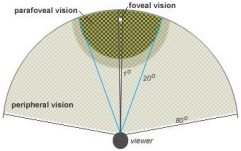
Statistics 120
Vision II

High Resolution Vision

- For a full visual examination of objects, we must move our eyes so that all parts of the object's image fall for a time on the fovea.
- We do this by moving our eyes from place to place over the object in a jerky fashion.



Eye Movements

- *Fixation* : A period of time when the eye is focused on a single point.
- *Saccade* : An eye motion from one fixation point to another.
- Normal vision alternates between saccades and fixations, with each lasting just 100ths of a second.

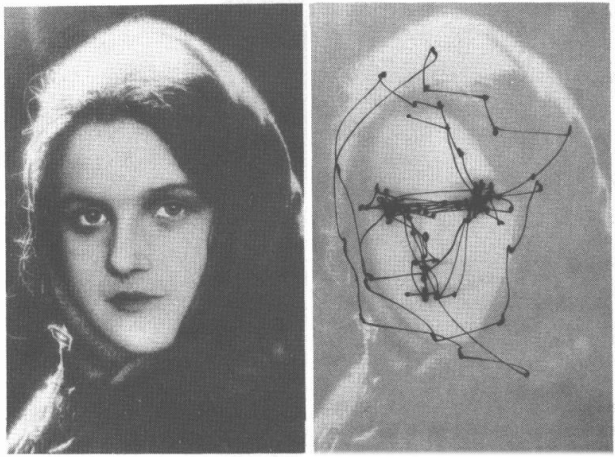
Eye Movement Studies

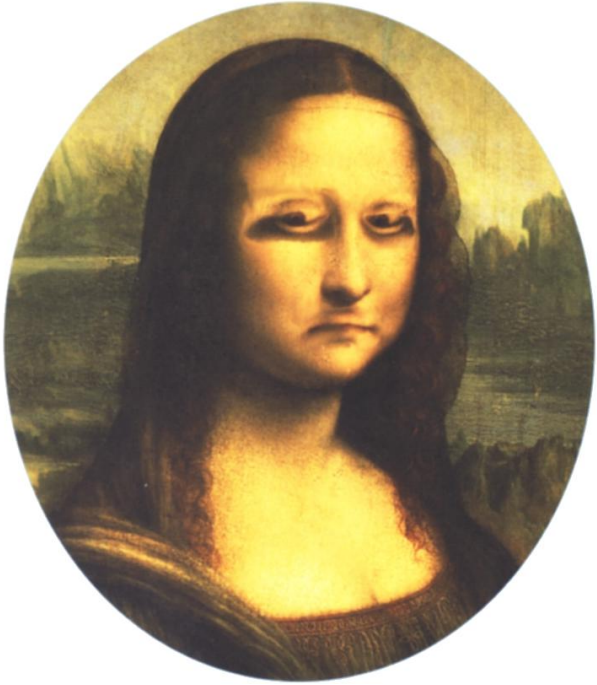
- An image is presented to a subject.
- The subject may (or may not) be given a specific task to carry out.
- A record is made of where the subjects eyes are directed as they study the image.

Studies by I. L. Yarbus

- Experimental work carried out in Russia during the 1940s and 1950s.
- A suction “cap” was fitted directly onto a subject’s eyeball.
- A small mirror on the cap reflected a light beam on to photo-sensitive paper.

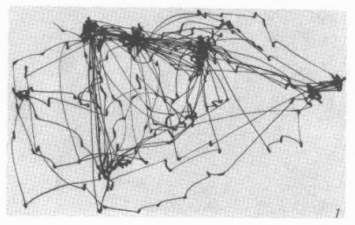
How We Look At Faces



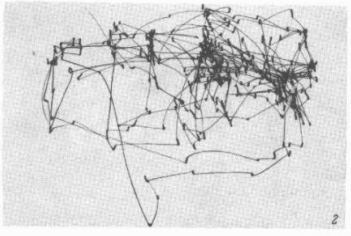


An Unexpected Visitor by I. E. Repin.

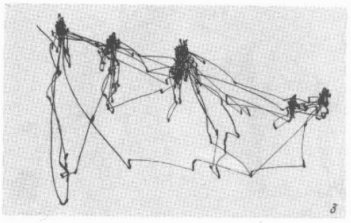
Examine the picture



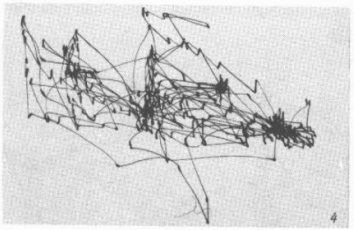
Decide how wealthy the family is



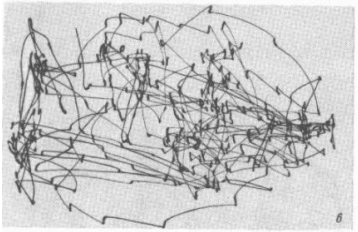
Estimate the ages of the people in the room



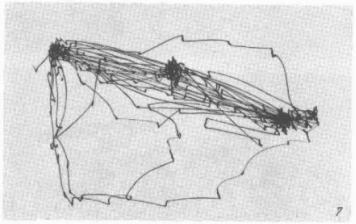
Decide what the family were doing before the visitor arrived

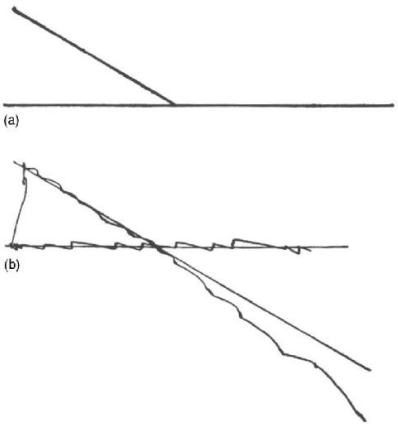


Remember the position of the objects and people in the room



Estimate how long the visitor has been away





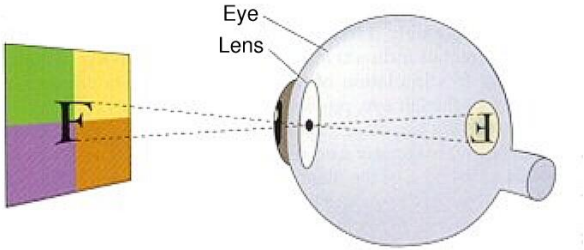
Trace the figure right-to-left, then trace the sloping line and follow its direction beyond the horizontal line.

Seeing in Three Dimensions

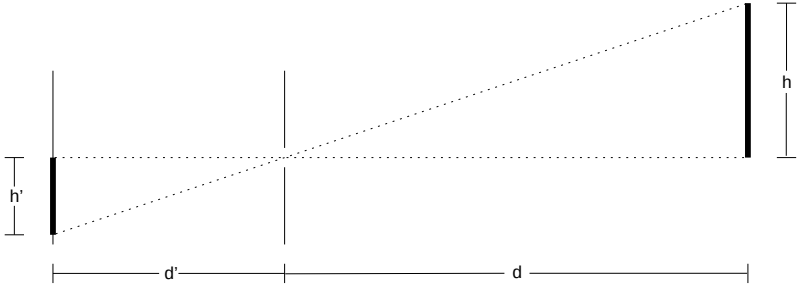
- Images projected through the pupil on to the retina are two dimensional.
- When we look at the world, we perceive it as three dimensional.
- How do we achieve this sense of depth?

The Eye as a Pinhole Camera

- Because light passes through a narrow hole (the pupil) before begin projected on the retina, the eye acts as a pinhole camera.
- Left/Right and Up/Down are inverted.



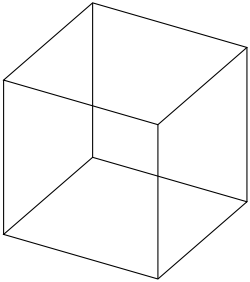
Perspective



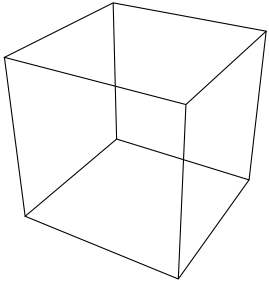
$$\frac{h'}{d'} = \frac{h}{d} \qquad h' = \frac{d'}{d}h$$

Perspective Example

Projections



Orthographic



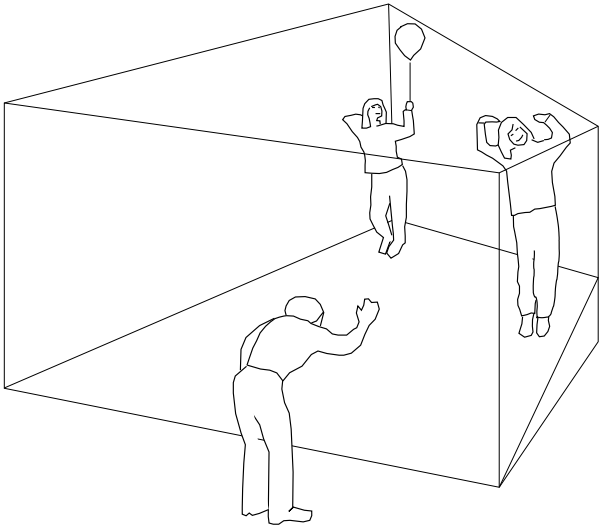
Perspective

Perspective as a Depth Cue

- Perspective gives us information about depth for objects at near to medium distances.
- When there is any hint of perspective, our visual systems try hard to extract depth information from the scene.
- We can be fooled by the appearance of perspective.

The Ames Room

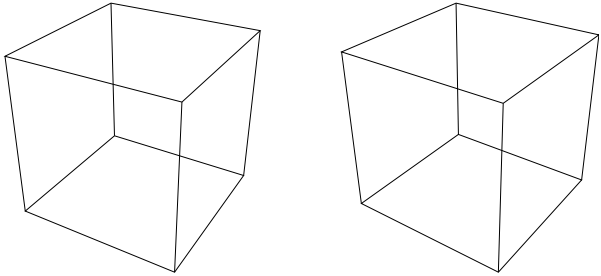
The Ames Room Explanation



Stereoscopic Vision

- Each of our eyes occupies a different position in space.
- When we look at an object, each eye sees a slightly different image.
- The brain can use the difference between the images to infer depth information.

A Cube As Seen By The Left And Right Eyes

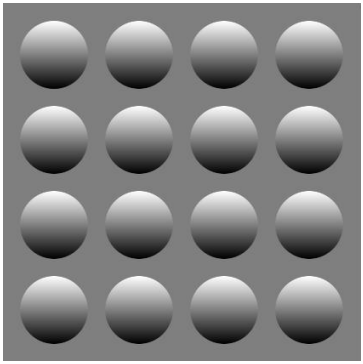


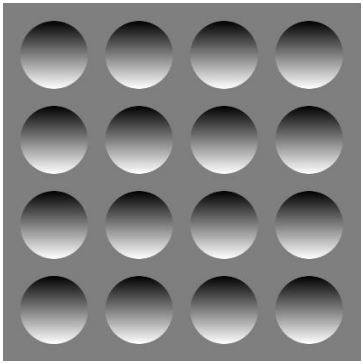
A Stereopticon and Virtual Reality Helmet

Light and Shade

- The pattern which light makes when it falls on an object can give us strong depth information.
- Light and shadow can reveal very fine detail on the surface of illuminated objects.

Lighting Effects

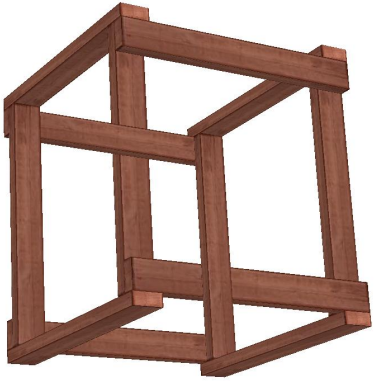




A Shaded Relief Topographic Map

Occlusion

Objects which are close, hide objects further away.



Haze and Fog