



Chapter 8

Perceiving Motion

Icebreaker: Spy Game Simulation

1. The class will be broken up into small groups.
2. Each group of students will discuss physical movements and actions that can be taken to hide one's face from a street or store camera.
3. Students will reconvene into a larger group to discuss their findings.
4. Students will consider the movements or actions that were not considered in the smaller discussion groups.

Chapter Objectives (1 of 2)

08.01 Describe five different functions of motion perception.

08.02 Understand the difference between real motion and illusory motion and what research has revealed about the relationship between them.

08.03 Describe how we perceive motion both when we move our eyes to follow a moving object, and when we keep our eyes steady as an object moves across our field of view.

08.04 Understand the multiple neural mechanisms that explain motion perception.

Chapter Objectives (2 of 2)

- 08.05 Describe why we need to go beyond considering the responses of single neurons to understand the physiology of motion perception.
- 08.06 Understand how perceiving the movement of the body has been studied both behaviorally and physiologically.
- 08.07 Describe what it means to say that we can perceive motion in still pictures.
- 08.08 Describe how infants perceive biological motion.

Functions of Movement Perception

Survival in the environment

- Predators use the movement of prey as a primary means of location in hunting.
- Attentional capture: motion attracts attention to the moving object.
- Thus, if prey remains motionless, it is less likely to be noticed.
- Akinetopsia: blindness to motion

Studying Motion Perception (1 of 2)

Real motion: an object is physically moving

Illusory motion

- Apparent movement: stationary stimuli are presented in slightly different locations
- Basis of movement in movies and TV

Induced motion: movement of one object results in the perception of movement in another object.

Studying Motion Perception (2 of 2)

Motion aftereffect

- Observer looks at movement of object for 30 to 60 seconds.
- Then, observer looks at a stationary object.
- Movement appears to occur in the opposite direction from the original movement.
- The waterfall illusion is an example of this.

Comparison of Real and Apparent Motion (1 of 2)

Experiment by Larsen et al.

- Participant is scanned by an fMRI while viewing three displays.
 - Control condition: two dots in different positions are flashed simultaneously.
 - Real motion: a small dot is moved back and forth.
 - Apparent motion: dots are flashed so they appear to move.

Comparison of Real and Apparent Motion (2 of 2)

Results:

- Control condition: each dot activated a separate area of visual cortex.
- Apparent and real motion: activation of visual cortex from both sets of stimuli was similar.
- Thus, the perception of motion in both cases is related to the same brain mechanism.

What We Want to Explain

An object moves, and the observer is stationary.

- Movement creates an image that moves on the observer's retina.

An object moves, and the observer follows the object with his or her eyes.

- Movement is tracked so that the image is stationary on the retina.

An observer moves through a stationary environment.

- Image of the environment moves across the retina, but environment is perceived as stationary.

What mechanism explains all three situations?

Motion Perception: Information in the Environment

Ecological approach (Gibson)

- Information is directly available in the environment for perception.
 - Optic array: structure created by surfaces, textures, and contours, which change as the observer moves through the environment.

Local disturbance in the optic array

- Objects relative to background, such that it is covered and uncovered

Global optic flow

- Overall movement of optic array
 - Indicates that the observer is moving, not the environment

Motion Perception: Retina/Eye Information (1 of 2)

Local disturbance in the optic array

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Global optic flow

- Overall movement of optic array
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Corollary discharge theory: movement perception depends on three signals.

- Image displacement signal (IDS): movement of image stimulating receptors across the retina
- Motor signal (MS): signal sent to eyes to move eye muscles
- Corollary discharge signal (CDS): split from the motor signal

Motion Perception: Retina/Eye Information (2 of 2)

Movement is perceived when comparator receives input from:

- Corollary discharge signal
- Image displacement signal

Movement is not perceived when comparator receives input from:

- Both corollary discharge and image displacement signals at the same time

Physiological Evidence for Corollary Discharge Theory

Damage to the medial superior temporal area in humans leads to the perception of movement of stationary environment with movement of eyes.

Real-movement neurons found in monkeys that respond only when a stimulus moves and do not respond when eyes move.

Motion Perception in the Brain

Perception of motion begins in the striate cortex, the region of the occipital lobe where information from the retinas first reaches the cortex.

Neurons on the striate cortex respond to movement of the ends of objects.

Middle temporal (MT) area

Firing and coherence experiment by Newsome et al.

- Coherence of movement of dot patterns was varied.
- Monkeys were taught to judge the direction of dot movement and measurements were taken from MT neurons.
- Results showed that as coherence of dot movement increased, so did the firing of the MT neurons and the judgment of movement accuracy.

Effect of Lesioning, Deactivating, and Stimulating

Microstimulation

- Small wire electrode causes specific neurons in the cortex to fire

Britten et al. (1992)

- Monkey sees dots moving right, responds that dots are moving right.
- Researchers microstimulate neurons activated by downward motion.
- Monkey responds to dots that are moving down AND to the right.

Motion from a Single Neuron's Point of View

Complex cortical cells respond preferentially to an oriented bar moving in a specific direction.

Aperture problem: observation of a small portion of larger stimulus leads to misleading information about direction of movement

- Activity of a single complex cell does not provide accurate information about the direction of movement.

Solving the Aperture Problem

Aperture problem:

- Viewing only a small portion of a larger stimulus can result in misleading information about the direction in which the stimulus is moving.

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- Viewing only a small portion of a larger stimulus can result in misleading information about the direction in which the stimulus is moving.

Motion and the Human Body

Apparent motion of the body

Biological motion: movement of person or other living organism

- Point-light walker stimulus: biological motion is made by placing lights in specific places on a person.
- Structure-from-motion takes place with point-light walkers.
- Neurological studies show biological motion is processed by STS and FFA.

Grossman et al.

- Participants viewed point-light stimuli for activities.
- The task was to determine whether motion was biological or scrambled.
- Noise was added to dots so they could only achieve 71% accuracy.
- Transcranial magnetic stimulation applied to STS caused a decrease in the ability to detect biological motion.

Motion Responses to Still Pictures

Implied motion are still pictures that depict an action that involves motion.

Representational momentum: observers show that the implied motion is carried out in the observer's mind.

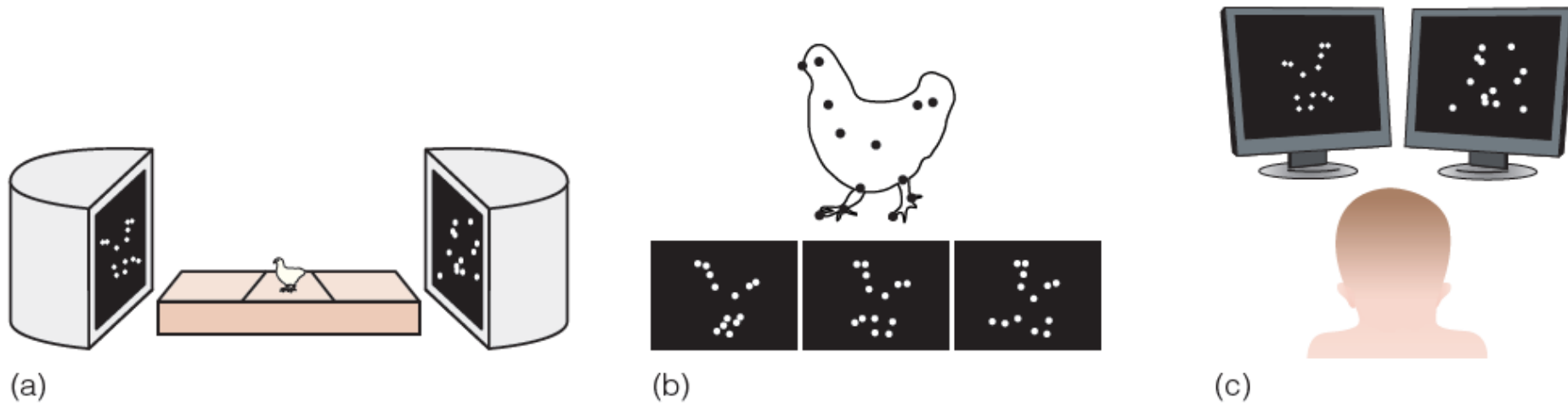
Experiment by Kourtzi and Kanwisher

- fMRI response was measured in MT and MST to pictures with:
 - Implied motion
 - No-implied motion
 - At rest
 - Houses
- Results showed areas of brain responsible for motion fire in response to pictures of implied motion.

Motion Preference Amongst Newborn Babies

Perception of biological motion may not depend on visual experience.

Vallortigara and his coworkers (2005) examined the preferences of newly hatched chicks for different types of motion.



Chapter Summary (1 of 2)

Now that the lesson has ended, you should have learned how to:

- Describe five different functions of motion perception.
- Understand the difference between real motion and illusory motion and what research has revealed about the relation between them.
- Describe how we perceive motion both when we move our eyes to follow a moving object, and when we keep our eyes steady as an object moves across our field of view.
- Understand the multiple neural mechanisms that explain motion perception.

Chapter Summary (2 of 2)

- Describe why we need to go beyond considering the responses of single neurons to understand the physiology of motion perception.
- Understand how perceiving movement of the body has been studied both behaviorally and physiologically.
- Describe what it means to say that we can perceive motion in still pictures.
- Describe how infants perceive biological motion.