

Visual Perception of Depth and Movement

The problem of perception

Where is an object? How do we know? Where is it going? What is it? How do we recognize an object?

Perception of 3-D space

Perceiving 2-D objects is fairly simple because 2-D visual images are already constructed at the level of the retina. The non-trivial 3-D perception that we experience everyday results, however, from our visual system's use of *depth cues*.

Because the position of the eyes and the shape of the lens are correlated with the distance of the objects we see, ***convergence***, or the pointing of the eyeballs (for objects closer than 10 feet) and ***accommodation*** (the changing of the shape of the lens in the eye) act as oculomotor cues for depth.

Because we see the world with two eyes that provide us with slightly different views, ***retinal image disparity*** (or binocular parallax) is a binocular cue for depth. Some neurons in the visual cortex are able to detect retinal disparity and act as *depth detectors*.

Monocular or ***pictorial cues*** for depth perception also exist: interposition, linear perspective, relative size, texture gradients, shading.

Our constant moving through space provides an additional source of visual information about the 3-D spatial arrangement of objects around us. Whenever we move, the images projected by objects located at different distances move across our retina with different speed, creating distinct patterns of motion in the retinal images (***motion parallax***, *optic flow*).

Perception of Movement

Our perception of movement arises from the motion of images across the retina as detected by visual neurons that either simply sensitive to motion or specifically selective to the direction of motion of visual stimuli. These neurons act as *motion detectors*.

Nevertheless, motion can be perceived even when there is no motion of an image across the retina. Appropriately timed change in position is sufficient for the visual system to make something appear as moving. Visual neurons detecting real motion are also sensitive to apparent motion.

We not only detect motion, we also interpret it. The elements surrounding an object influence and can even induce the perceived motion of this object. The perceptual system is at all times confronted by the *correspondence problem*, i.e., determining which elements of the current view corresponds with which elements in the previous view.