Motion Perception

DT2350 Human Perception for Information Technology

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HT 2015

Literature

Goldstein, E. (2009/2014) **Sensation and Perception**

- Chapter 8: Motion Perception

Weinschenk, S.M. (2011) **100 Things Every Designer Needs to Know About People**

- surprisingly I could not find any relevant chapter

Motion Perception

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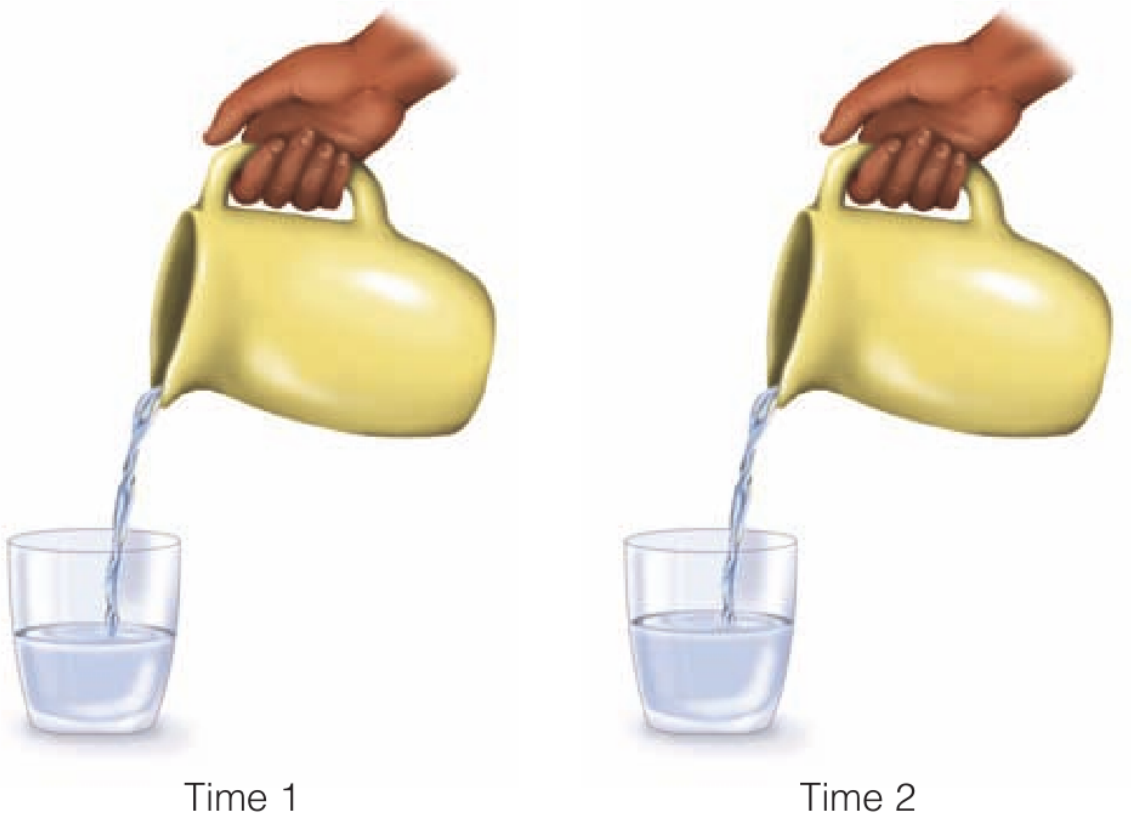
1. stationary observer, moving stimuli
2. moving observer

Importance of Motion Perception

- detect danger
- perceive behaviour
- disambiguate vision

Motion Agnosia

Example: 43-years-old woman who suffered a stroke



Zihl et al. (1983,1991)

Motion as Attention Capture

The three "F"s

1. Fight
2. Flee
3. Freeze

3. makes it harder to differentiate between the animal and the background

Camouflage Demonstration

Regan (1986)

Camouflage Demonstration

Regan (1986)

Explanation

- bird hard to see because same lines as background
- movement perceptually organises bird lines into one object

Important Even Without Camouflage

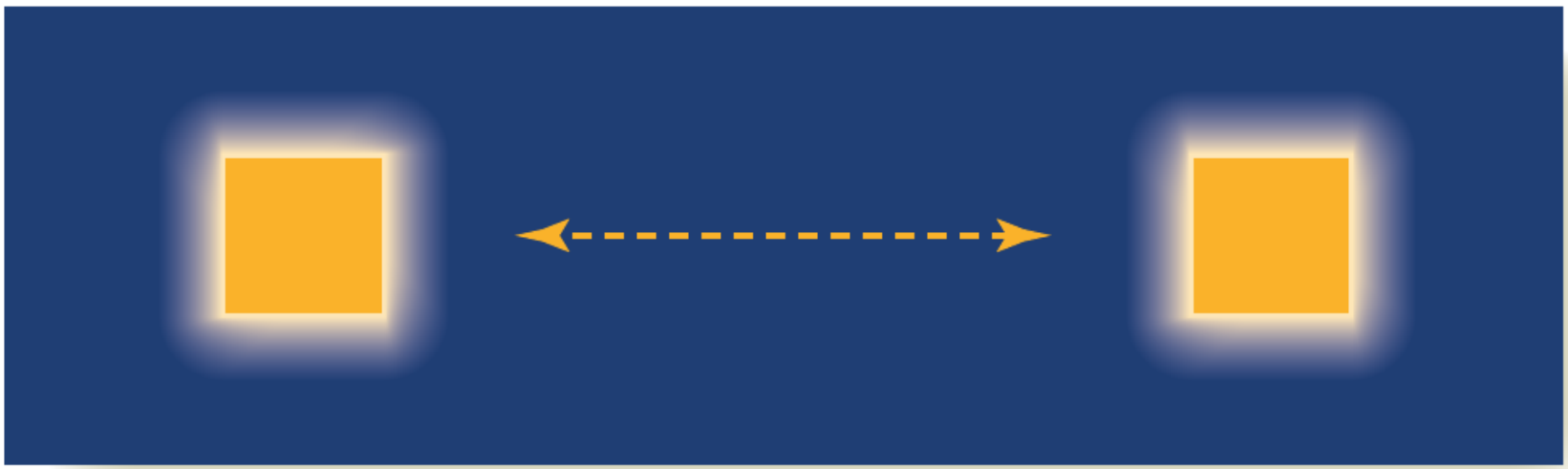
- vision is ambiguous
- pattern recognition more difficult than movement detection
- research show we perceive shapes more accurately if the object is moving

Real vs Illusory Motion

Illusory motion:

- apparent motion
- induced motion
- motion aftereffects

Apparent Motion

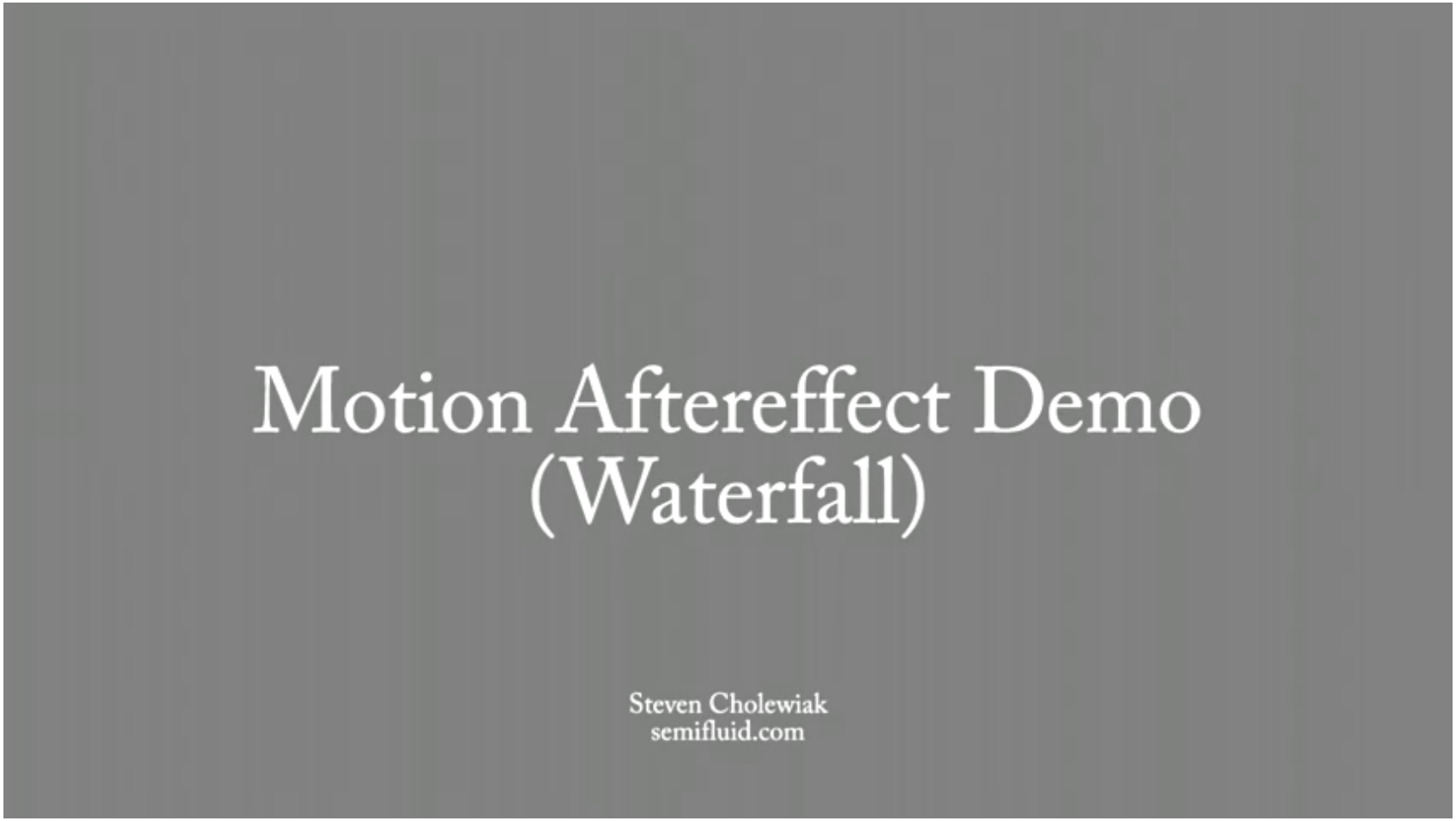


It is the basis for movies and television

Induced Motion

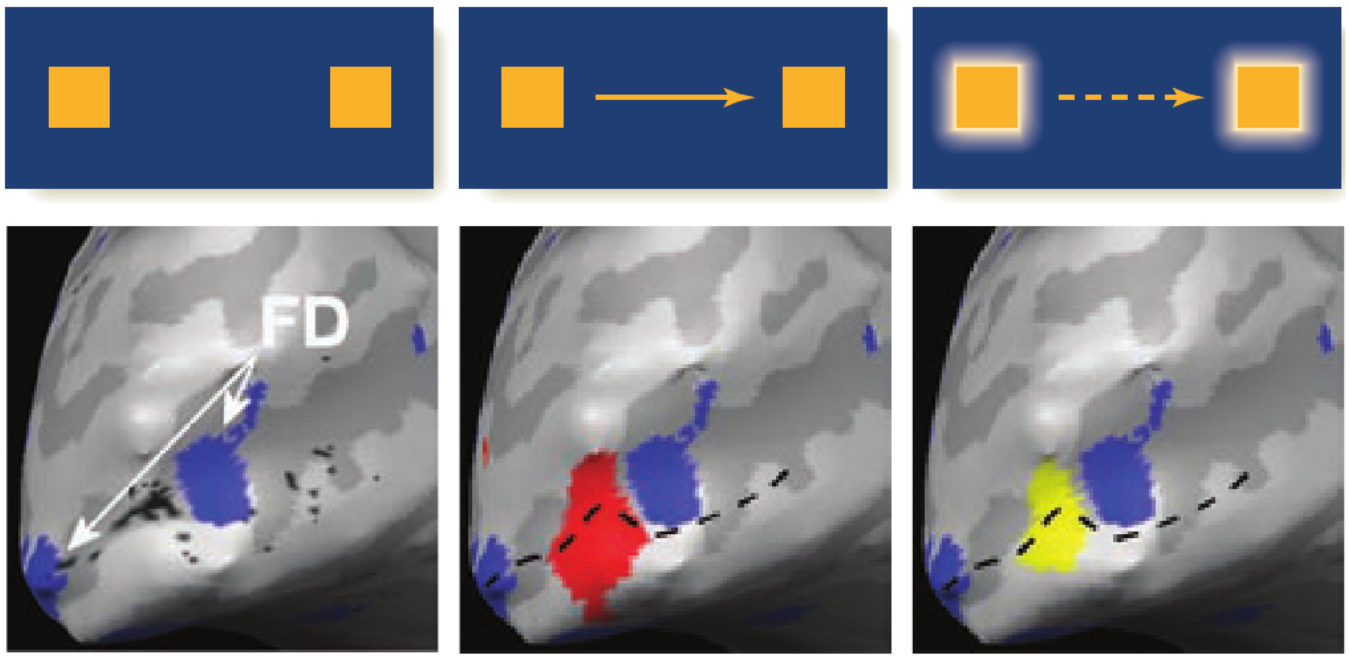
Motion Aftereffects

Demonstration



http://youtu.be/oNhcpOIQCNs

Are Real and Apparent Motion Different Perceptually?



Visual cortex
Larsen et al. (2006)

Motion Perception Cannot Be Explained with the Retina

(a) Jeremy walks past Maria; Maria's eyes are stationary
(creates local disturbance in optic array)

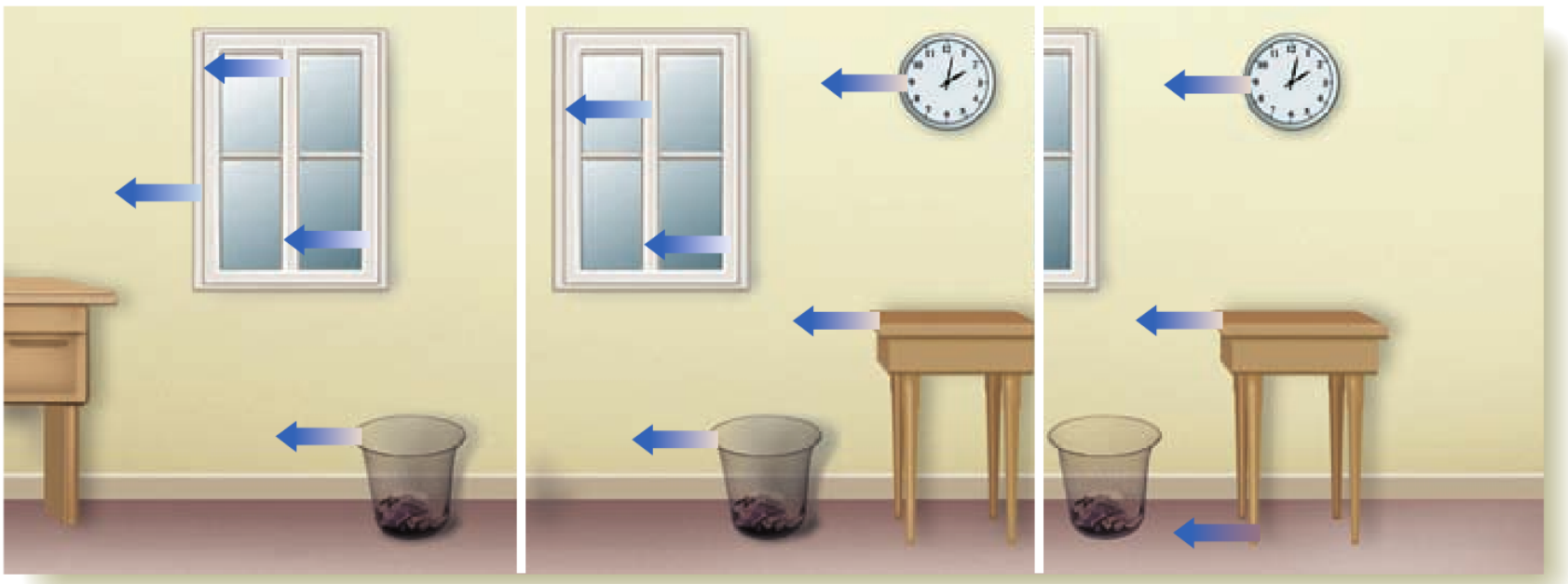
Jeremy walks, Maria looks straight at the window

Motion Perception Cannot Be Explained with the Retina

(b) Jeremy walks past Maria; Maria follows him with her eyes
(creates local disturbance in optic array)

Jeremy walks, Maria follows him with the eyes

Motion Perception Cannot Be Explained with the Retina



(c) Maria walks through the scene
(creates global optic flow)

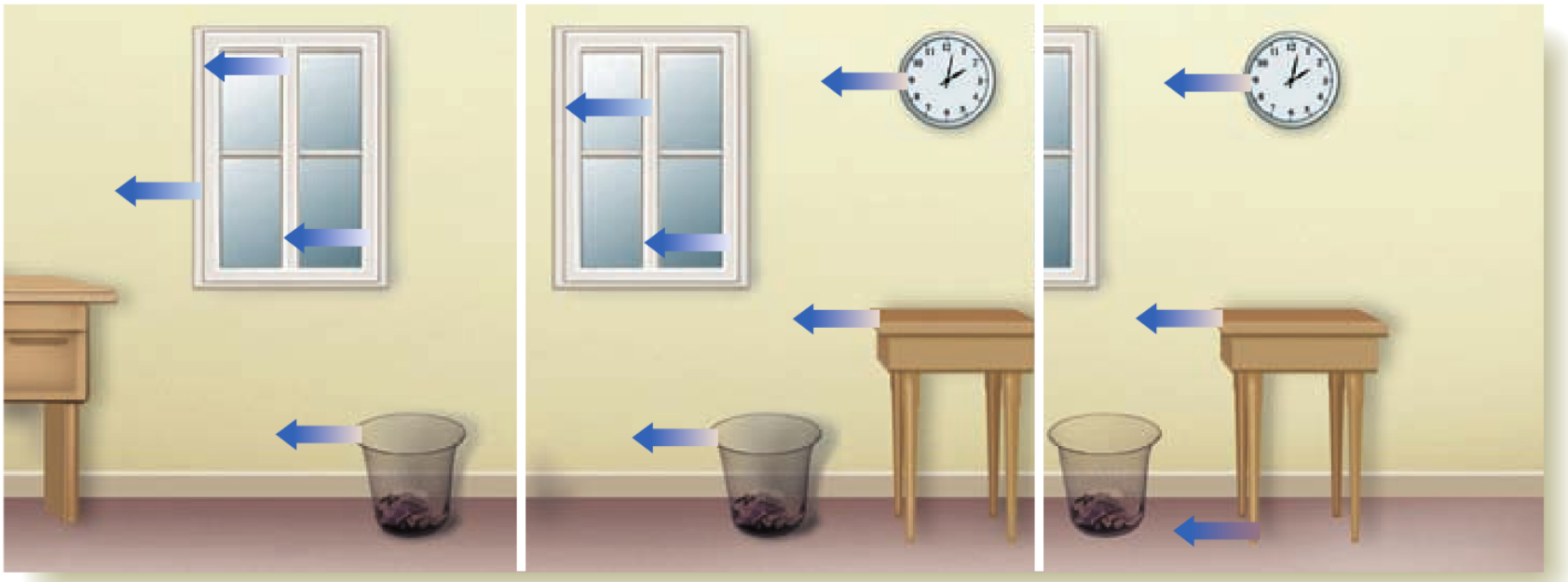
Maria walks in the room

Information In The Environment

Gibson: disregard the retina

- Jeremy generates a local disturbance of the optic array
- this happens both if Maria looks straight or follows him
- when Maria moves it is different: global optic flow

Global Optic Flow

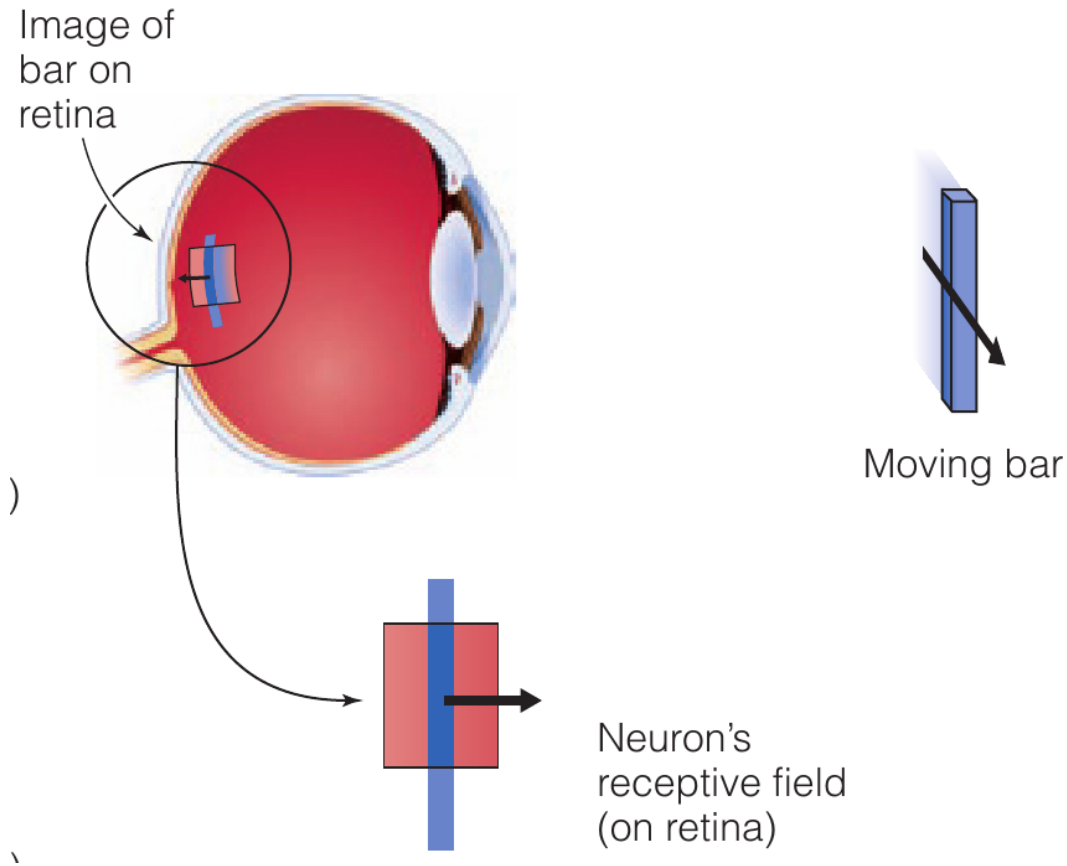


(c) Maria walks through the scene
(creates global optic flow)

- in this case everything moves
- this tells Maria that what she sees is stationary and that she is the one moving

Neural Explanation of Motion Perception

Reichardt detector

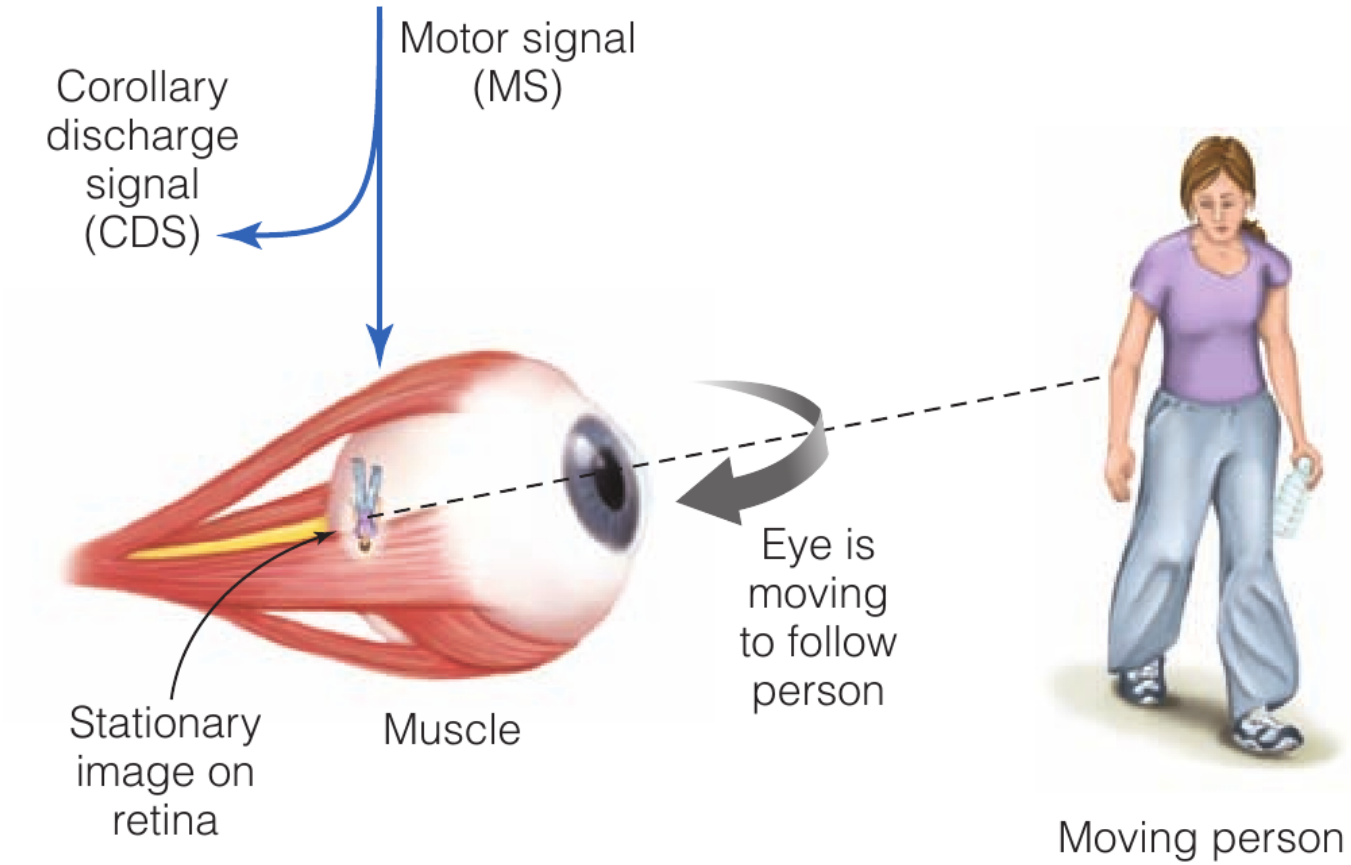


Werner Richardt (1969)

Problems

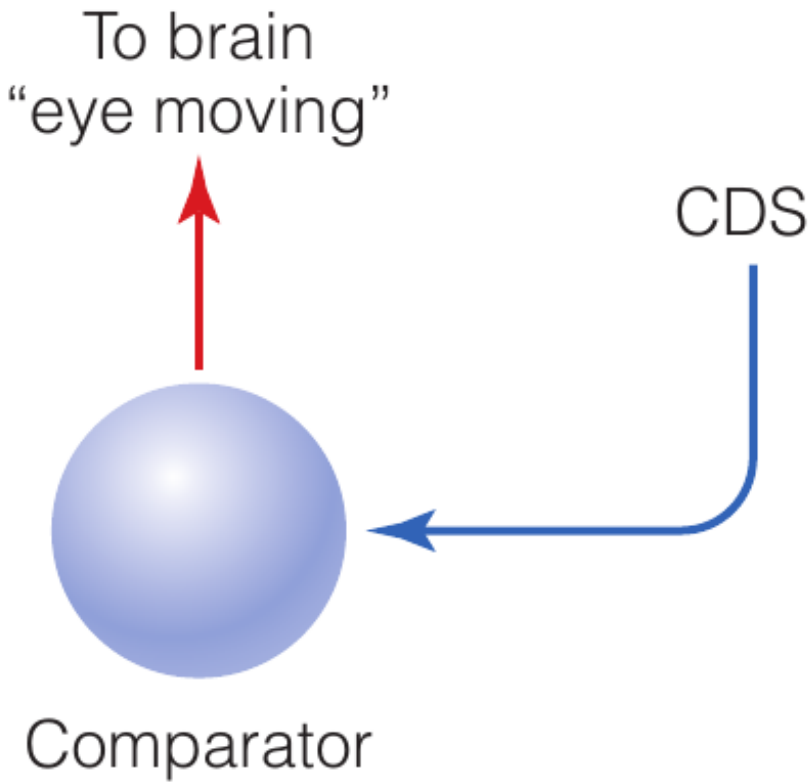
- Eye motions: Corollary discharge theory
- Aperture problem (neuron receptive field)

Taking Eye Motions Into Account



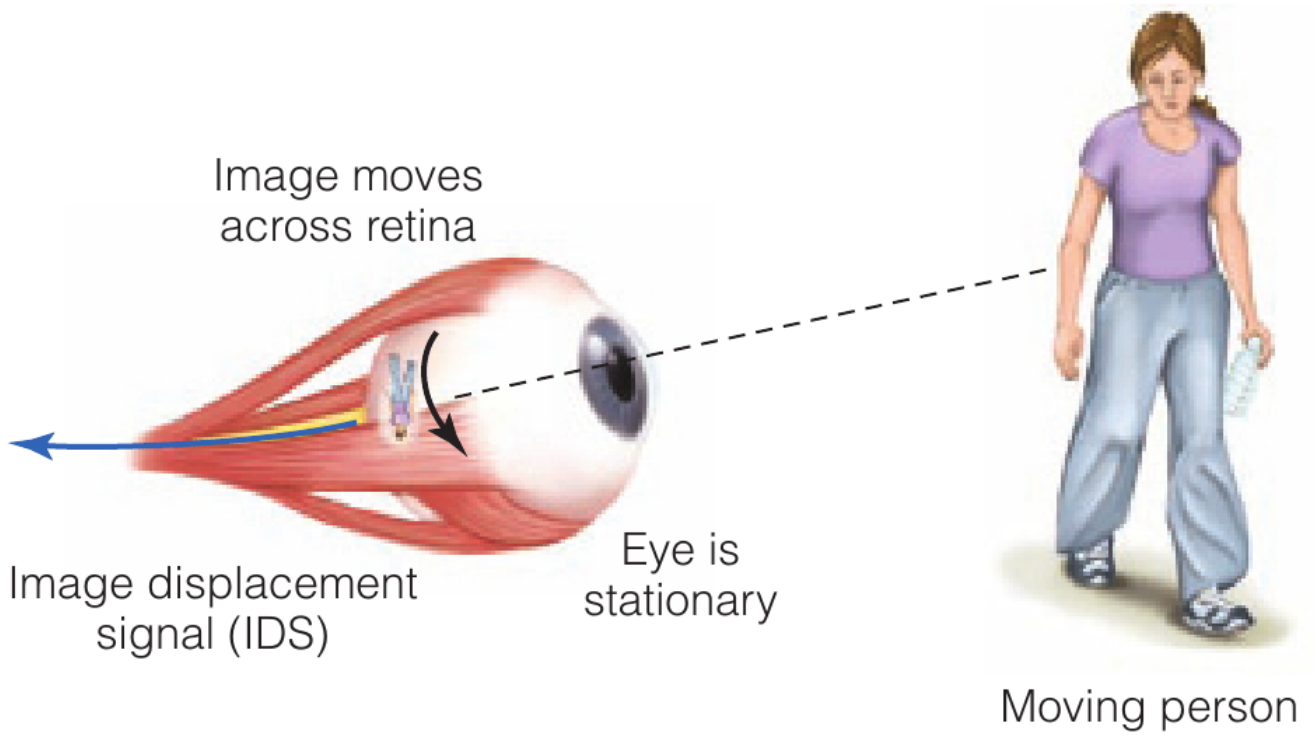
NOTE: the book does not take head movements into account

Corollary Discharge Model

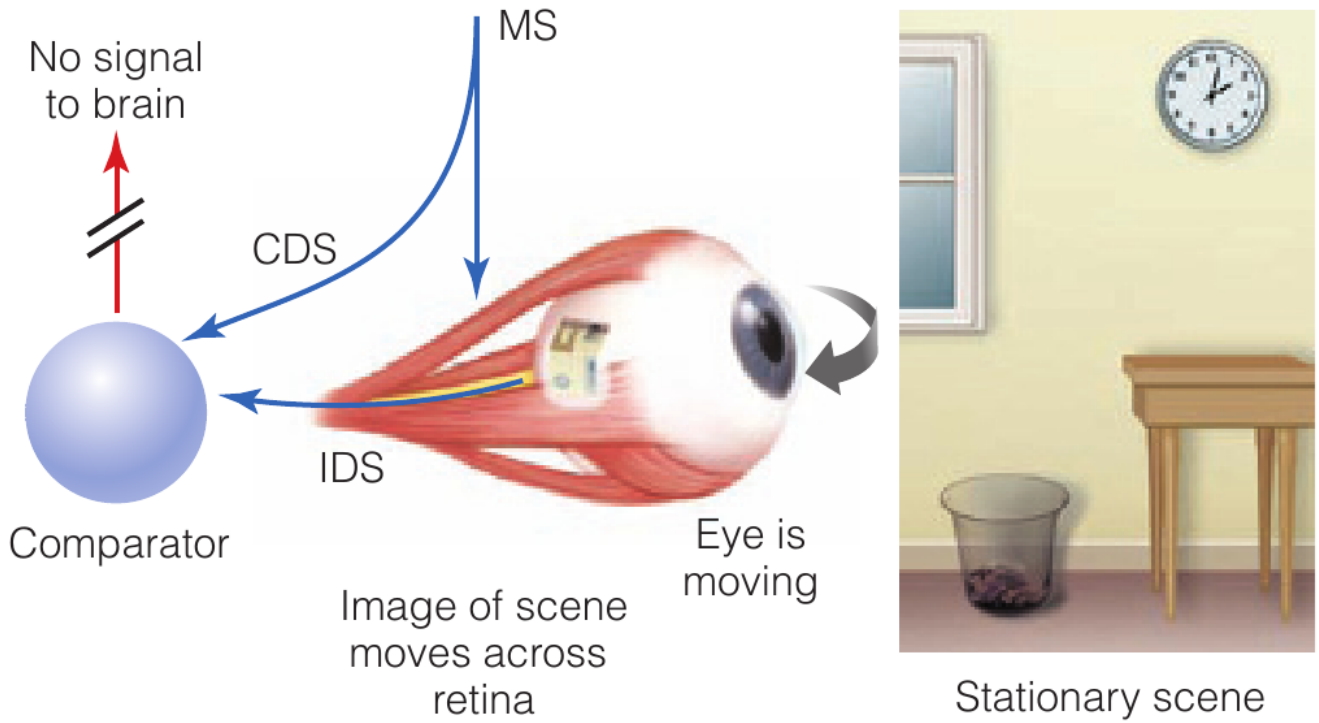


- corollary discharge signal (CDS)
- image displacement signal (IDS)

CDM: Moving Person

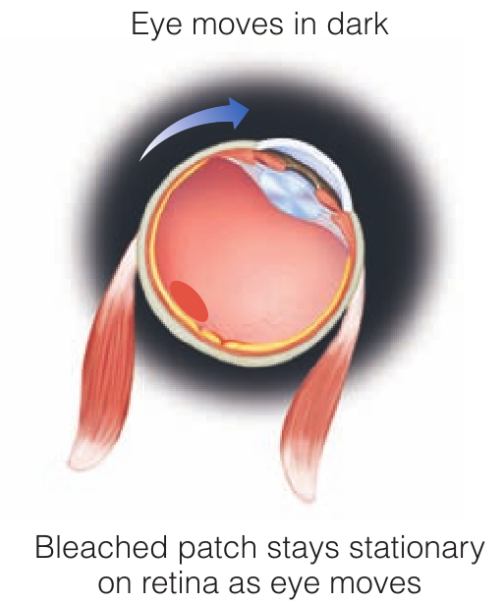


CDM: Scanning Stationary Scene



Behavioural Demonstration 1

corollary discharge (eye movement) without image displacement



Behavioural Demonstration 2

corollary discharge (muscle contraction) without image displacement

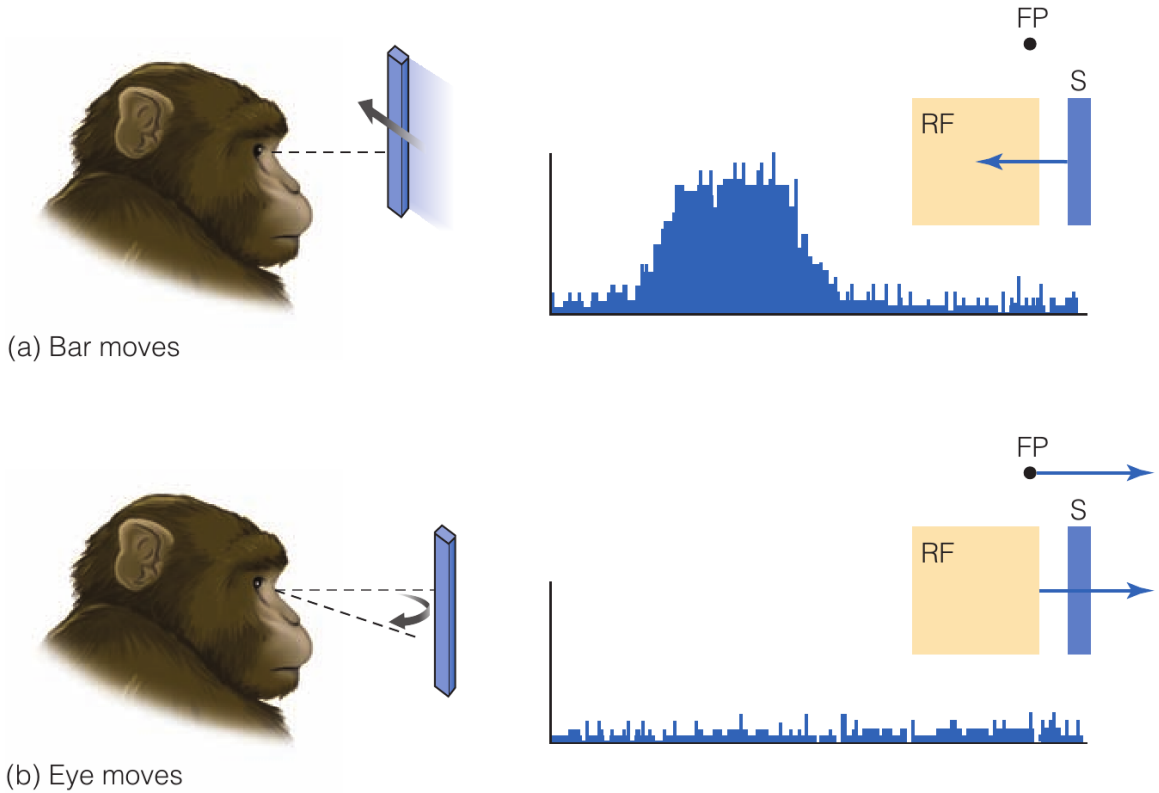
Physiological Evidence

- patient with lesions
- did not receive corollary discharge
- everything moved around when he moved his eyes

Haarmeier et al. (1997)

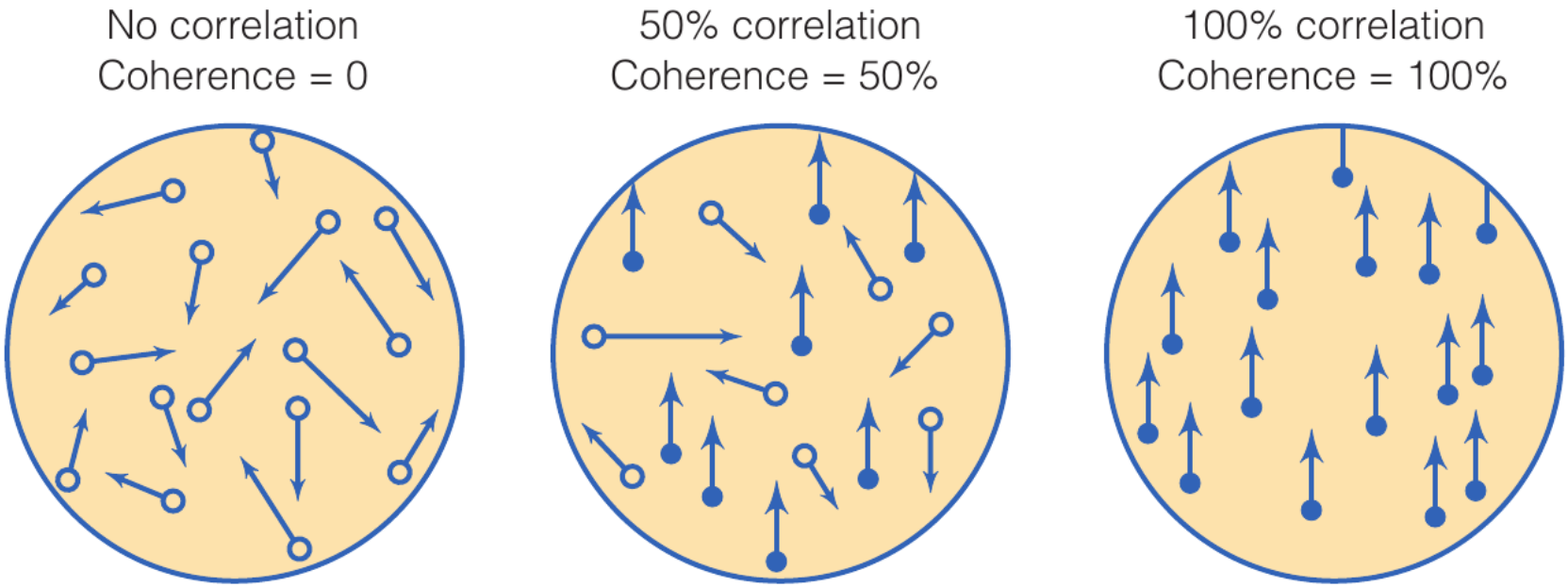
Physiological Evidence in Monkeys

"real motion neuron"



Galletti and Fattori (2003)

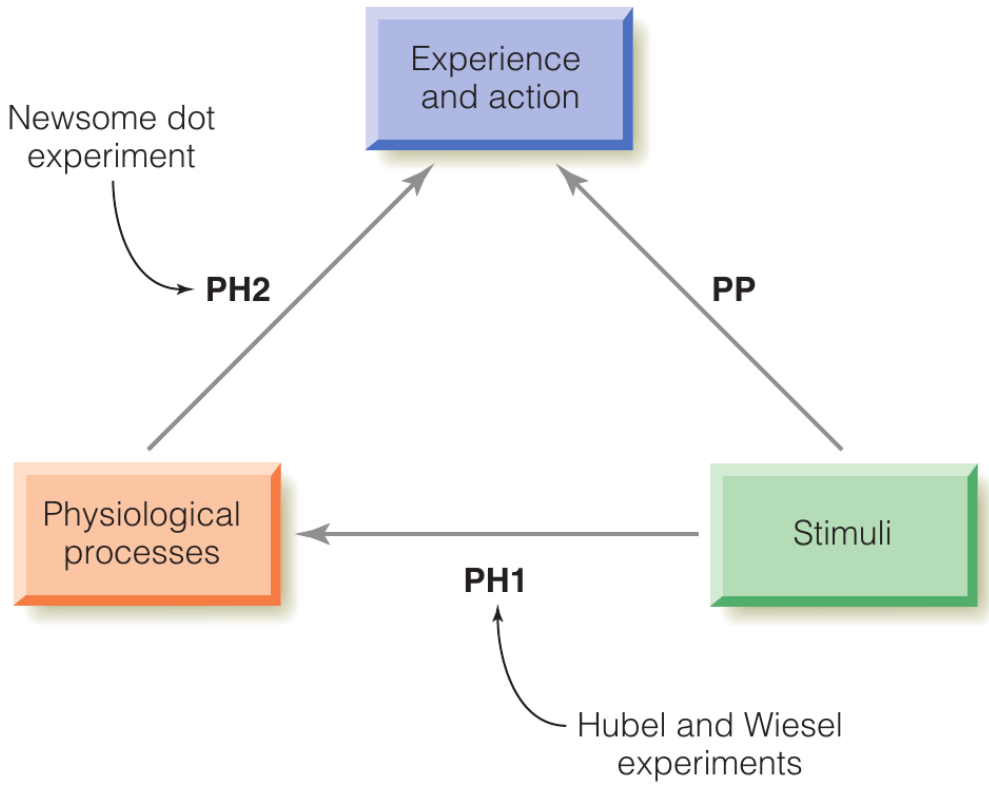
Motion of Arrays of Dots



- possible to vary difficulty of perception (degree of coherence)
- monkeys' ability to detect direction
- response of neuron in Medial Temporal cortex

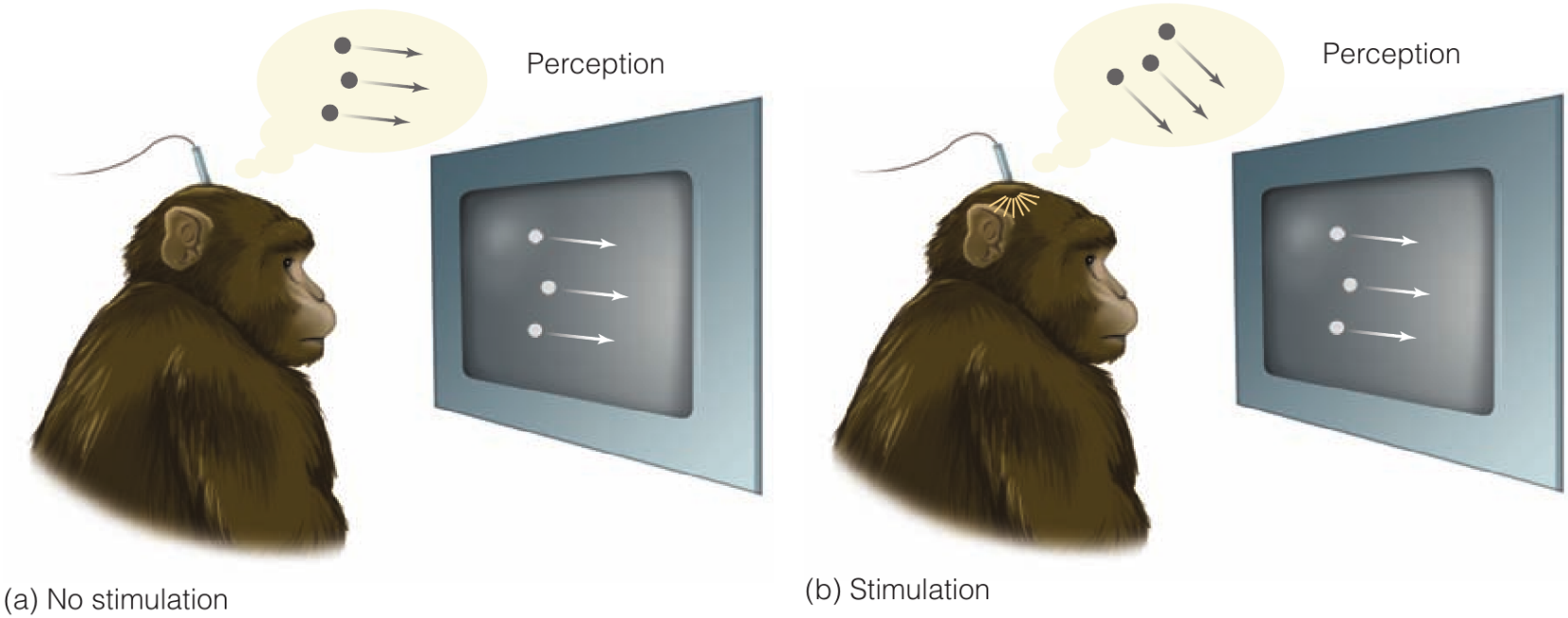
Newsome et al. (1989)

Relationship to Physiology



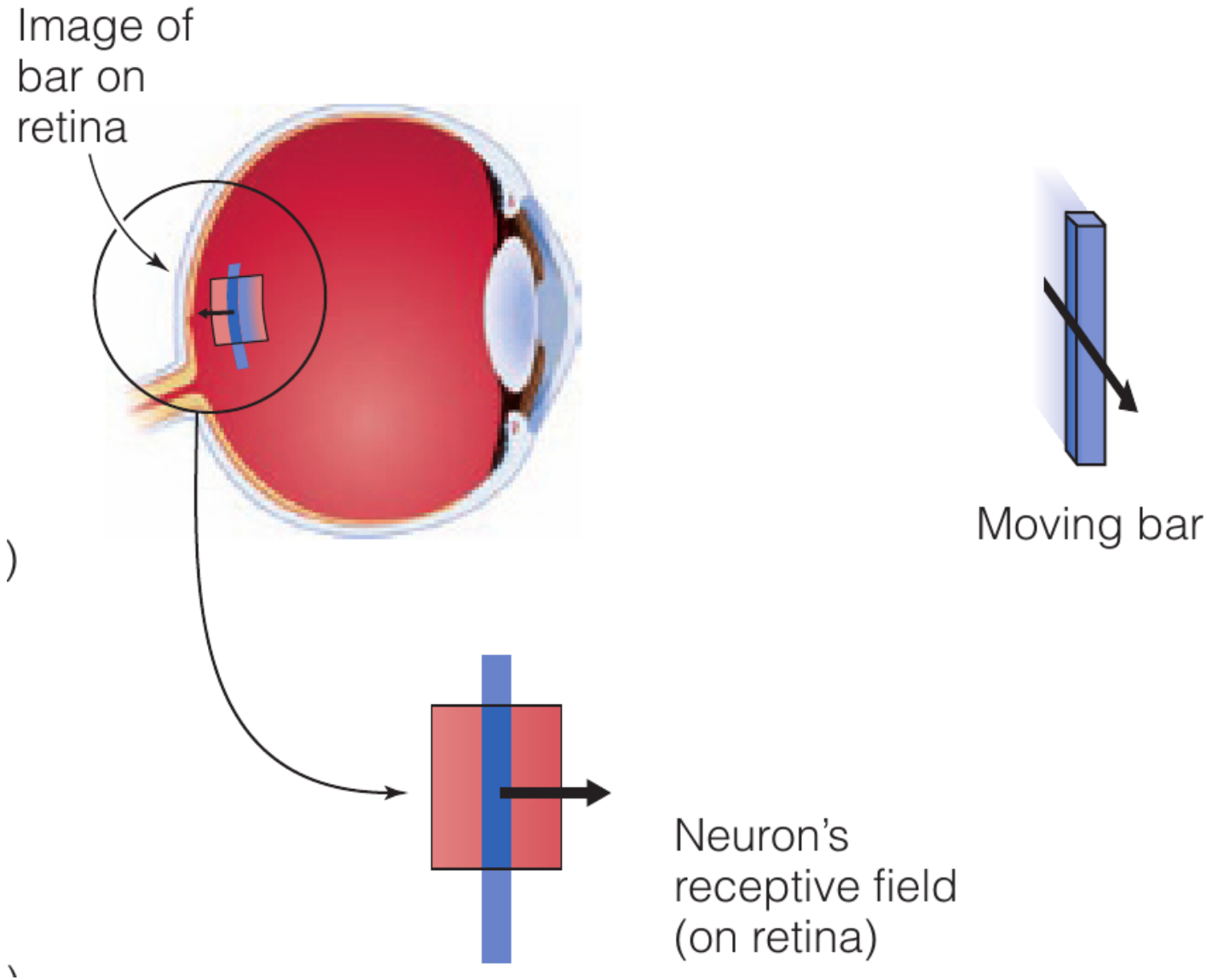
(Monkeys must be trained for months to indicate the direction)

Effect of Lesioning and Microstimulation

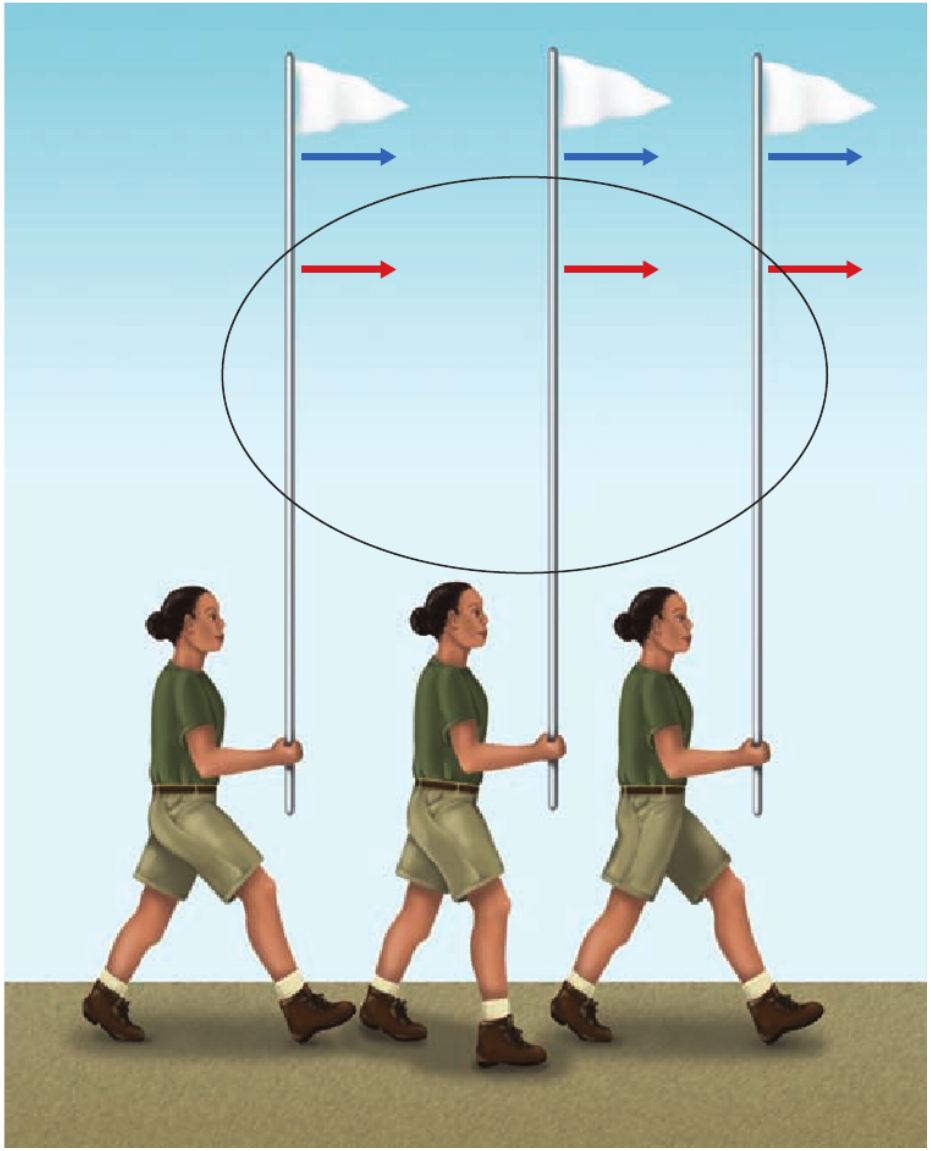


- without lesioning they detect motion with 1-2% coherence
- with lesioning they need 10-20% coherence
- with stimulation can change direction of movement

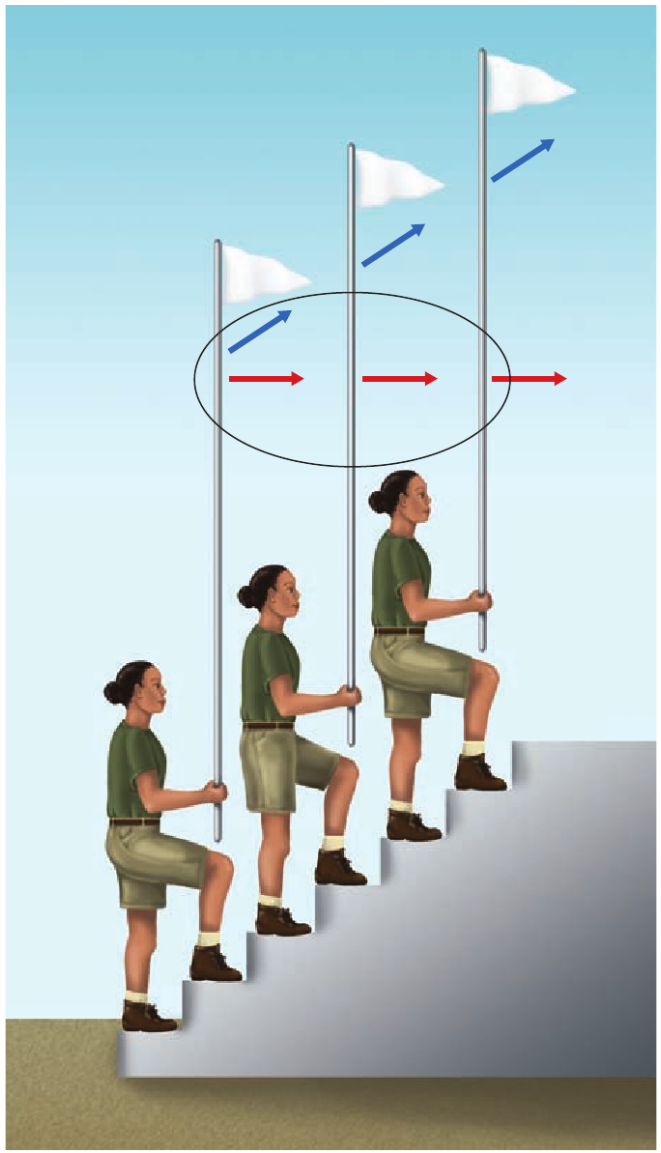
Physiology: The Aperture Problem



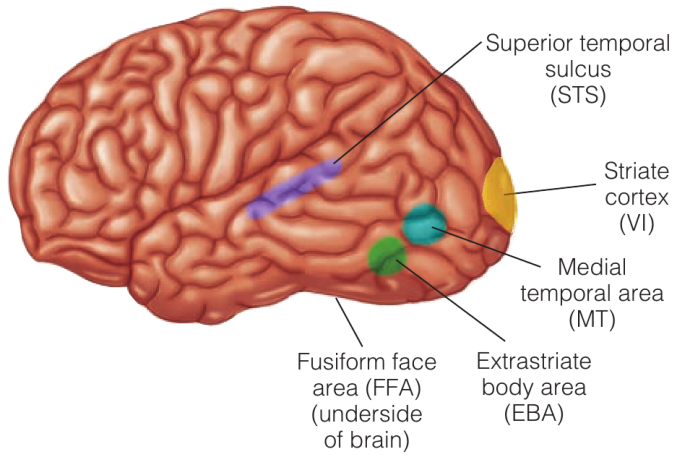
Physiology: The Aperture Problem



Physiology: The Aperture Problem



Medial Temporal Area: Pooling Responses



Neurons in Medial Temporal Area

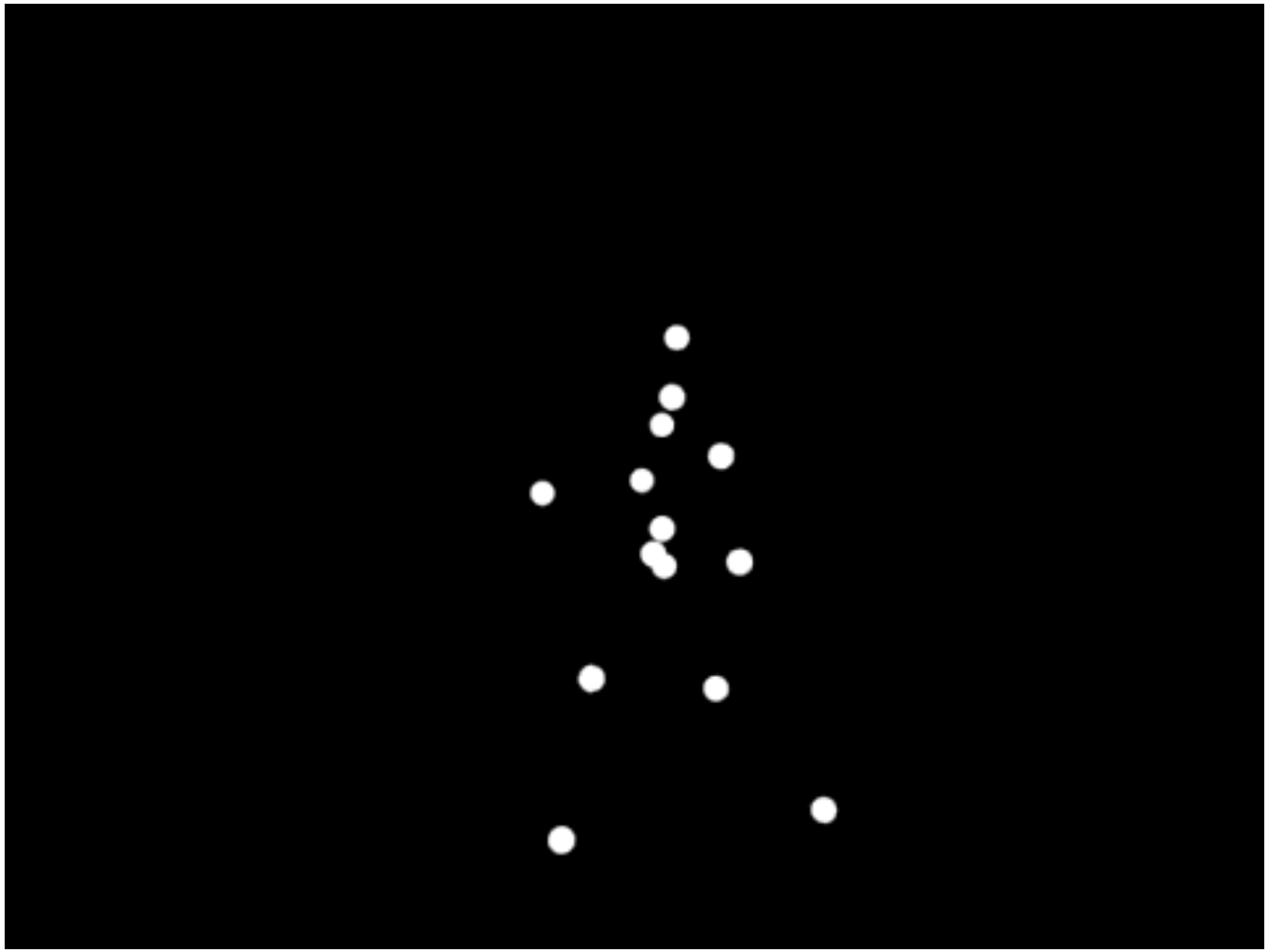
- up to 70msec orientation of the bar
- after 140msec real movement
- use object edge detectors in Striate Cortex

Pack and Born (2001)

Perceiving Biological Motion

Point-light walker

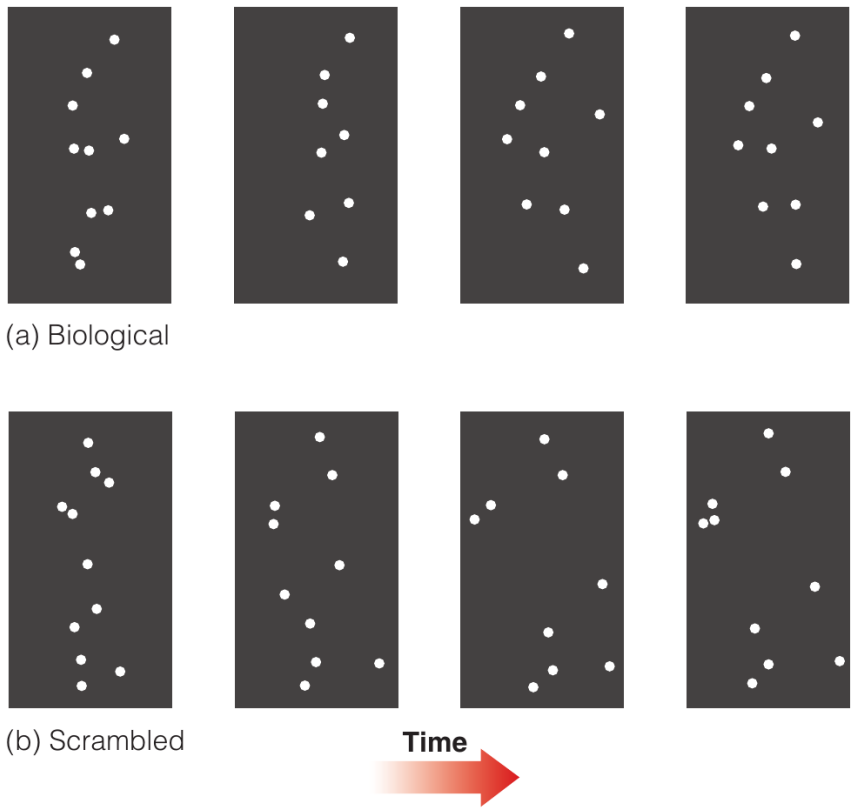
Point-light Walker Example



http://youtu.be/r0kLC-pridI

Brain Activation to Biological Motion

Stimulating Superior Temporal Sulcus (STS) disrupts biological motion perception

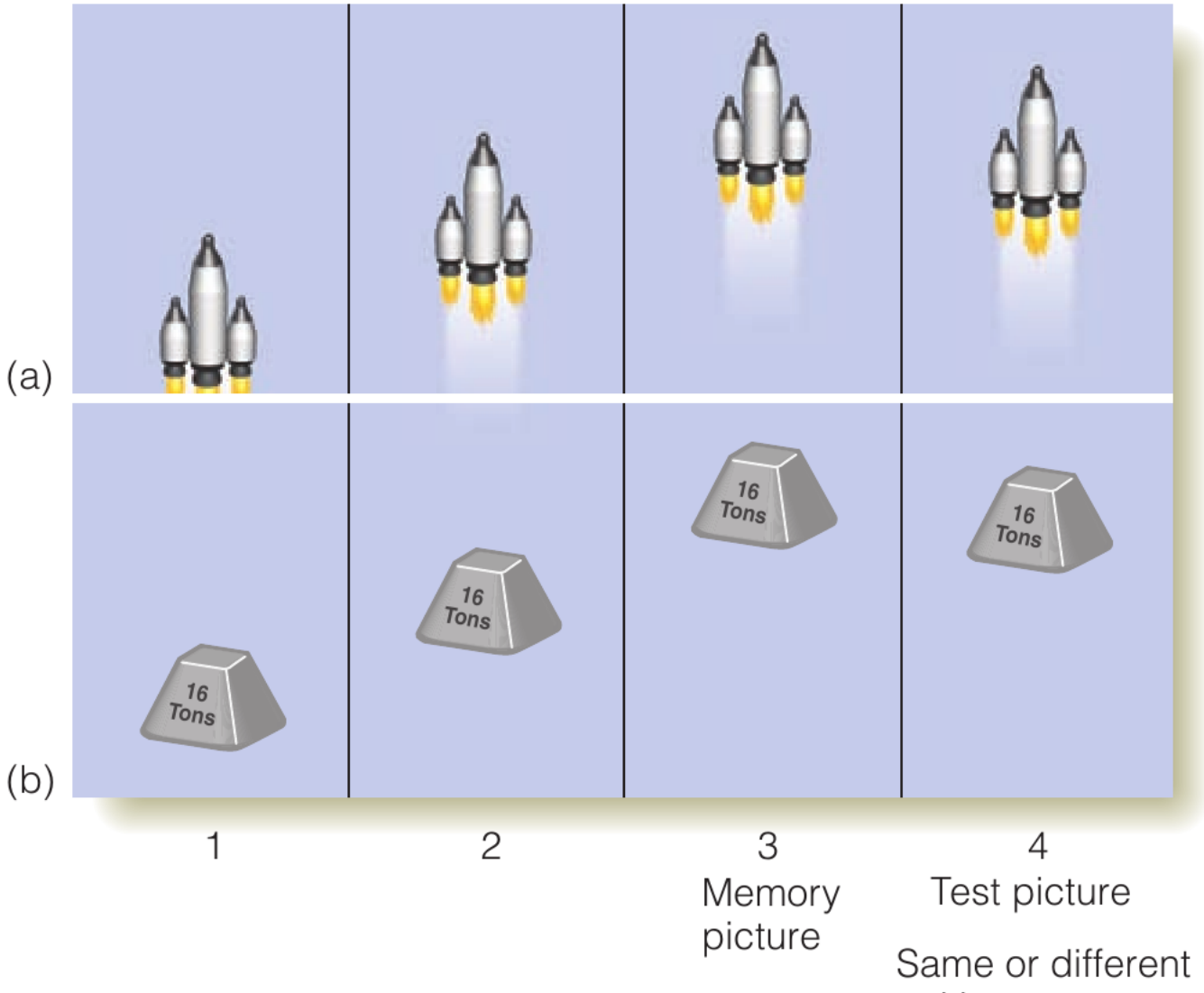


Grossman et al. (2005)

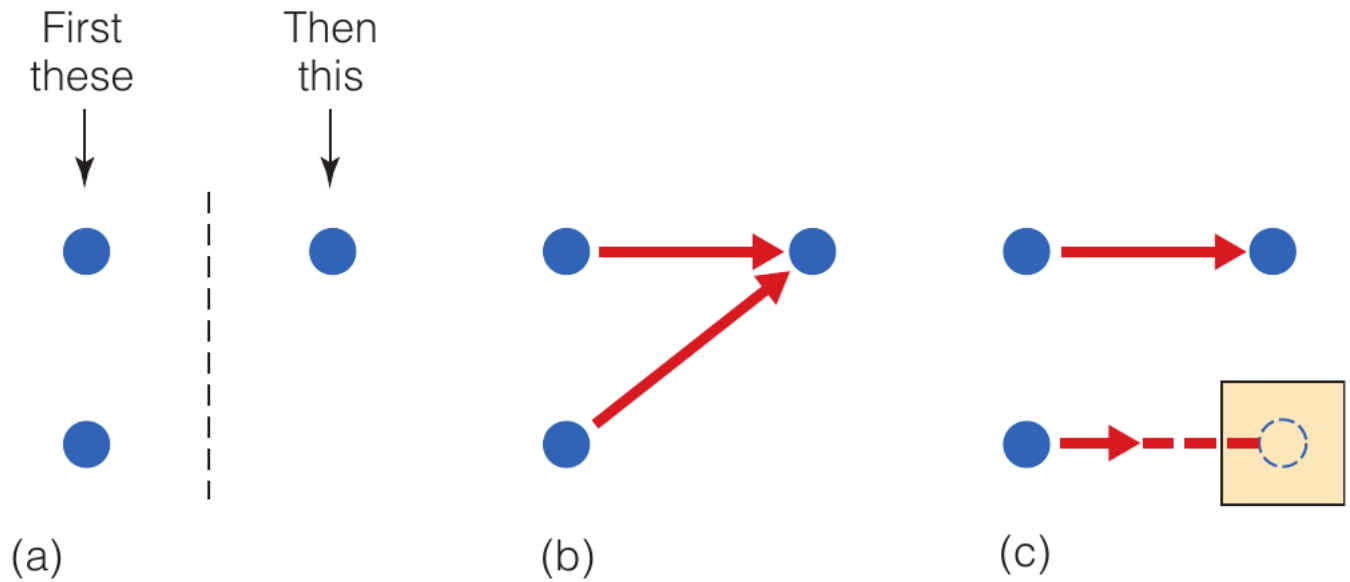
Beyond the Stimulus: Implied Motion

Knowledge based motion perception

representational momentum



Implied and Apparent Motion



Johansson's Motion Perception

Uppsala University 1973