PERCEIVING DEPTH AND SIZE

Visual Perception

DEPTH

Cue Approach

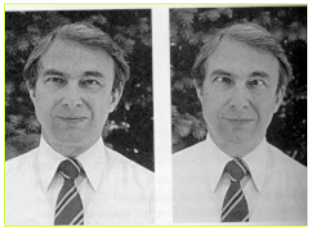
- Identifies information on the retina
- Correlates it with the depth of the scene
- Different cues
- Previous knowledge

Depth Cues

- Oculomotor
- Monocular
- Binocular

Oculomotor Cues

- Convergence
  - Inward movement for nearby objects
  - Outward movements for farther objects
- Accommodation
  - Tightening of muscles the change the shape of the lens

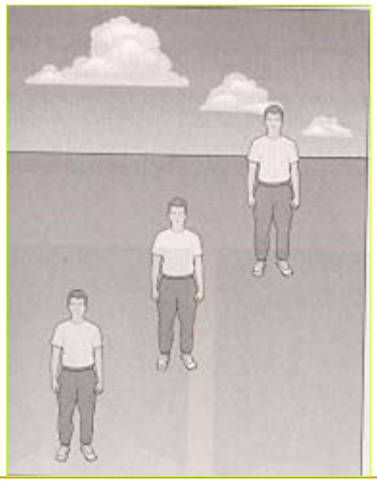


Monocular Cues (Pictorial)

- Occlusion
- Relative height
- Cast shadows
- Relative size
- Familiar size
- Atmospheric perspective
- Linear perspective
- Texture gradient
- Movement-based cues
  - Motion Parallax
  - Deletion and accretion

Occlusion

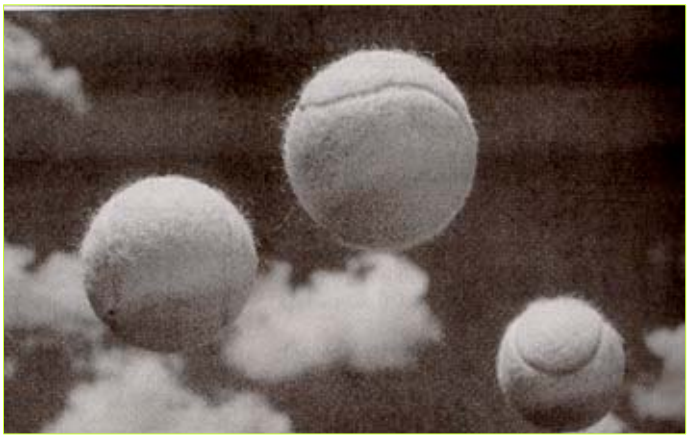
Relative Height



Conflicting Cues

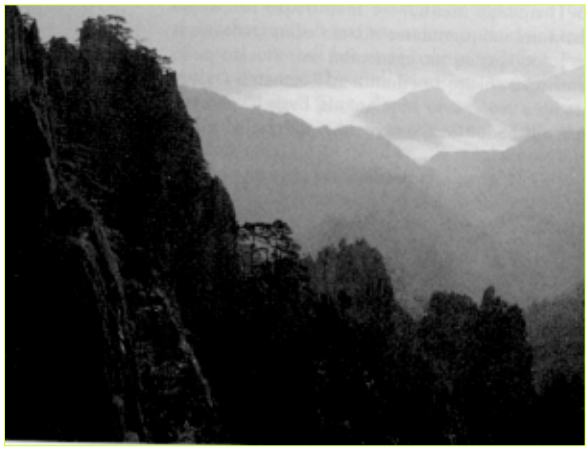
Cast Shadows

Relative Size



Familiar Size

Atmospheric Perspective



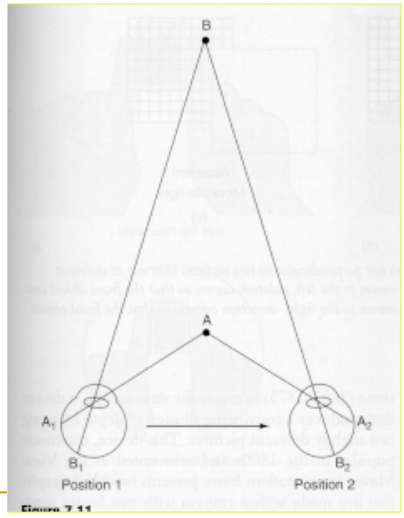
Linear Perspective
Texture Gradient

Presence of Ground

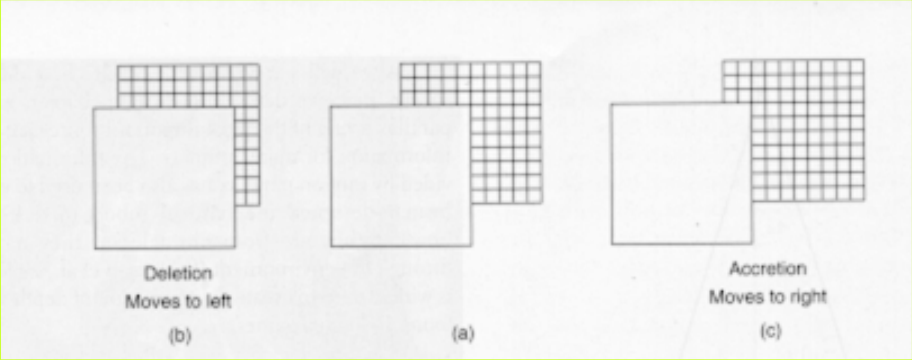
- It helps in perception
- Removal of ground causes difficulty in perception

Motion Parallax

- Further points have lesser parallax
- Closer points move more



Deletion and Accretion



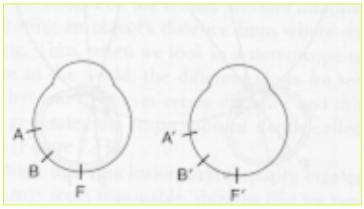
Binocular Cues

- Binocular disparity and stereopsis
- Corresponding points
  - Correspondence problems
- Disparity information in the brain

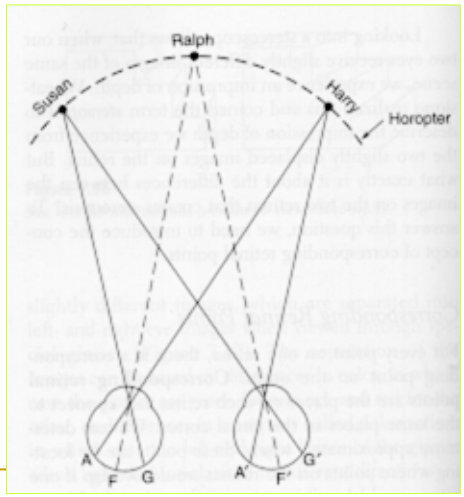
Binocular Disparity and Stereopsis

- Binocular disparity
  - Difference in the images of the two eyes
- Stereopsis
  - Disparity is transformed into perception of depth
- Discovery of stereoscope in 1800s

Corresponding Retinal Points

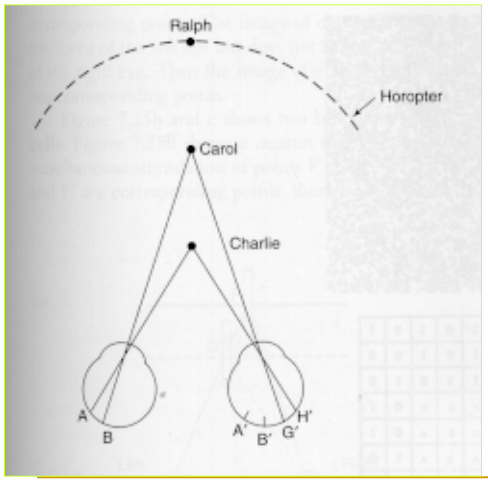


Corresponding Points



Points on horopter are images at corresponding points of the two eyes

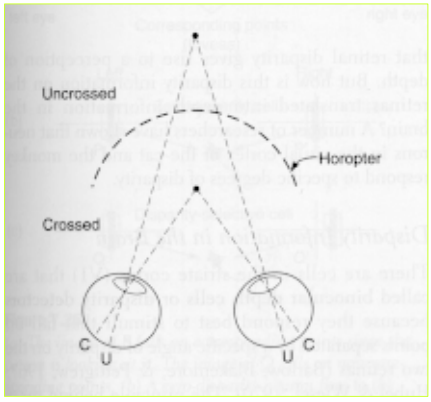
Corresponding Retinal Points



Disparity is defined by the angle between the image of a point and the corresponding point of its image on the other eye subtended from focus

Crossed and Uncrossed Disparity

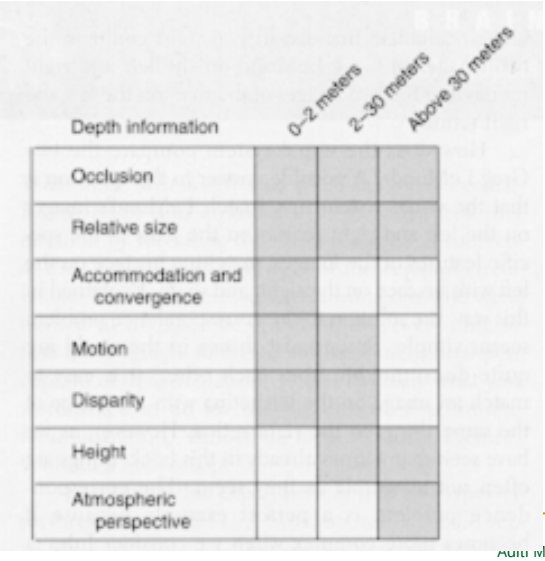
- For points in front of the horopter
  - The image is on the outer side of the retina from the image of a point on horopter
- For points behind the horopter
  - The image is on the inner side of the retina from the image of a point on horopter



Disparity in Brain

- Striate cortex has binocular depth cells or disparity detectors
- Disparity selective cells
- Also selective about crossed or uncrossed disparity
- However, important is to solve the correspondence problem
  - Matching images of the same point on two different eyes
  - Only after this we can find the disparity

How do they work together?

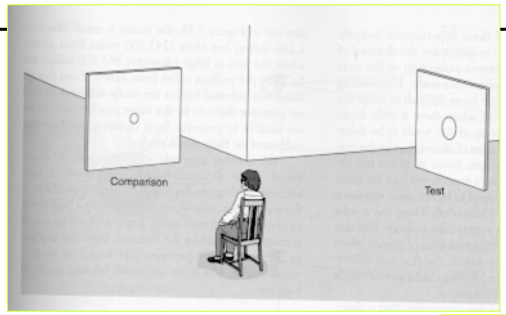


Depth perception in other species

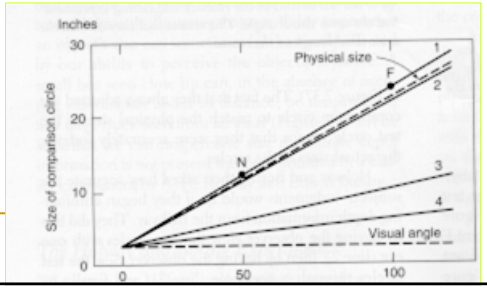
- Frontal Eyes needed for binocular disparity
  - Rabbits etc cannot use disparity for depth
  - Pigeon has 35 degree overlap

SIZE

Depends on depth estimation



- **All depth cues present**
- **Closing one eye**
  - **No binocular cues**
- **Through a peephole**
  - **No monocular cues**
- **Adding drapes**
  - **No shading cues**



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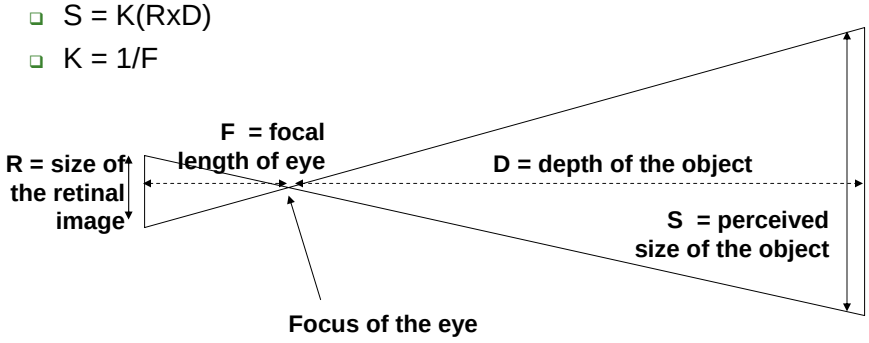
Size Constancy

- Size-distance Scaling
  - S = K(RxD)
  - K = 1/F



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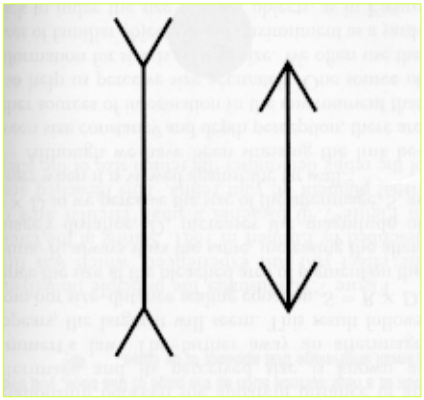
Relative size

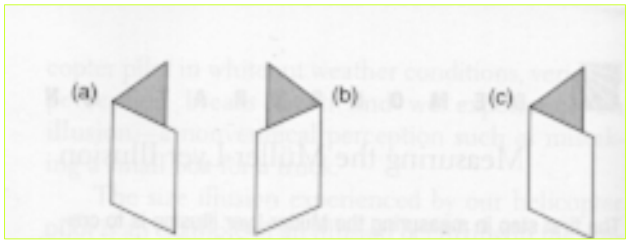
Visual Illusions

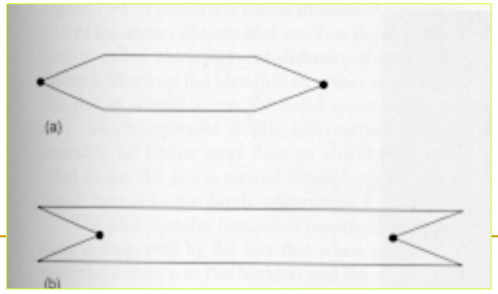
Muller-Lyer Illusion



Explanation 1: Misapplied size constancy scaling

Explanation 2 : Conflicting Cues Theory





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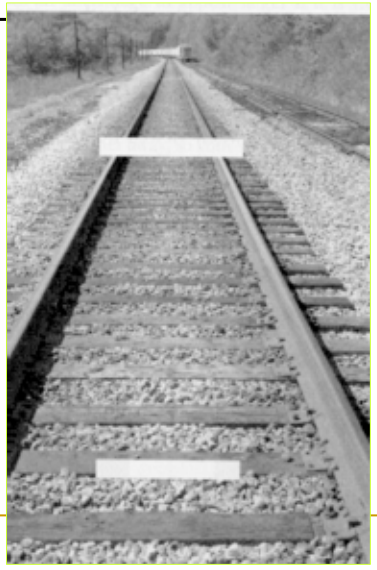
Ponzo Illusion



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Ames Room