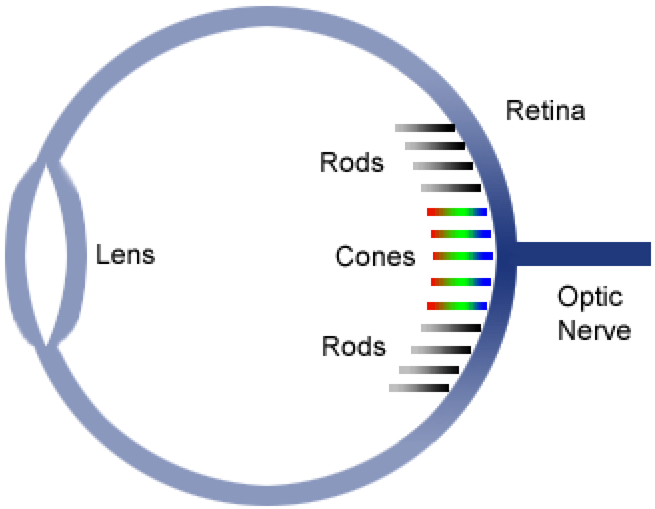
Perception and the Brain

Introduction to Cognitive Science

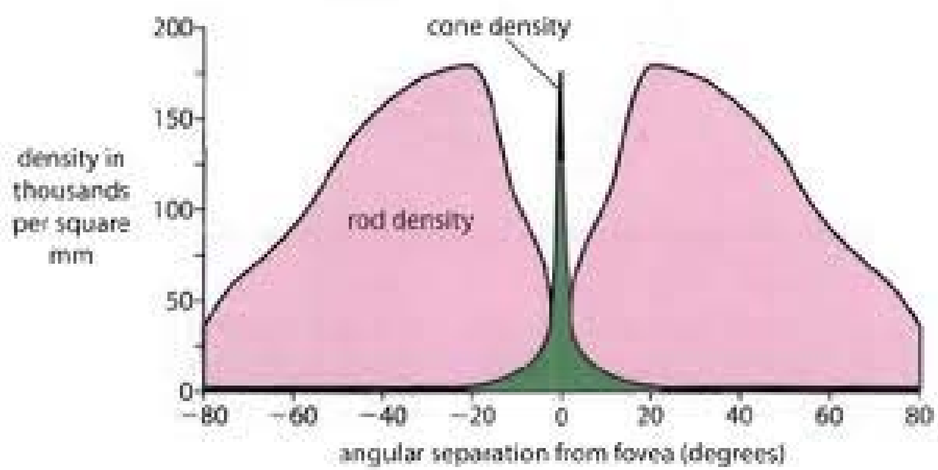
Vision: The Eye



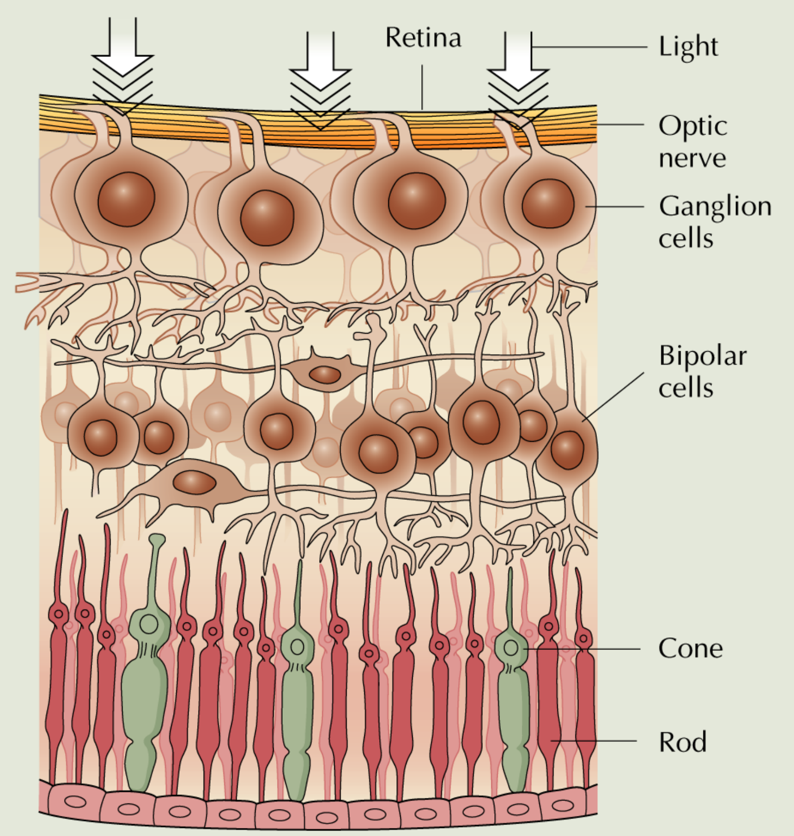
Pupil works as a pinhole, so that light coming from a certain direction will hit retina at a specific spot (camera works the same way)
Without pupil, there would just be a light-sensitive patch; we couldn't tell what direction light came from

Rods:
-more light-sensitive
-not sensitive to color
-in periphery

Cones:
-less light-sensitive
-pick up 'green', 'blue', and 'red'
-in center of vision



Vision: The Retina



(a)

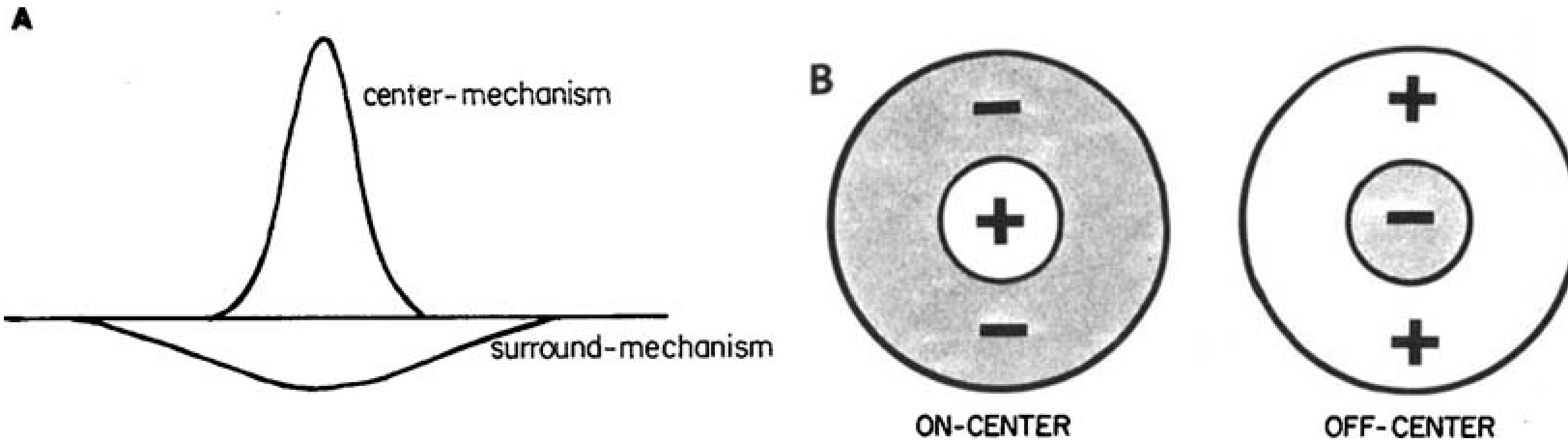
Transduction: the conversion of light (or other sensory input) into neural activity

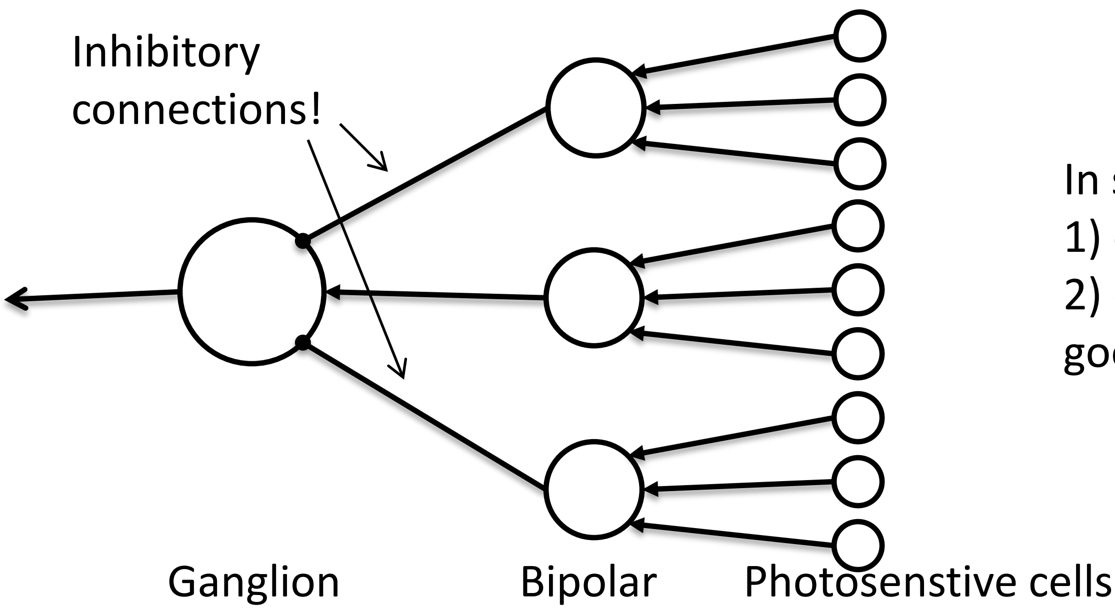
This is done by the photoreceptor cells: the rods and cones.

The rods and the 3 different kinds of cones use different photosensitive pigments

Note the 'stupid' design: cells and optic nerve are between the light and the retina. Blind spot is where the optic nerve breaks through the retina.

Vision: Visual Processing in the Retina

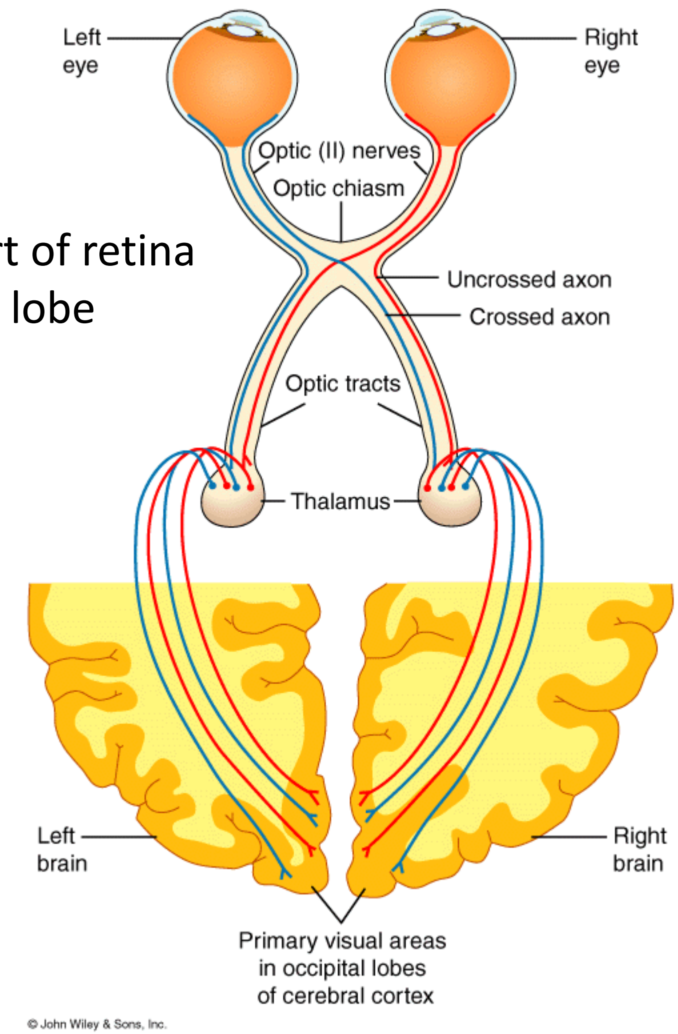




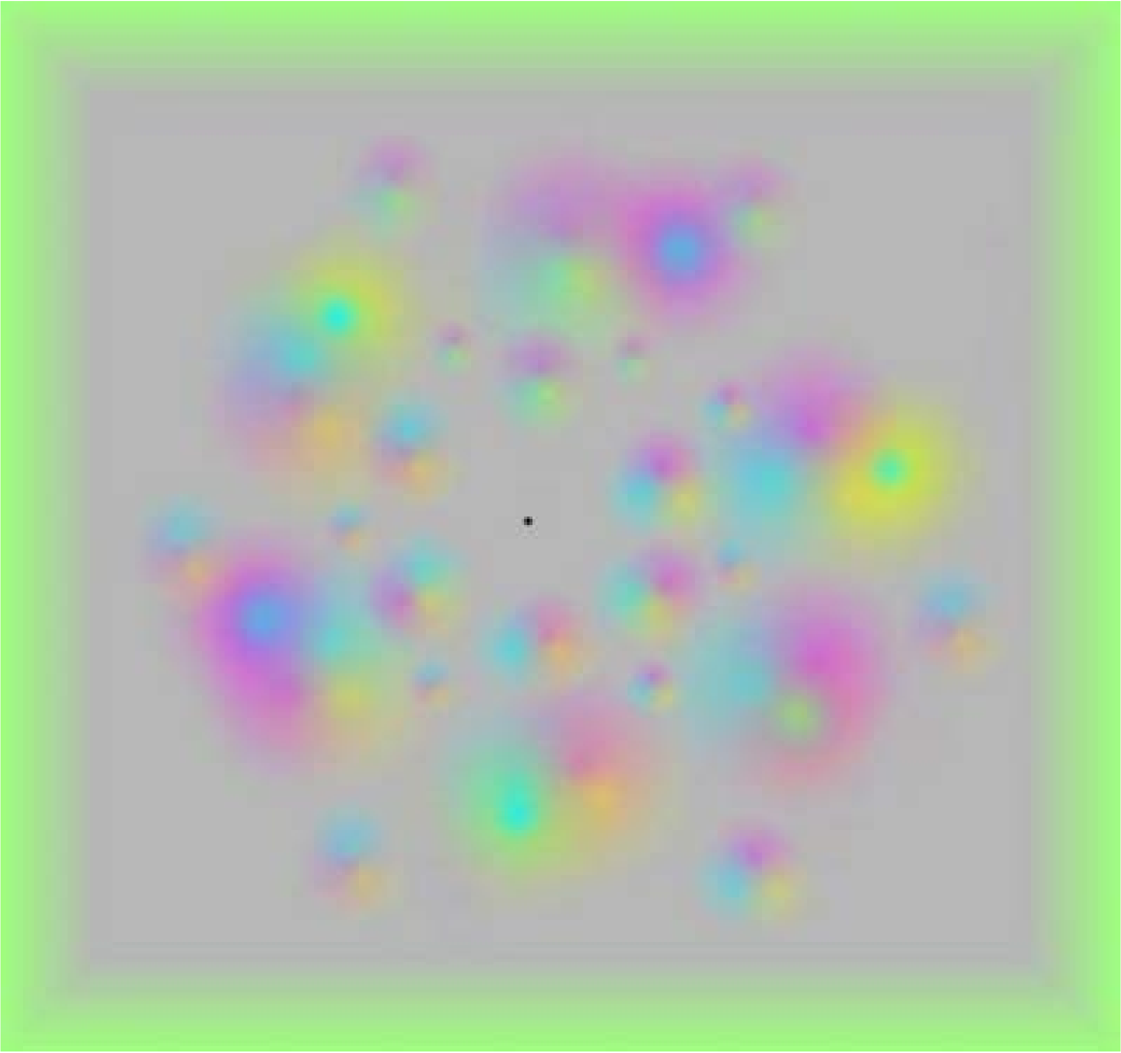
In sum, ganglion cells:
1) compress information
2) emphasize contrast ->
good for edge detection

Vision: From Optic Nerve to (Brain Stem?) to Thalamus to Occipital Lobes

Note: what's on our right
will be detected by left part of retina
and end up in left occipital lobe



Focus on black dot in the middle



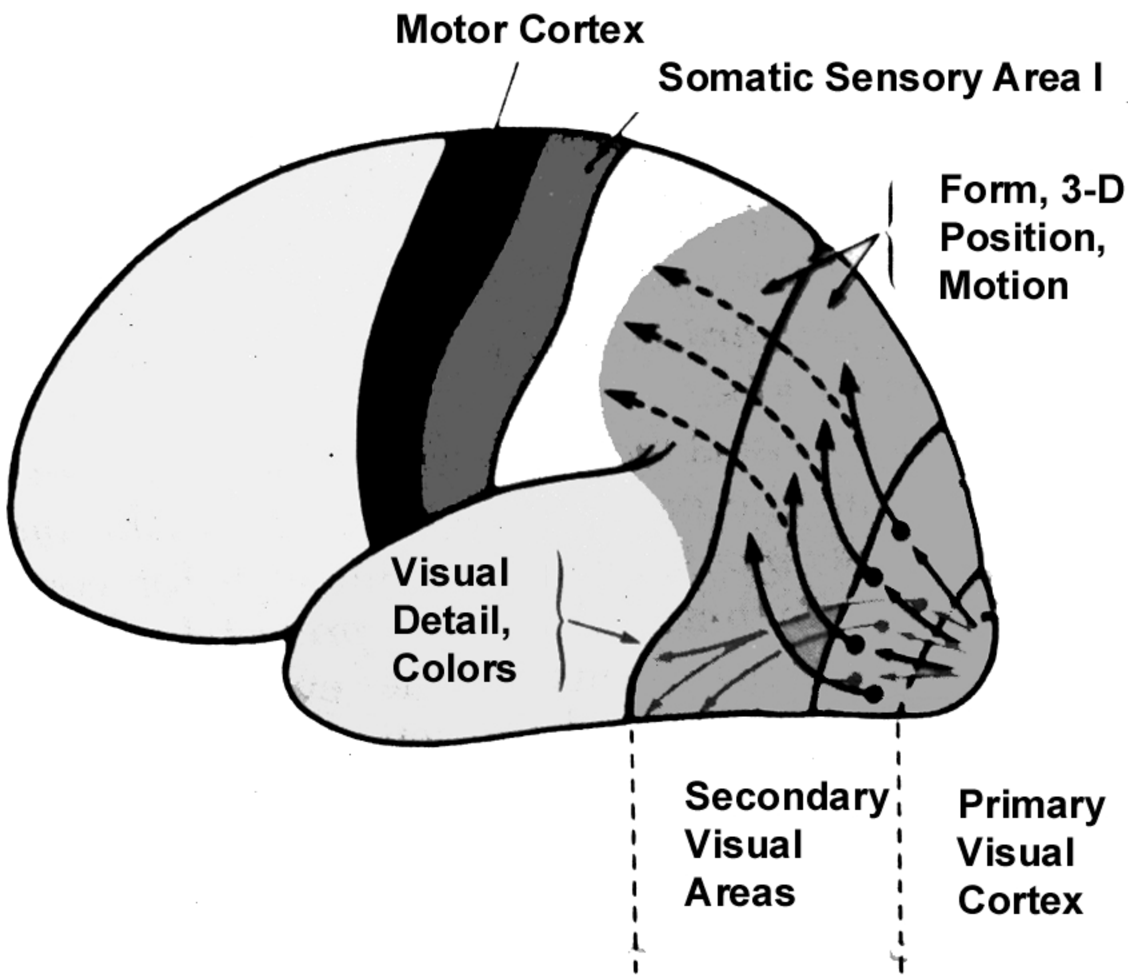
Sensory Adaptation

- As cognitive agents, we are most interested in changes in our environment.
- Our brain processes things in such a way that things that remain constant become less and less noticed.
- One way to do this: Subtract current (or predicted) stimulus from current stimulus, and pass on the difference to rest of brain.

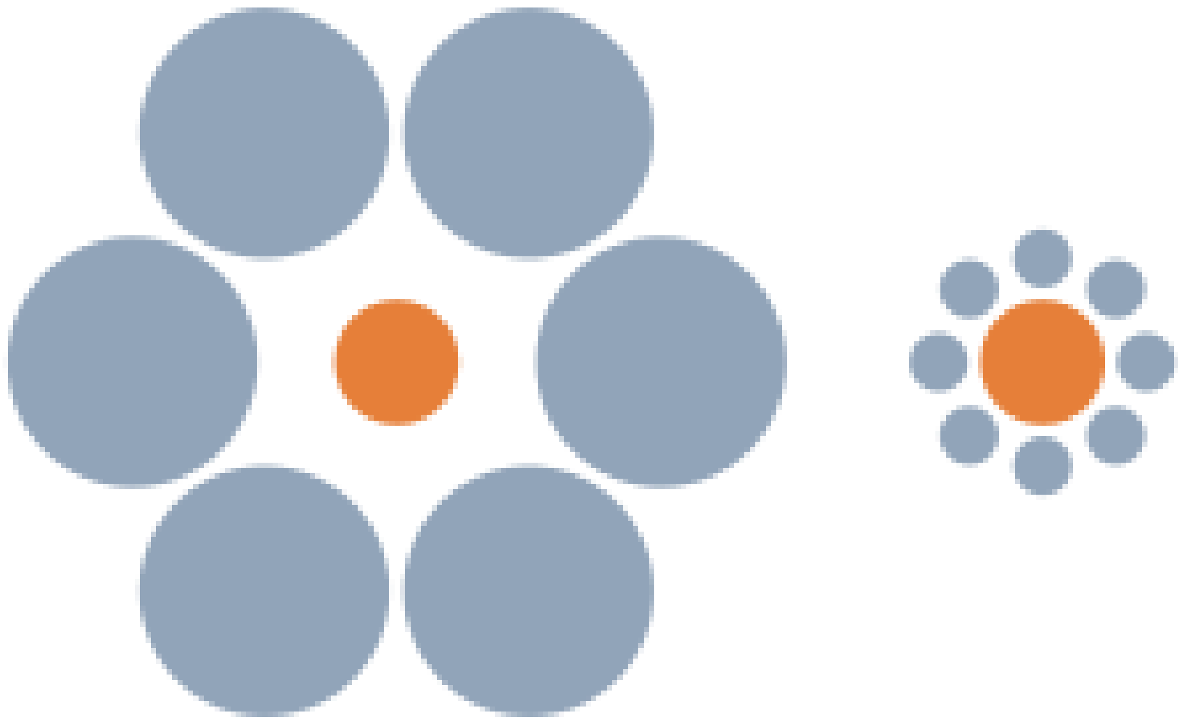
Case Study: Binocular Rivalry

- Binocular rivalry happens when a subject is presented with two different images: one in each eye (yes, it requires an elaborate set-up)
- Instead of seeing a juxtaposition of the two images, the subject perceives first one image, then the other, then the first one again, etc.
- The alternation could be explained by the predictive-subtractive model of sensory adaptation: when subtracting the current visual experience (image1) from the input (image1 + image2), you are left with image2.

Vision: Visual Cortex

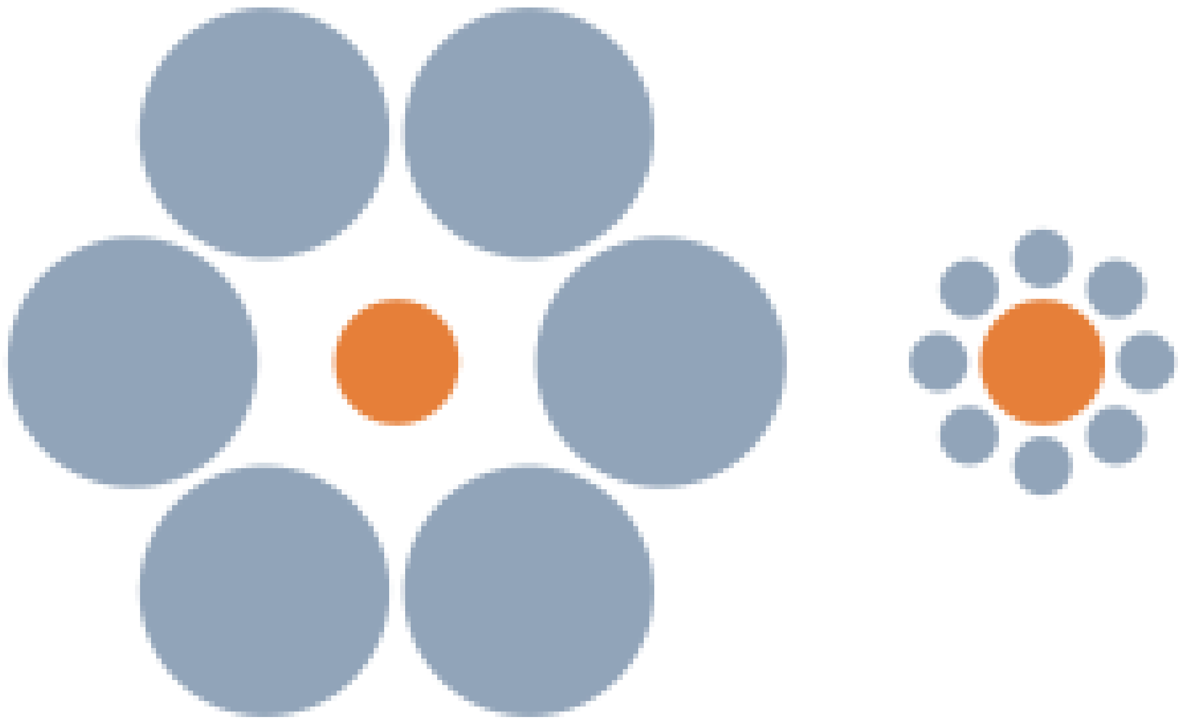


Ebbinghaus Illusion



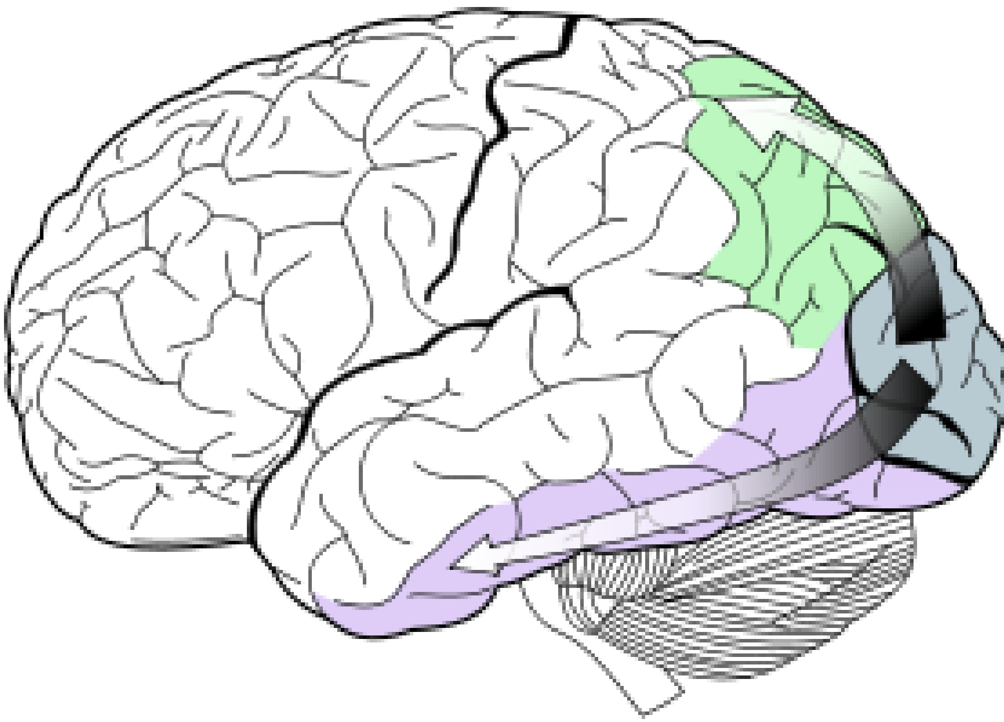
We see right orange circle as bigger than the left orange circle

Ebbinghaus Illusion (Cont'd)



However, when asked to imagine picking up the circle in the middle, people hold their fingers apart at just the right distance in both cases.

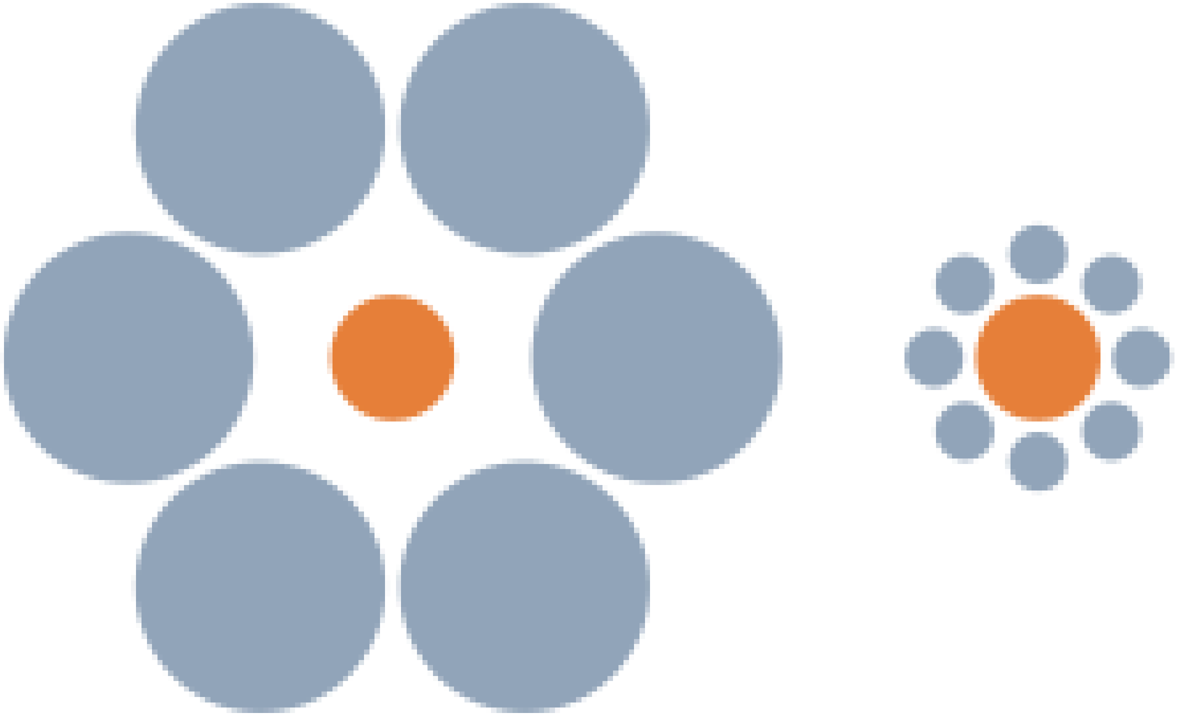
Two Distinct Visual Information Processing Streams



Green: Dorsal Stream. ‘Where’
Processes spatial information: where things are located
Note connection to Parietal lobe that deals with spatial information and contains sensori-motor cortex

Purple: Ventral Stream. ‘What’
Processes object recognition: what it is we’re seeing
Note connection to Temporal lobe where language is located

Ebbinghaus Illusion



Evidence that ‘what’ we are consciously seeing (ventral stream) is different from spatial information (dorsal stream) that is unconsciously available.

Judging Steepness of Slope (Goodale and Milner)

- When asked to judge how steep a slope is that they are facing, may subjects overestimate.
- But, when they are asked to hold their hand (unseen!) at the angle of the slope, they get it exactly right
- Hypothesis: the judgment is a semantical ‘what’ judgment (ventral stream), the hand response a ‘where’ judgment (dorsal stream).

Blindsight

- Blindsight is a condition that some people have when their primary visual cortex (V1) has been damaged: while they can't consciously see objects, they can still react in appropriate ways
  - e.g. when forced to guess where a (moving!) object is going (left, right, up down), they get it right
- Information seems to get to the dorsal stream, but not to the ventral stream