Sensation & Perception

Ch. 8: Perceiving Movement

© Takashi Yamauchi (Dept. of Psychology, Texas A&M University)

Main topics

The functions of motion perception
The direction of movement
Perceiving movement

• How do we perceive movement?

• How come we perceive movement even when things are not actually moving?
4 different ways to create the perception of movement

• **Real movement**
  – The object is physically moving

• **Apparent movement**
  – Displacement of objects

• **Induced movement**

• **Movement aftereffect**
What does this tell?

- Apparent motion
- Movement aftereffect

Inhibitory mechanism?
Functions of Movement Perception

- Survival in the environment
  - Predators use movement of prey as a primary means to location in hunting
  - Motion agnosia
    - Damage to the cortex resulting in inability to perceive movement
    - Extremely debilitating and dangerous for the patient
• Motion agnosia
• Video clip:
Functions of Movement Perception - continued

• Perceiving objects
  – Movement of objects or the observer’s movement through objects help perceive the 3D organization of stimuli
  – Kinetic depth effect - movement of an object’s 2-D shadow can change into perception of a 3-D object
    • This is an example of structure-from-motion

– Perceptual organization
Figure 9.4 Setup similar to the one used by Wallach and O’Connell (1953) to demonstrate the kinetic depth effect.
– Demonstration: structure-from-motion

• http://www.cs.ubc.ca/nest/imager/contributions/flinn/Illusions/Illusions.html
Motion parallax

• Demonstration
  – Depth perception by motion

• YouTube
  – http://video.google.com/videoplay?docid=-5983729407150064898&q=motion+parallax&total=43&start=0&num=10&so=0&type=search&plindex=2
Perceptual organization and movement perception

- Grouping objects that move together.
- Demonstration
  - My program
Motion detection is very basic

- You can detect motion with peripheral vision (you don’t need to capture an image on the fovea).
The distribution of cones and rods on the retina

- Cones are concentrated mainly on the fovea.
- There are no rods on the fovea.
- We move eyes to capture images on the fovea.
Three Situations that Lead to Movement Perception

• 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
Three Situations the Lead to Movement Perception - continued

• An observer moves through a stationary environment
  – Image of environment moves across retina but environment is perceived as stationary

• What mechanism explains all three situations?
Figure 9.6 In (a) and (b), Jeremy walks past as Maria observes him. Maria perceives him as moving in (a), when his image moves across her retina, and in (b), when his image stays fixed on her fovea. In (c), when Maria walks through the environment, she perceives the environment as stationary, even though its image is moving across her retina. The text describes how the stimulus information provided by the optic array and global flow helps determine these perceptions.
Physiological Approach: Corollary discharge theory

- movement perception depends on three signals
  - Motor signal (MS),
    - which is sent to the eye muscles when the observer moves or tries to move her eyes.
  - Corollary discharge signal (CDS),
    - which is a copy of the motor signal.
  - Image movement signal (IMS),
    - which occurs when an image stimulates the receptors as it moves across the retina.
Corollary discharge theory

- When either **CDS** (corollary discharge signal) or **IMS** (image movement signal) is sent to the structure called “Comparator”, we perceive motion.

- Movement is **not** perceived when comparator receives input from - Both **CDS** and **IMS**.
When you push your eyelid, your eye and the image you get move too, but you don’t perceive “motion.”

**CDS or IMS** → Movement perception  
**CDS And IMS** → No movement perception
Movement perception

(a) Signal to cortex

(b) Signal to cortex

(c) No signal

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Physiological Evidence for Corollary Discharge Theory

• Damage to the medial superior temporal area leads to perception of movement of stationary environment with movement of eyes
Visual Pathway (MT)
Determining Direction of Fields of Moving Dots

• Firing and coherence experiment by Newsome et al.
  • Coherence of movement of dot patterns 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
Perceiving motion

A monkey is shown random dots moving in a particular direction.
• As the correlated movement of random dots increased, neurons in MT fired more.

MT (Middle temporal area)
• Let the monkey learn to point to the direction of the movement.

The monkey pressed the “Up” button

• Stimulate the monkey’s MT neurons without showing the visual stimuli

The monkey pressed the “Up” button
Determining Direction of Fields of Moving Dots - continued

• Lesioning experiment by Newsome and Paré

  – Normal monkeys can detect motion with coherence of 1 or 2%

  – Monkeys with lesions in MT cortex cannot detect motion until the coherence is 10 to 20%
Neural mechanism

- Neurons that are sensitive to the direction of motion

- Sequential activation in a visual field induces the perception of movement.
• Neurons that are sensitive to a specific direction of motion.

• Inhibitory connections

Figure 8.14
A neural circuit in which a neuron (M) responds to the movement of a stimulus across the receptors from right to left. The neuron does not, however, respond to movement from left to right.
Figure 8.15

What happens as a light moves across the receptors of Figure 8.14. (a and b) Movement of a light from left to right; (c and d) movement from right to left.
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  – Perceptual organization
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The intelligence of movement perception

• Top-down processes

  – Certain stimuli (like the human body) have special meaning that affects perception
Motion Perception and Past Experience

• Biological motion - movement of person or other living organism
  – Point-light walker stimulus - biological motion 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 in the superior temporal sulcus (STS)
Figure 9.18 Frames from the stimuli used by Grossman and Blake (2001). (a) Sequence from the point-light walker stimulus. (b) Sequence from the scrambled point-light stimulus.
Biological Motion (Demonstration)

http://www.biomotionlab.ca/