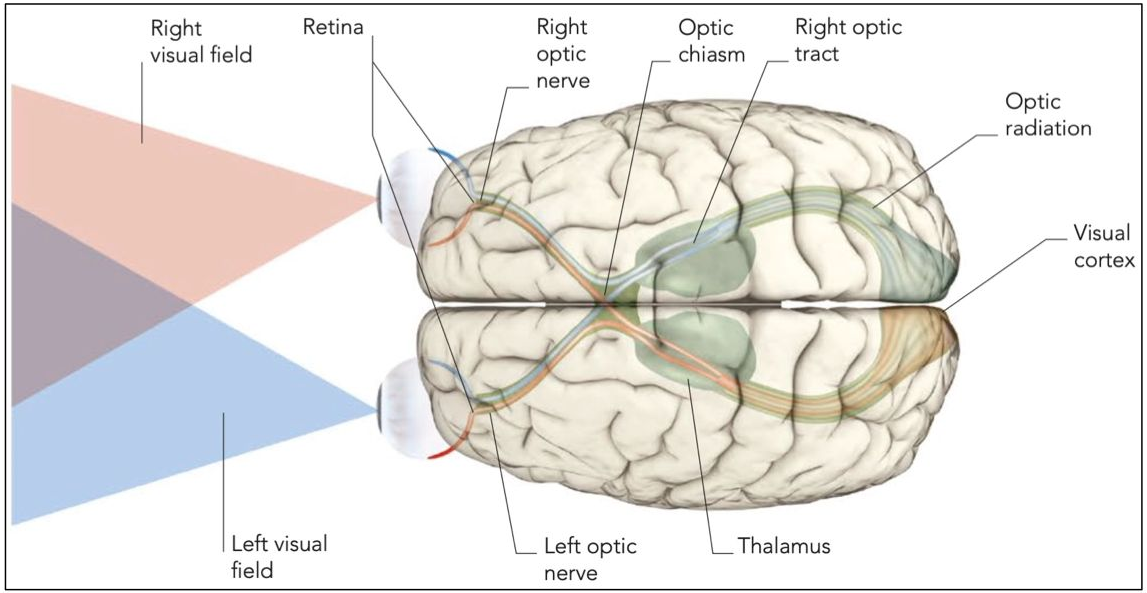
The Retina

- The retina has 3 layers connected by synapses that allow information in the form electrical signals pass through.
- 1st and 2nd layers send information to the visual cortex but don't necessarily respond to light
- The 3rd layer has photoreceptors(which are light sensitive cells)
  - Cells fire electrical signals
  - Rods – vision in dim light
  - Cones – detail and color
- The fovea is an area of the retina with densely packed cones that process finer detail



Path to the Visual Cortex

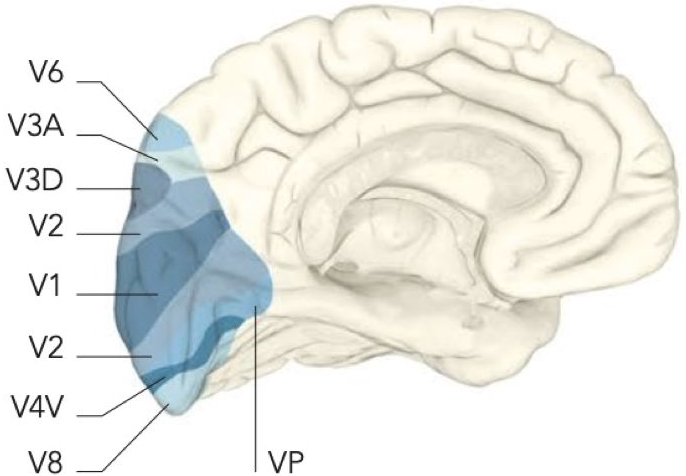
- The right and left optic nerves carry visual info from the eye and decussate at the optic chiasm
- The signal is then passed over the optic tracts and ends in the lateral geniculate nucleus in the thalamus
- The signal continues from the thalamus on the optic radiation tracts to the visual cortex processing areas in the posterior occipital lobe



NOTE: the visual cortex receives the information from the opposite side of the vision field because of the decussation in the optic chiasm

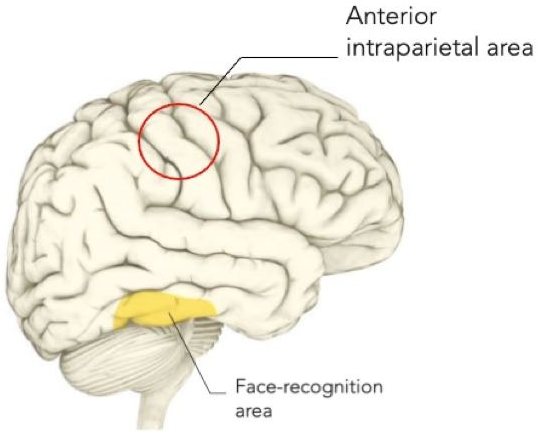
Visual Processing Areas

- The visual cortex is split up into functional areas that each process an aspect of vision (see table)
- The light information that comes from the eye pathway goes through a series of “editing” steps to form an image and (un)conscious thoughts

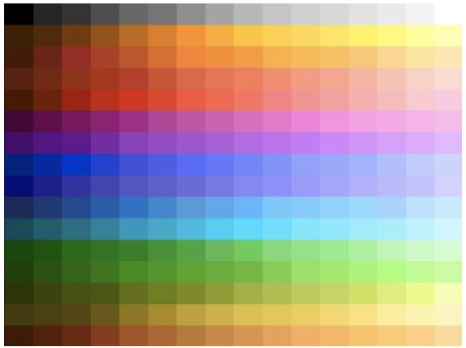


AREAS OF THE VISUAL CORTEX	
AREA	**FUNCTION**
V1	Responds to visual stimuli
V2	Passes on information and responds to complex shapes
V3A, V3D, VP	Registers angles and symmetry, and combines motion and direction
V4D, V4V	Responds to color, orientation, form, and movement
V5	Responds to movement
V6	Detects motion in periphery of visual field
V7	Involved in perception of symmetry
V8	Probably involved in processing of color

Processing an Image



- **Colors**
  - **Areas:** V4D, V4V, V8
  - Humans can distinguish millions of colors, but we only learn to distinguish some of them based of language rather than hues
- **Recognition**
  - Images gain significance when compared to memory and emotional areas of the brain, can be brought to frontal lobe for conscious thought
  - Object recognition occurs in the temporal lobe
  - Facial Recognition has a distinct area, if it is damaged people can't recognize other humans
- **Depth & Dimension**
  - The brain uses spatial binocular disparity (slight differences in view of each eye) and movement of a shape to produce a 3D view
  - Both cues come together in the anterior intraparietal area (AIP) to form a visual image



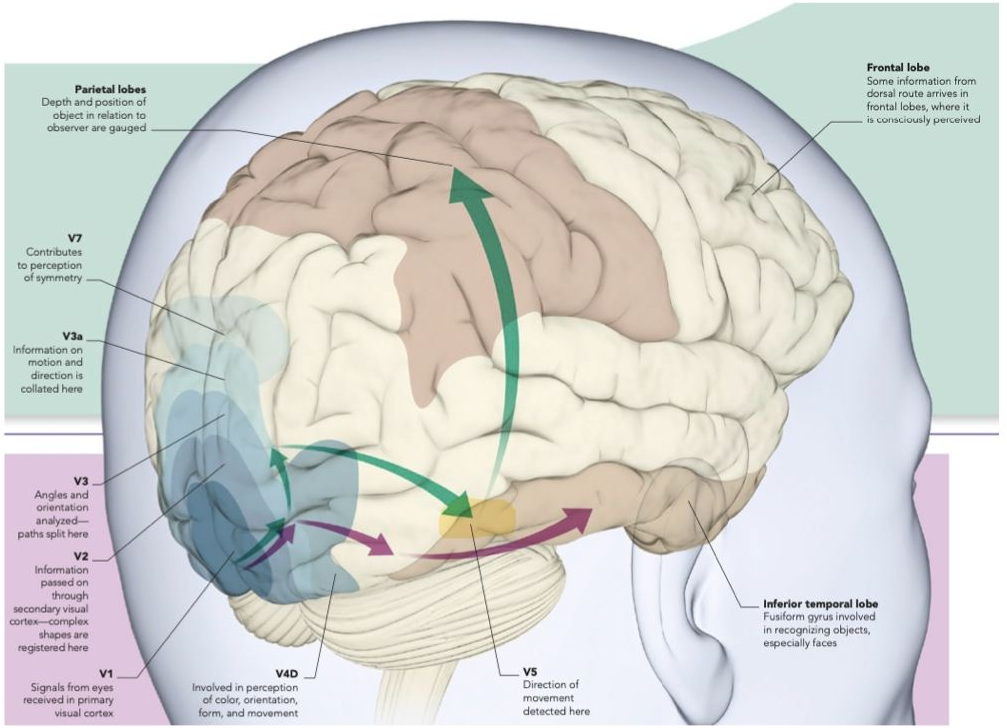
Paths From the Visual Cortex

Dorsal Route

- "The Where Pathway", unconscious
- **Route:** (green) travels from the visual cortex to the parietal lobe
- **Function:** Unconscious, gathers info about motion & timing, calculates location, creates plan of action without need for conscious thought

Ventral Route

- "The What Pathway", conscious
- **Route:** (purple) runs through visual processing areas then to the temporal lobe to be compared to memories, then to the frontal lobe to become conscious thought
- **Function:** object / facial recognition, conscious visual thought
- Damage to the ventral route can cause agnosia (the inability to recognize things)



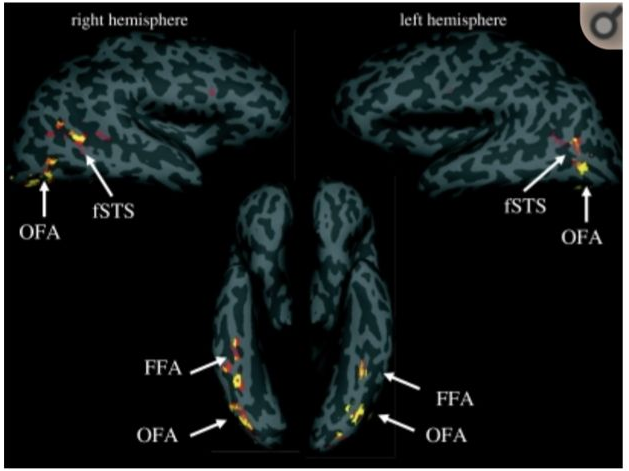
Studying the Visual Cortex Area

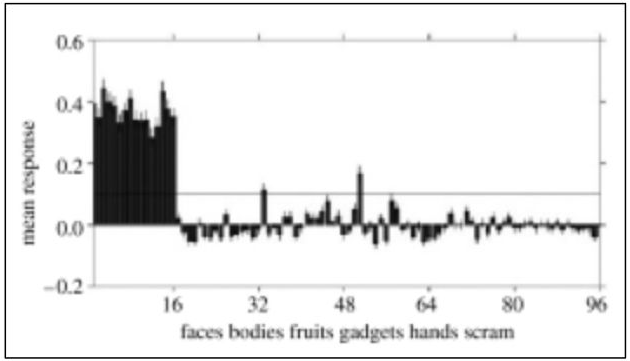
Measures From Class:

- **Average firing rate** to show the response to a stimulus
- **Synchrony** recording to see if a network of neurons is working together in response to a stimulus
- **ISI graphs** to show how normal the firing pattern is compared to a Poisson distribution

An Example Study: "The fusiform face area: a cortical region specialized for the perception of faces"

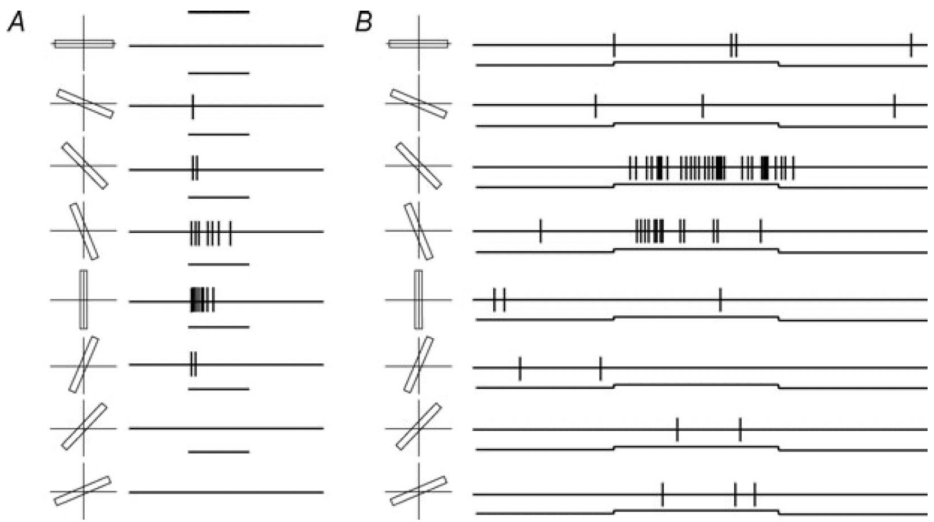
- *"We review the literature on a region of the human brain that appears to play a key role in face perception, known as the fusiform face area (FFA)"*
- **Lesion / Neuropsychology:** damage to the FFA causes prosopagnosia
- **Electrophysiology:** recorded responses of single cells in the FFA to see which types of images they responded to the most
- **fMRI Studies:** records the change in blood flow in the brain to show activity, this was in response to showing images of faces





Studies of the Visual Cortex(continued)

- David Hubel and Torsten Wiesel experimented on a cat in 1959
- They moved a bright light across the retina of the cat
    - 1) the neurons fired only when in a particular place on the retina(**Receptive Field**)
    - 2) the activity of these neurons changed depending on the orientation of the line
    - 3) sometimes the neurons fired only when the line was moving in a particular direction.



These are some recordings of neuron spikes based on the orientation of the light

SOURCES

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  - Hesse, Jason. “Going Global: Which Colours Can Help to Win over Local Customers.” *Real Business*, 8 Oct. 2018, https://realbusiness.co.uk/going-global-which-colours-can-help-to-win-over-local-customers.
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