

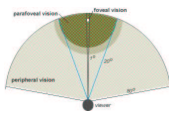
Statistics 120 Vision II

Studies by I. L. Yarbus

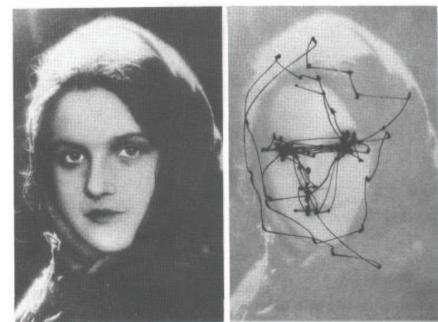
- Experimental work carried out in Russia during the 1940s and 1950s.
- A suction “cap” was fitted directly onto a subject’s eyeball.
- A small mirror on the cap reflected a light beam on to photo-sensitive paper.

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.



How We Look At Faces



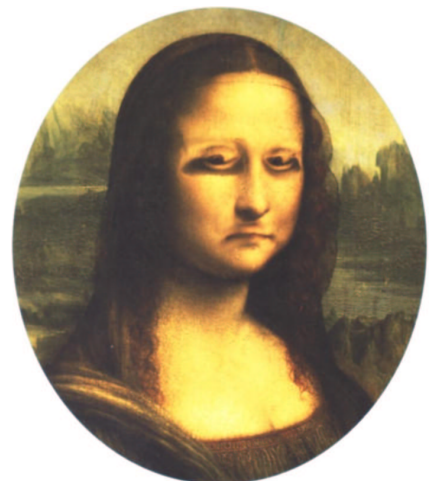
Eye Movements

- *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

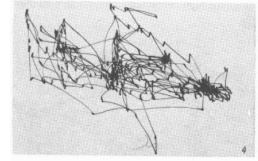
- An image is presented to a subject.
- The subject may (or may not) be given a specific task to carry out.
- A record is made of where the subjects eyes are directed as they study the image.



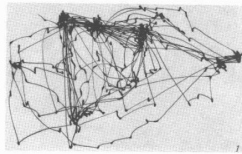
An Unexpected Visitor by I. E. Repin.



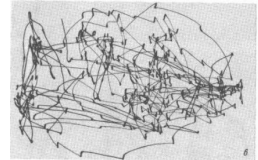
Decide what the family were doing before the visitor arrived



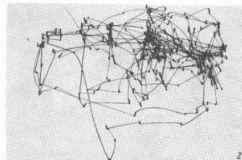
Examine the picture



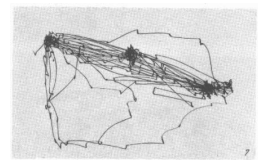
Remember the position of the objects and people in the room



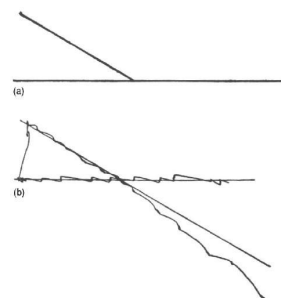
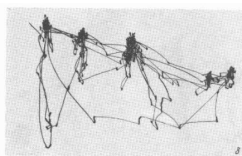
Decide how wealthy the family is



Estimate how long the visitor has been away



Estimate the ages of the people in the room

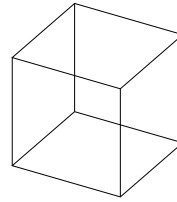


Trace the figure right-to-left, then trace the sloping line and follow its direction beyond the horizontal line.

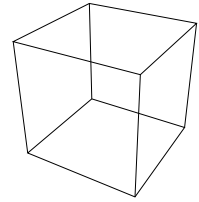
Seeing in Three Dimensions

- 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?

Projections



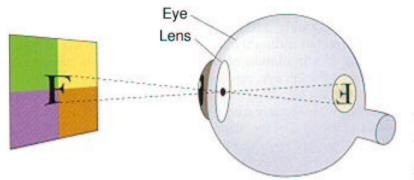
Orthographic



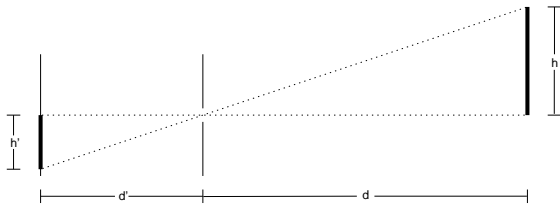
Perspective

The Eye as a Pinhole Camera

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



Perspective



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

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.

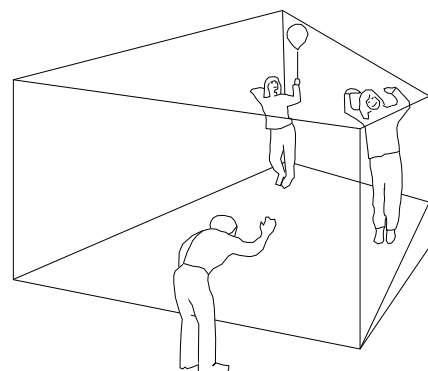
The Ames Room



Perspective Example



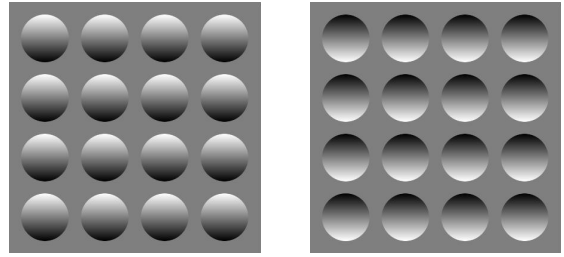
The Ames Room Explanation



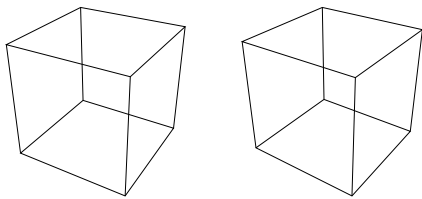
Stereoscopic Vision

- 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.

Lighting Effects



A Cube As Seen By The Left And Right Eyes



A Shaded Relief Topographic Map

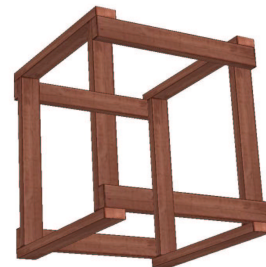


A Stereopticon and Virtual Reality Helmet



Occlusion

Objects which are close, hide objects further away.



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.

Haze and Fog

