

Binocular Vision and The Perception of Depth

Visual Perception

- v How one visually interprets a scene
- v 4 forms of perception to be studied:
 - v Depth
 - v Color
 - v Temporal
 - v Motion



Depth Perception

- How does one determine how far away an object is located?



Depth Perception

- v Monocular Cues

- v Require only 1 eye to perceive depth;
Cyclops.



<http://www.shag-art.com/cyclops.html>

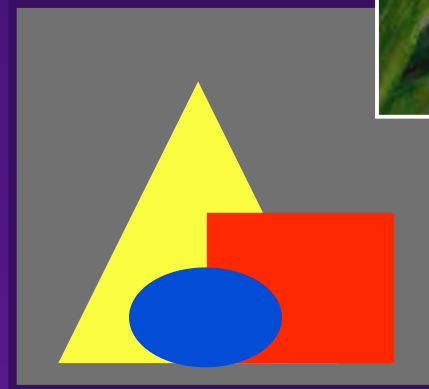
Depth Perception

- v Binocular Cues
 - v Require 2 *eyes* to perceive depth.



Monocular Cue #1

- v Interposition
(Overlap)
 - v An object that is partially covered by another object is farther away.



Monocular Cue #2

- v Familiar Size
 - v Previous knowledge of object sizes aid in judging distance



Which object appears closer?

Monocular Cue #3

- v Linear Perspective
 - v The farther away an object is the smaller it appears to be.



Monocular Cue #4

- v Atmospheric Perspective
 - v Objects farther off in the distance appear less saturated and less sharp (fuzzier) than those nearby.
 - v The more atmospheric particles between the viewer and a distant object the more light that is scattered.



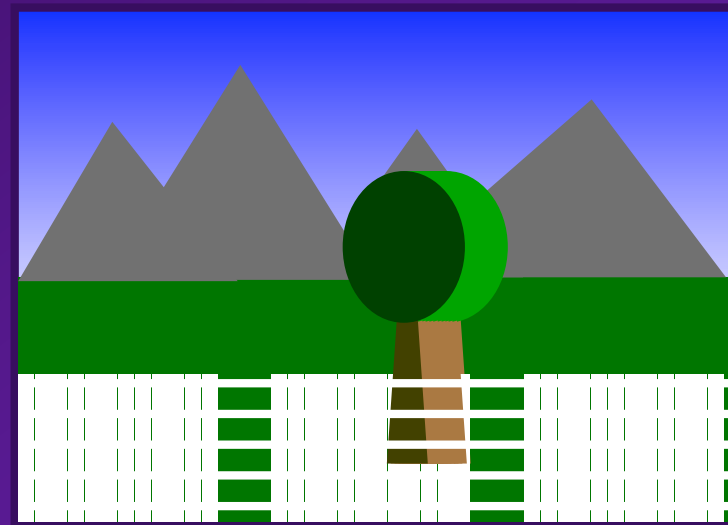
Monocular Cue #5

- ⋮ Motion Parallax

- ⋮ Stationary objects that are physically closer to a moving viewer appear to shift faster than those farther away.

- ⋮ Example 1

- ⋮ Driving by in a car looking at objects near and far (animation).



Monocular Cue #5

v Example 2

- v Close one eye.
- v Hold your left thumb upward at arm's length.
- v Hold your right thumb upward at half arm's length.
- v Position the thumbs so the right thumb blocks the left and move your head to one side.

Observe that the background did not move, but the thumbs appeared to move relative to each other and the background.

v Example 3

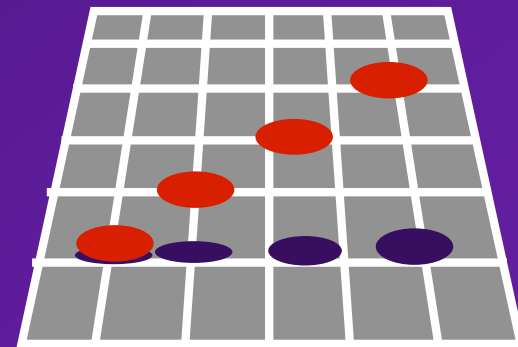
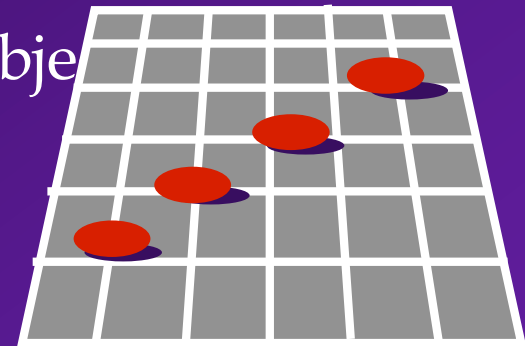
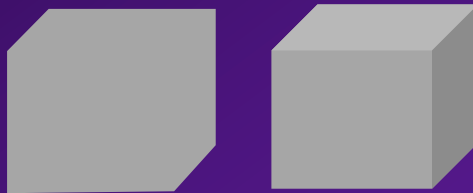
- v Close one eye.
- v Hold both index fingers pointing toward each other.
- v Circle the fingers in a bike pedaling motion.
- v Stop them at eye level and move them inward to make them meet forming a straight line.

Try again, but this time move your head side-to-side to tell the distance between your index fingers.

Monocular Cue #6

v Shading

- v Uses light falling on an object from a certain angle to give form and depth to an object.
- v Cast shadows aid in locating an object.



Monocular Cue #7

- Patterns

- Use contour lines to infer depth.



Monocular Cue #8

v Accommodation

- v The change of shape performed by the eye lens to focus on an object aids the brain in determining the object's distance.

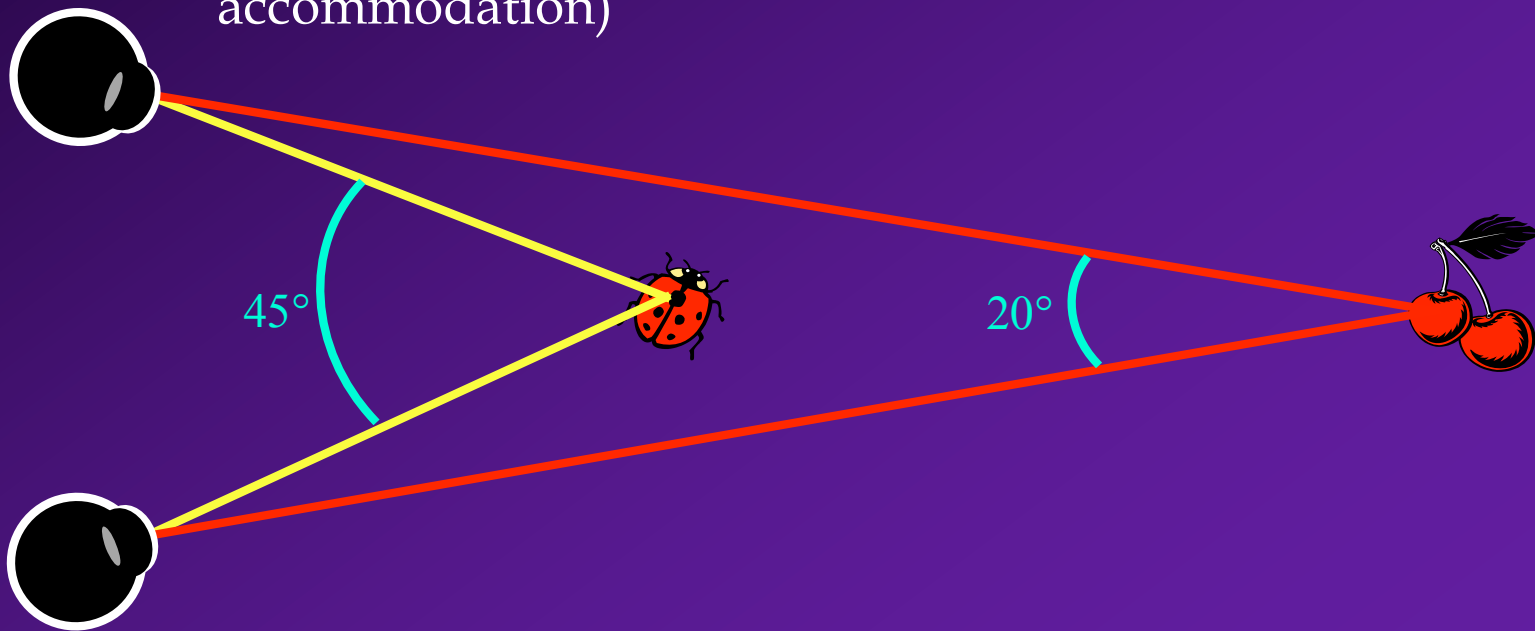


Binocular Cue #1

v Convergence

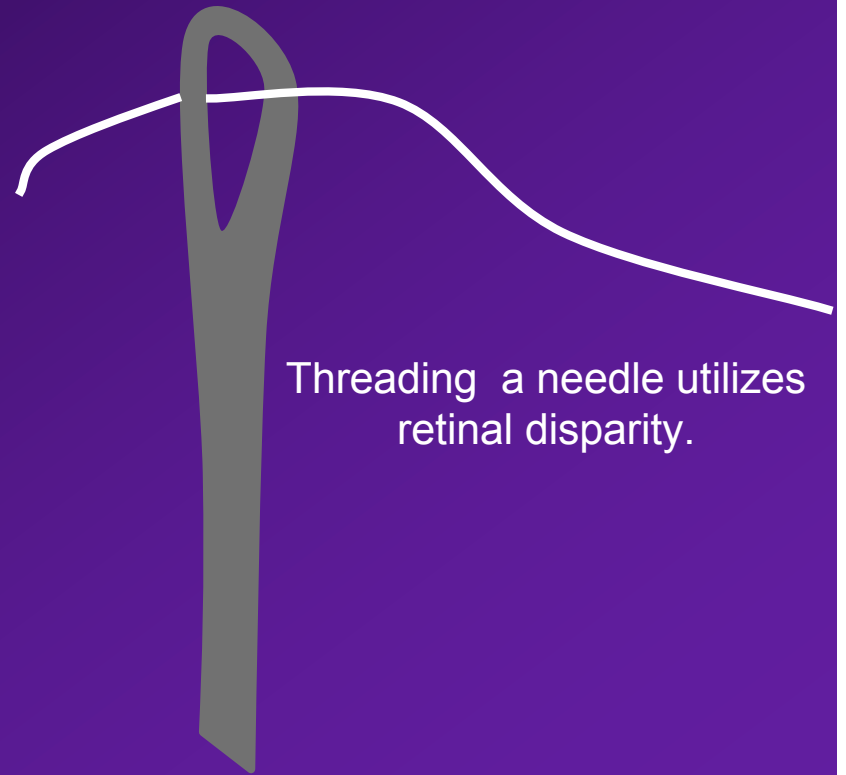
v The angle between the line of sight of each eye is larger as an object moves closer.

v This works for nearby objects (with accommodation)



Binocular Cue #2

- v Retinal Disparity
 - v Each eye receives a slightly different view of a scene.
 - v The two views are used to determine the ratio of distances between nearby objects.
 - v Example
 - v Close one eye and position your thumbs so that one blocks the other with ~1 cm distance between them.
 - v Switch your viewing eye.
 - v Open both eyes.



Threading a needle utilizes retinal disparity.