# Motion Perception

## DT2350 Human Perception for Information Technology

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# 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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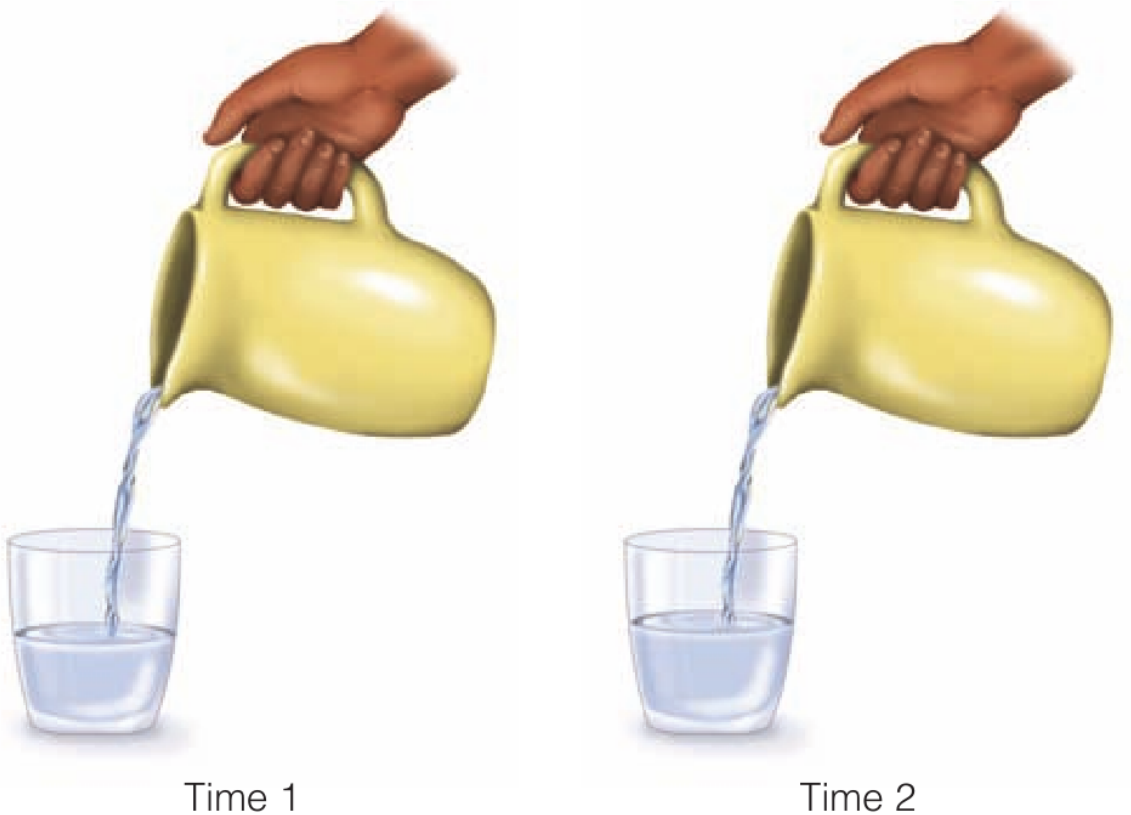
1. stationary observer, moving stimuli
2. moving observer

# 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

# Explanation

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

# Important Even Without Camouflage

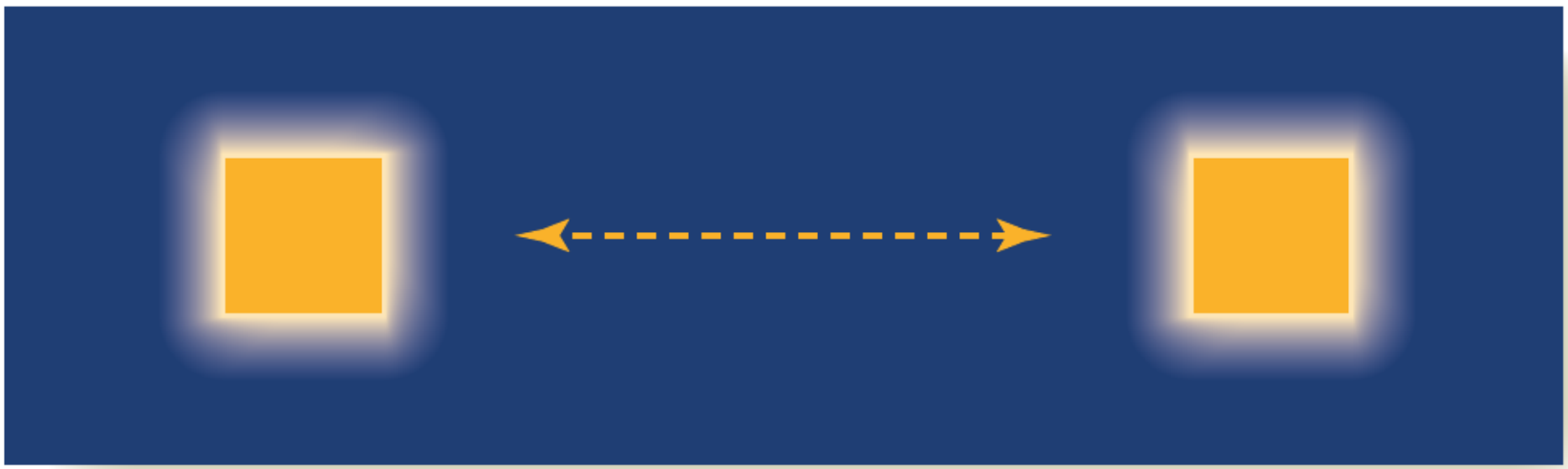
- vision is ambiguous
- pattern recognition more difficult than movement detection
- research show we perceive shapes more accurately if the object is moving

# Real vs Illusory Motion

Illusory motion:

- apparent motion
- induced motion
- motion aftereffects

# Apparent Motion

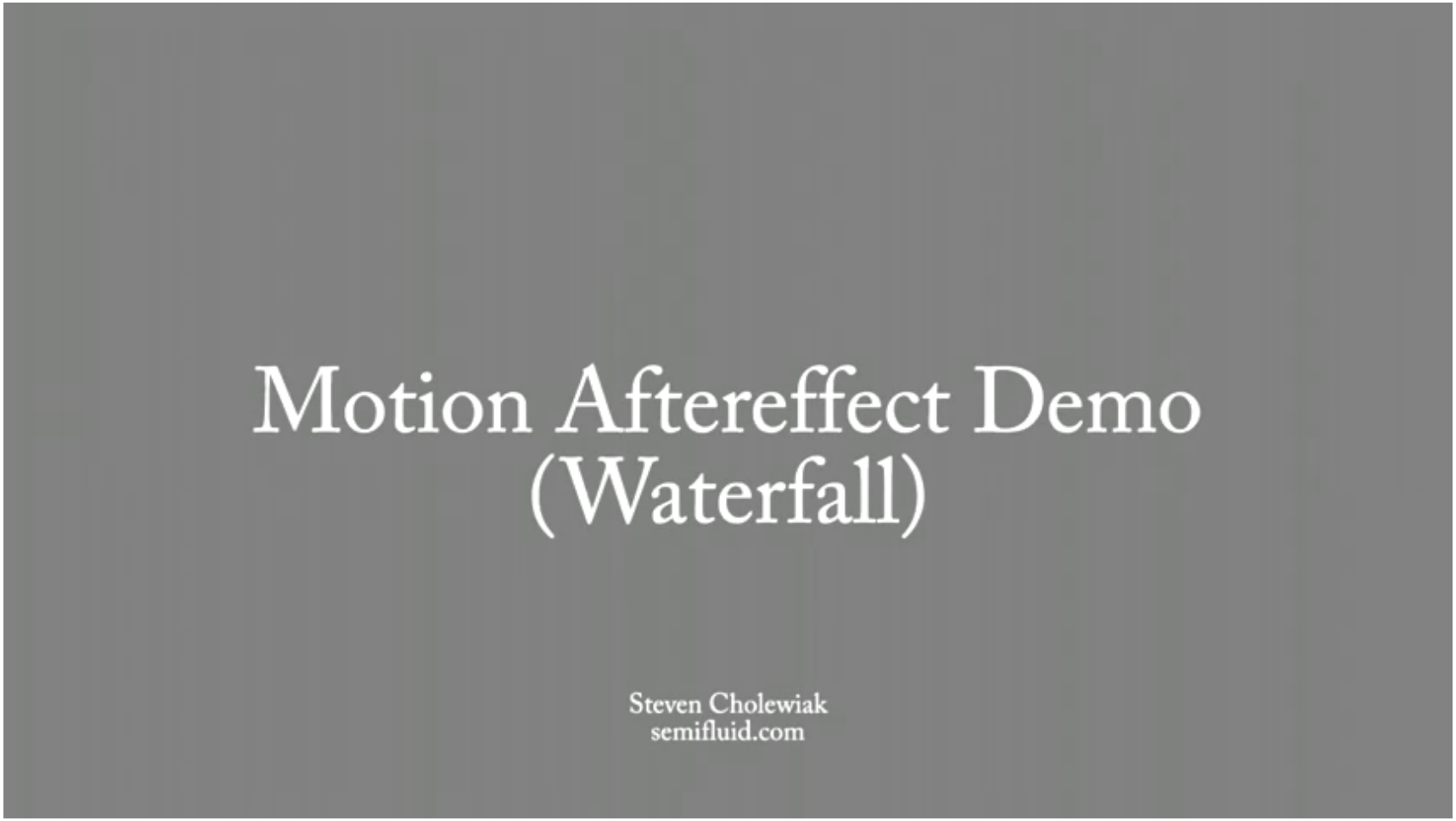


It is the basis for movies and television

# Induced Motion

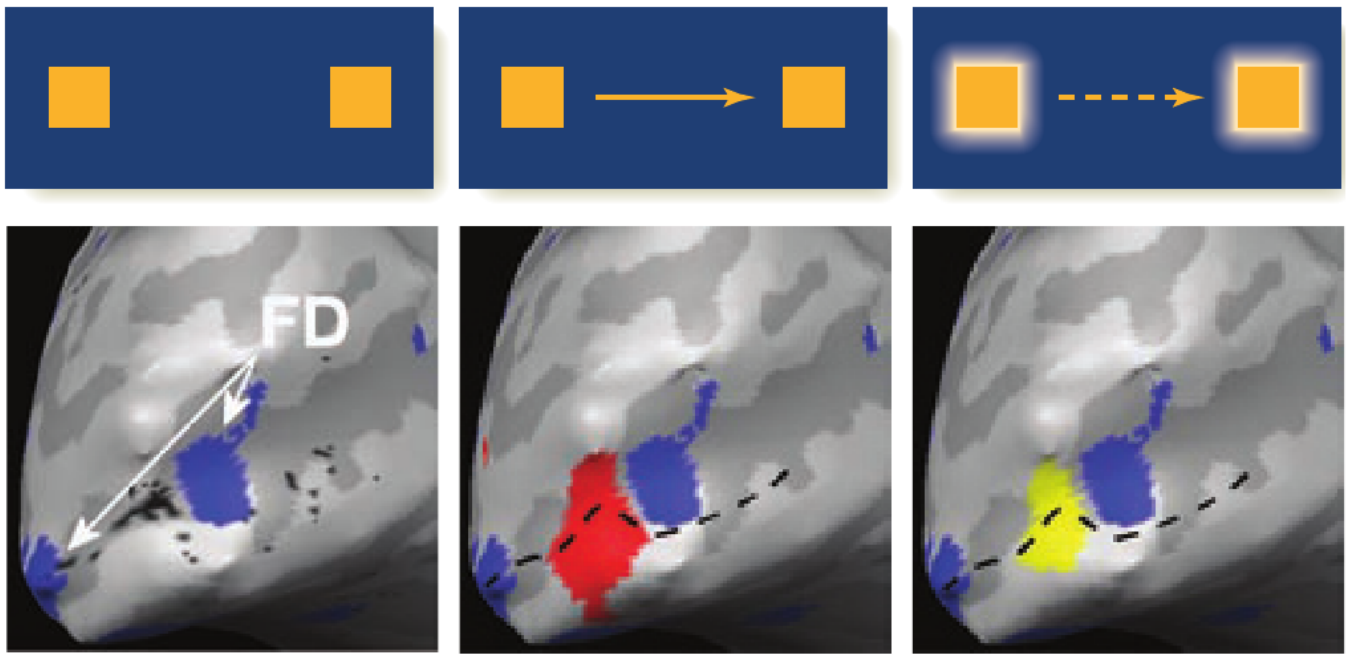
# Motion Aftereffects

# Demonstration




http://youtu.be/oNhcpOIQCNs

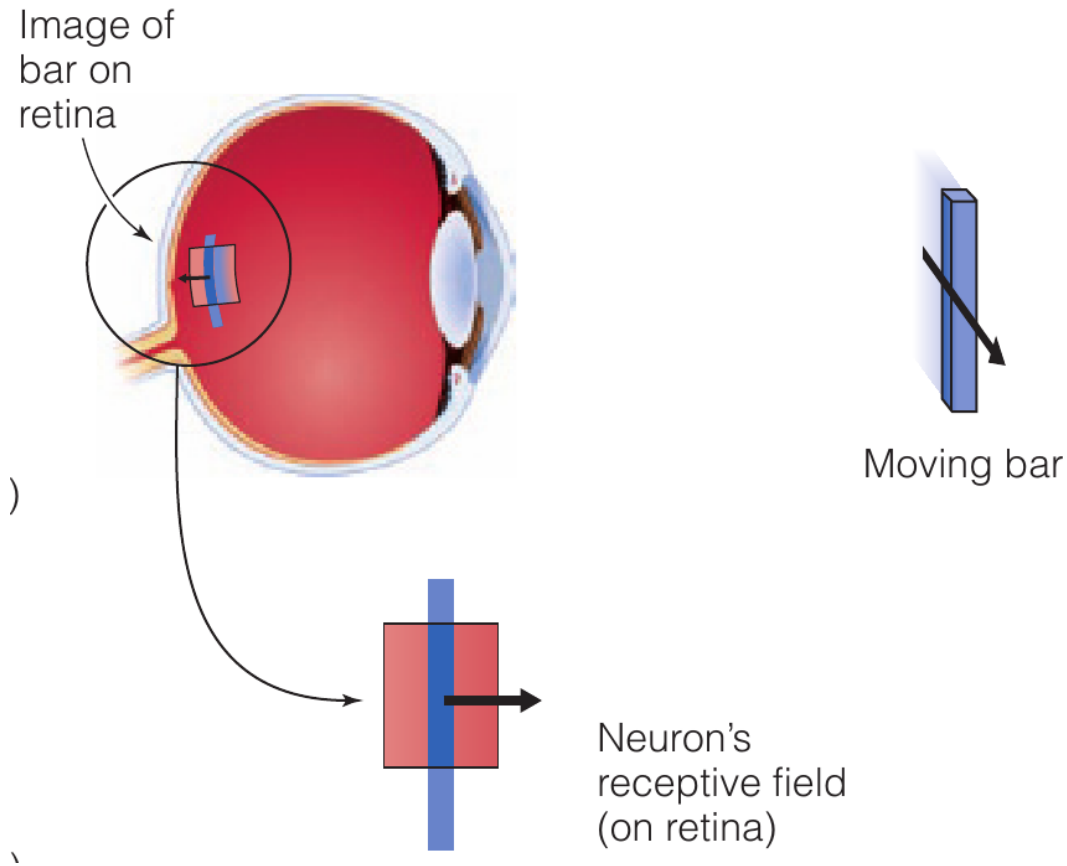
# Are Real and Apparent Motion Different Perceptually?




Visual cortex
Larsen et al. (2006)

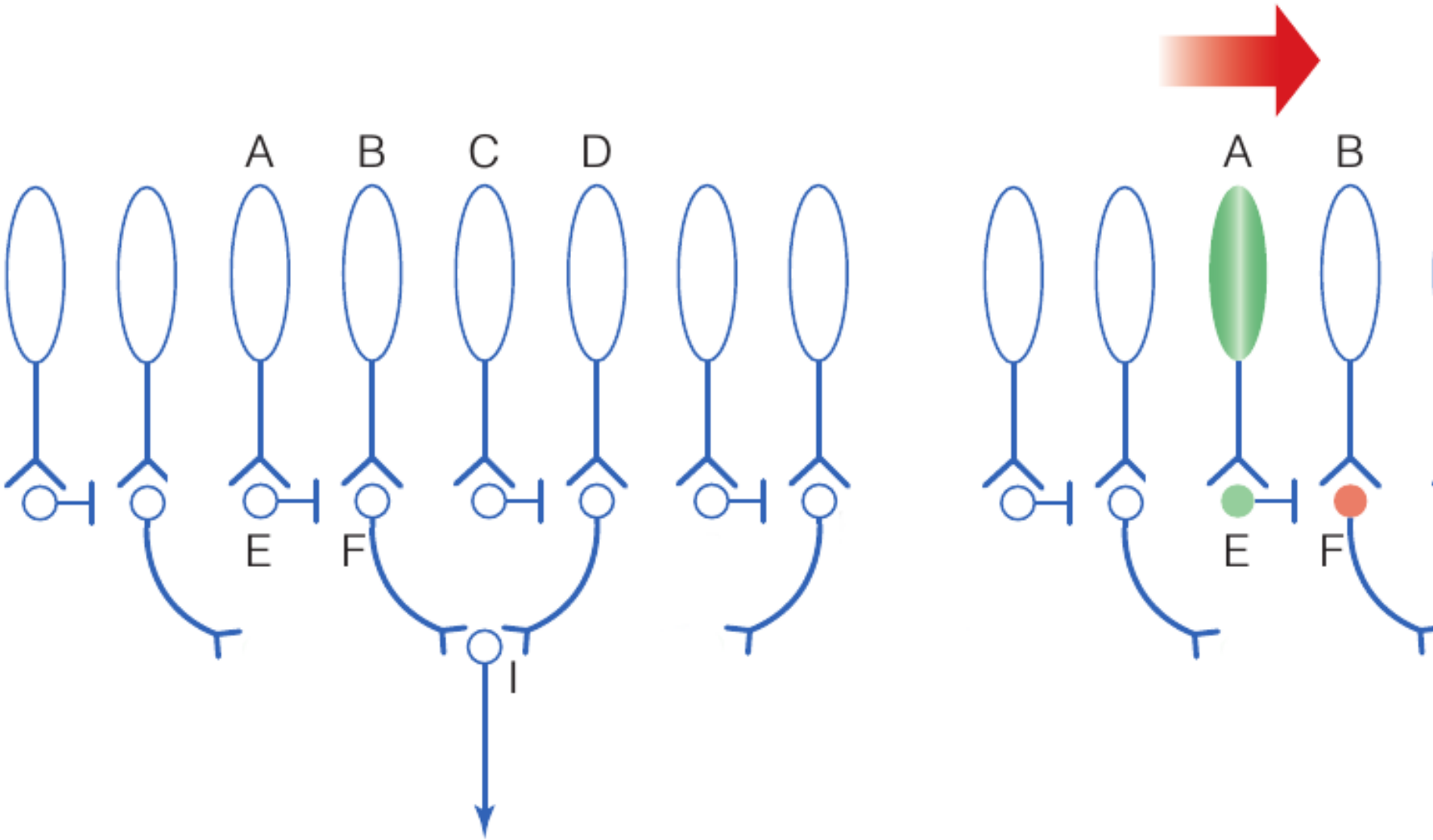
# Neural Explanation of Motion Perception

## Reichardt detector




Werner Richardt (1969)

# Reichardt detector (1969)



# Motion Perception Cannot Be Explained with the Retina

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

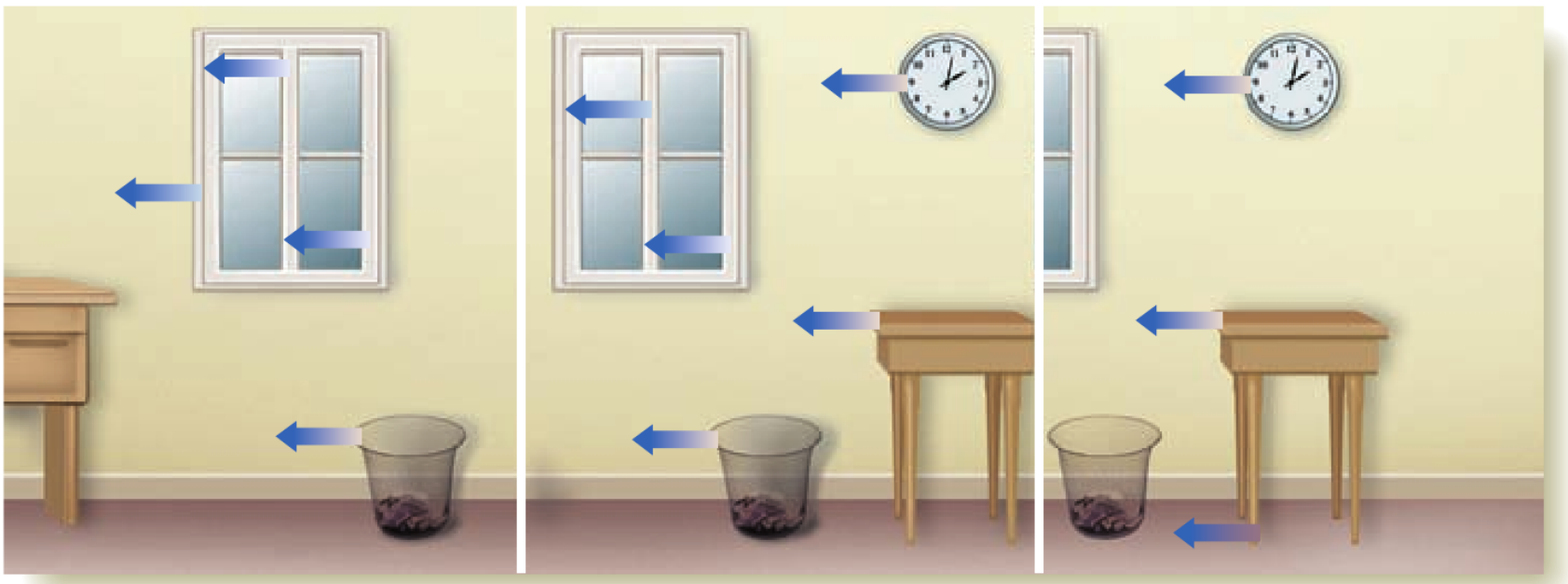
Jeremy walks, Maria looks straight at the window

# 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)

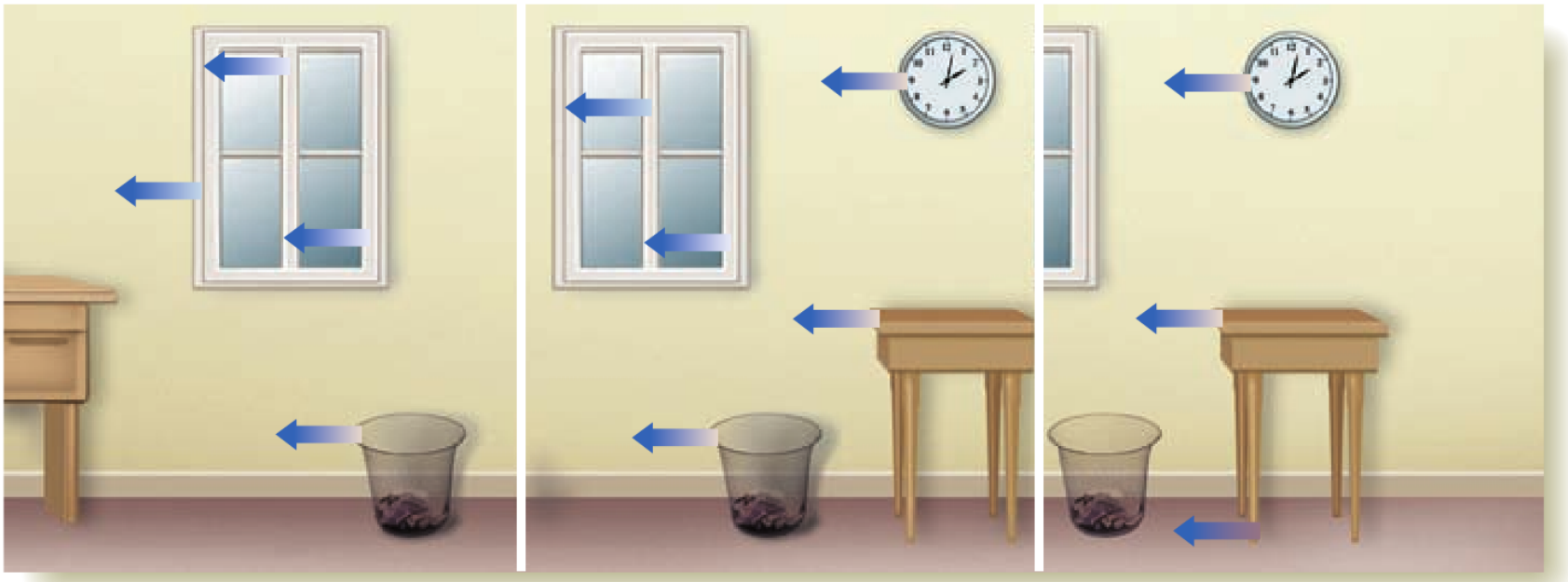
Maria walks in the room

# 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



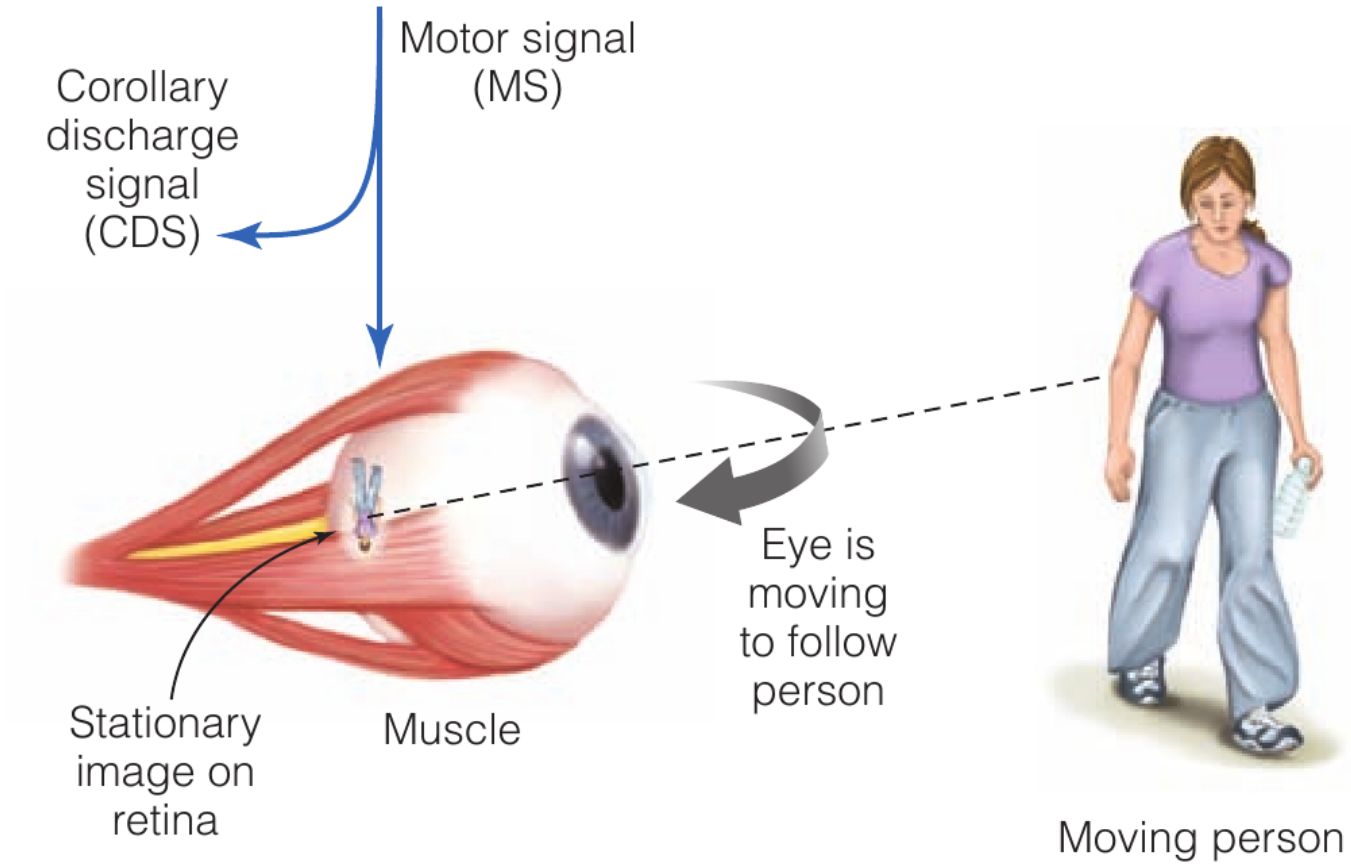
(c) Maria walks through the scene
(creates global optic flow)

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

# Problems

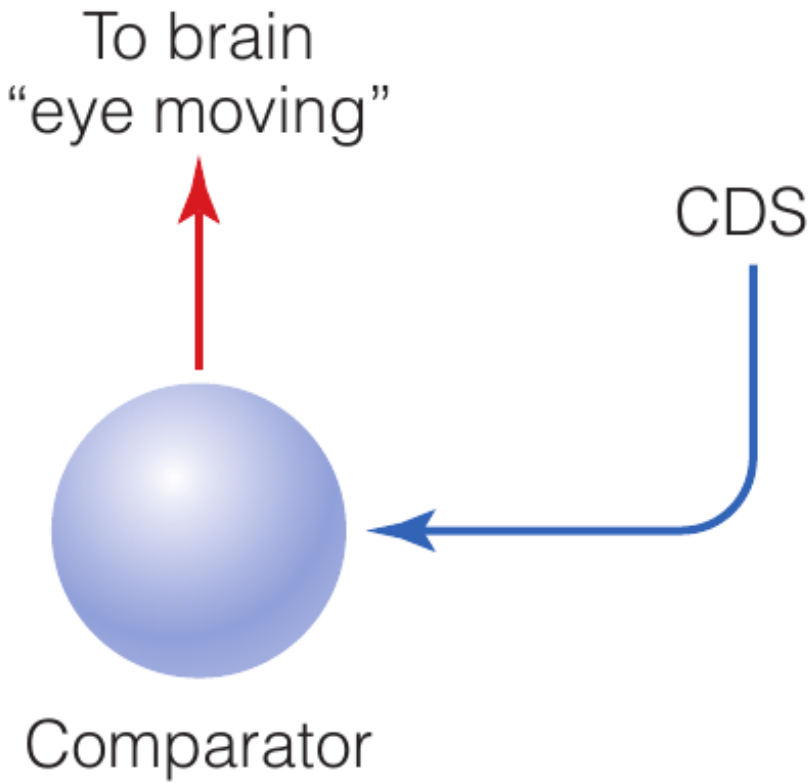
- Eye motions: Corollary discharge theory
- Aperture problem (neuron receptive field)

# Taking Eye Motions Into Account



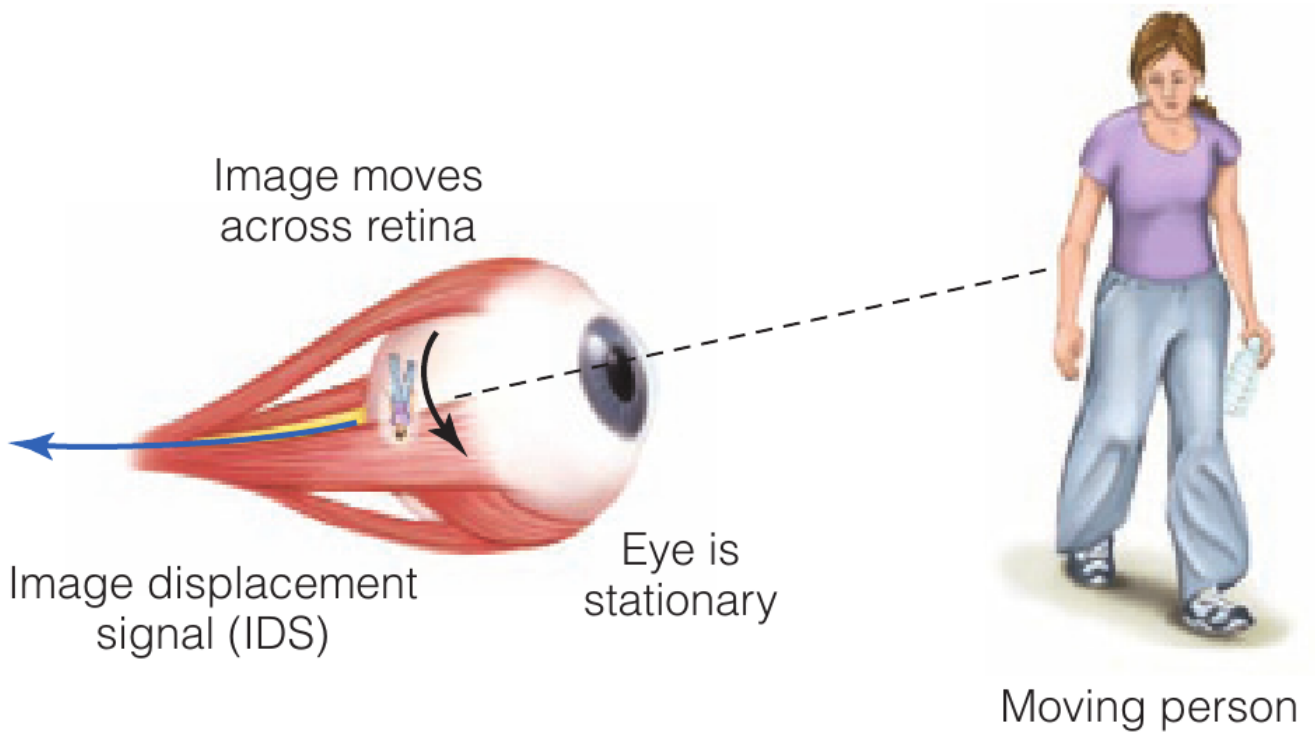

NOTE: the book does not take head movements into account

# Corollary Discharge Model

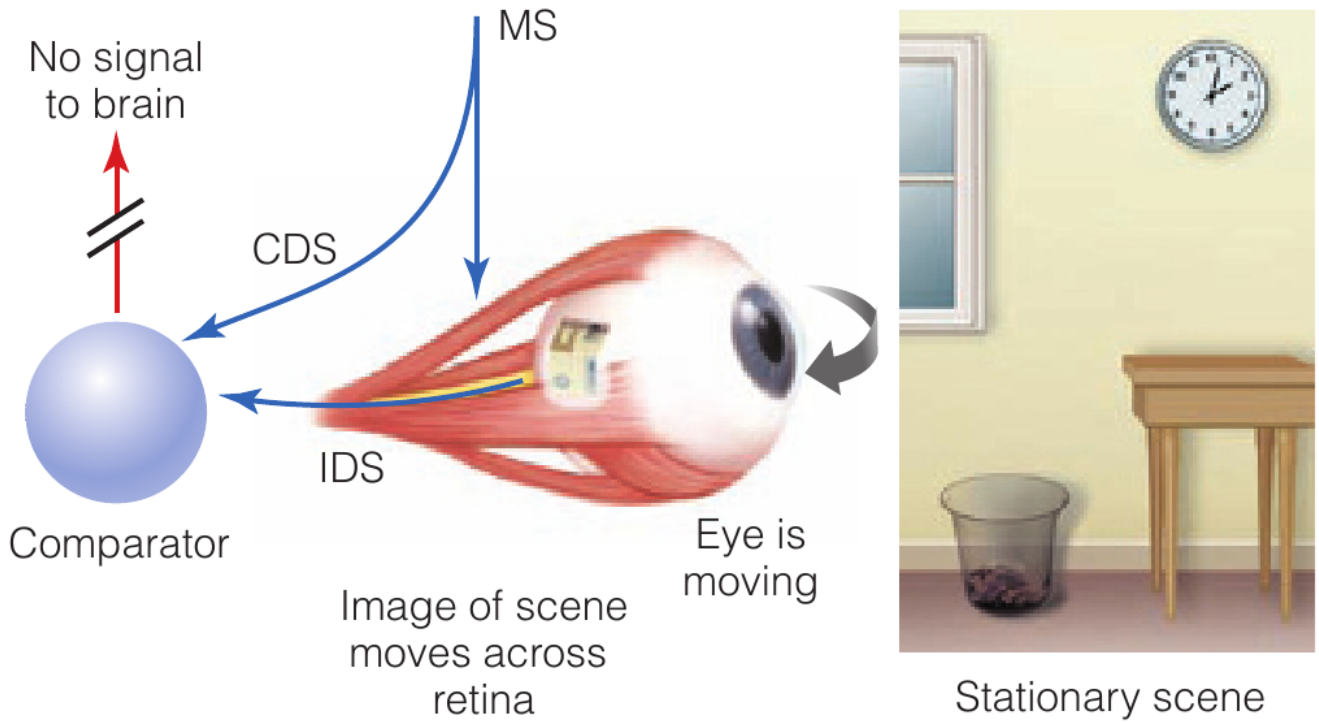



- corollary discharge signal (CDS)
- image displacement signal (IDS)

# CDM: Moving Person

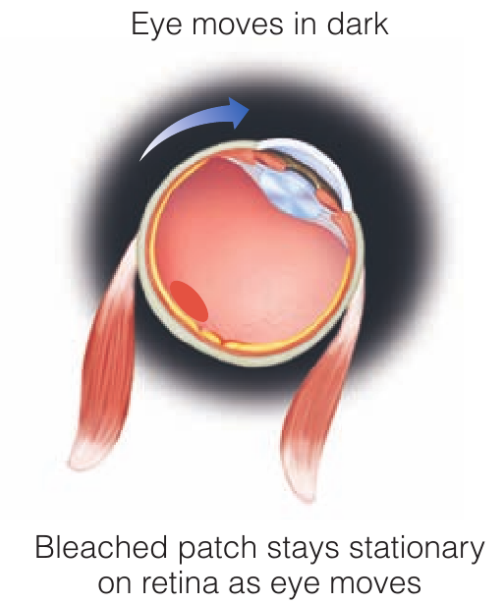


# CDM: Scanning Stationary Scene



# Behavioural Demonstration 1

corollary discharge (eye movement) without image displacement



# Behavioural Demonstration 2

corollary discharge (muscle contraction) without image displacement

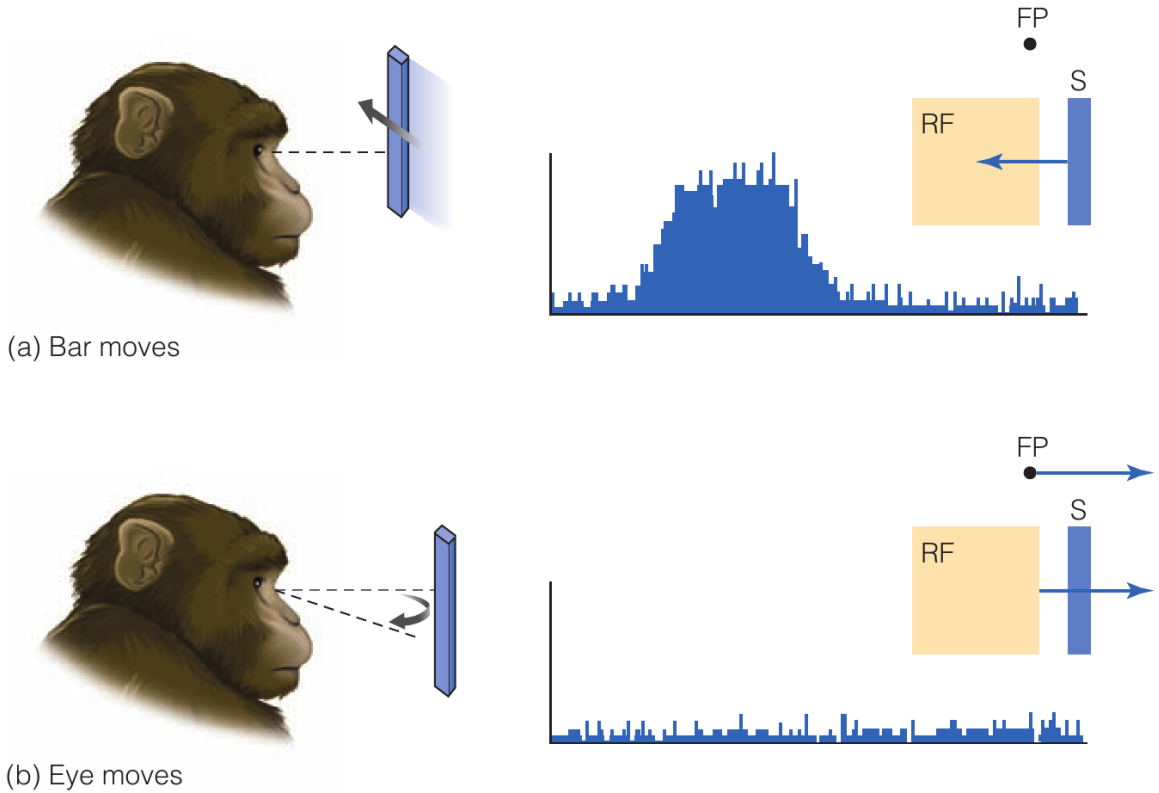
# Physiological Evidence

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

Haarmeier et al. (1997)

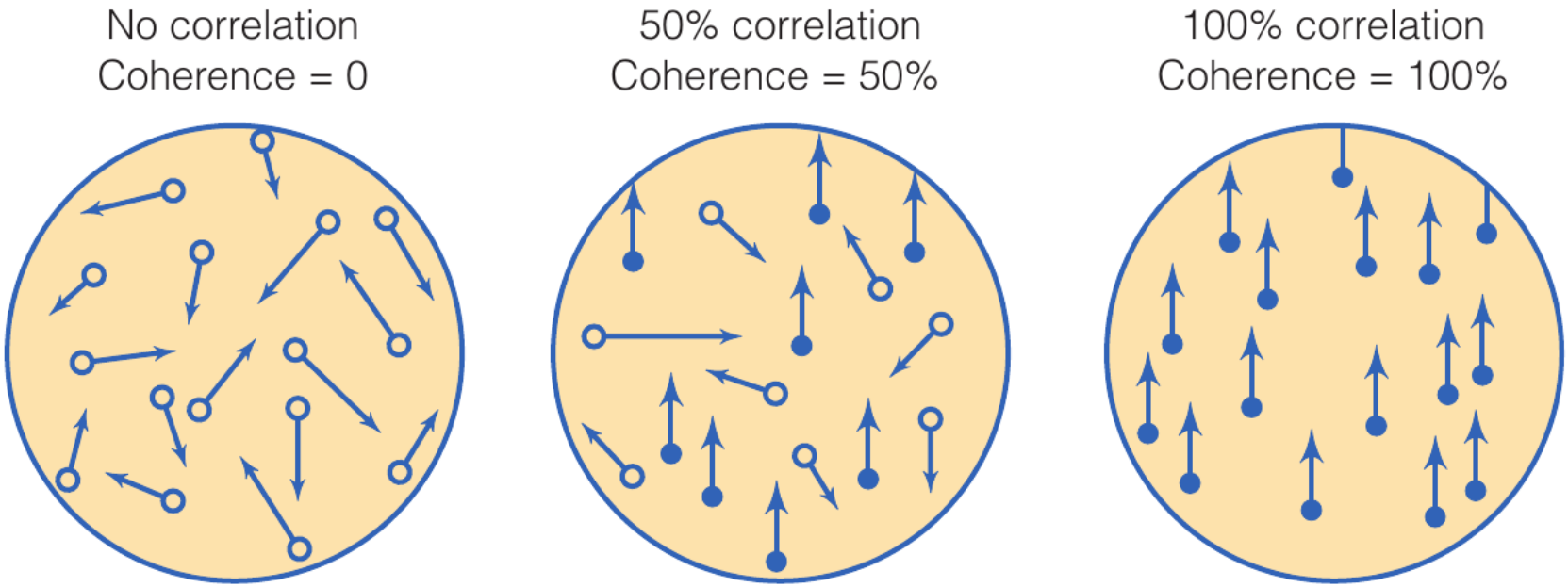
# Physiological Evidence in Monkeys

"real motion neuron"




Galletti and Fattori (2003)

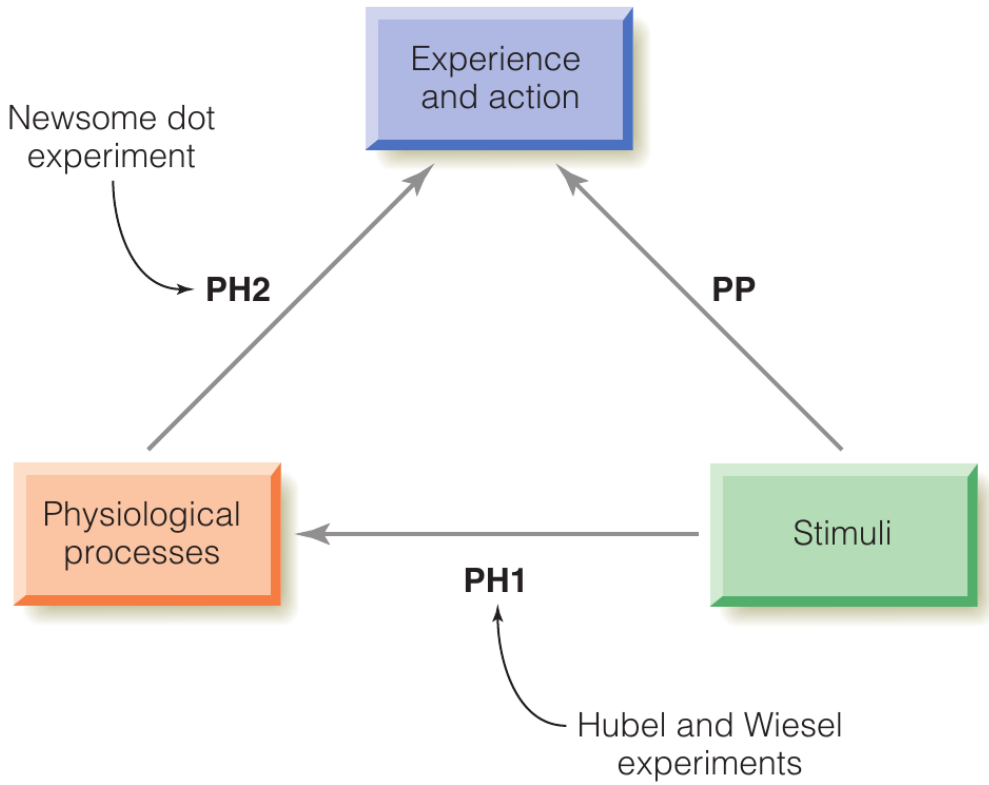
# Motion of Arrays of Dots




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

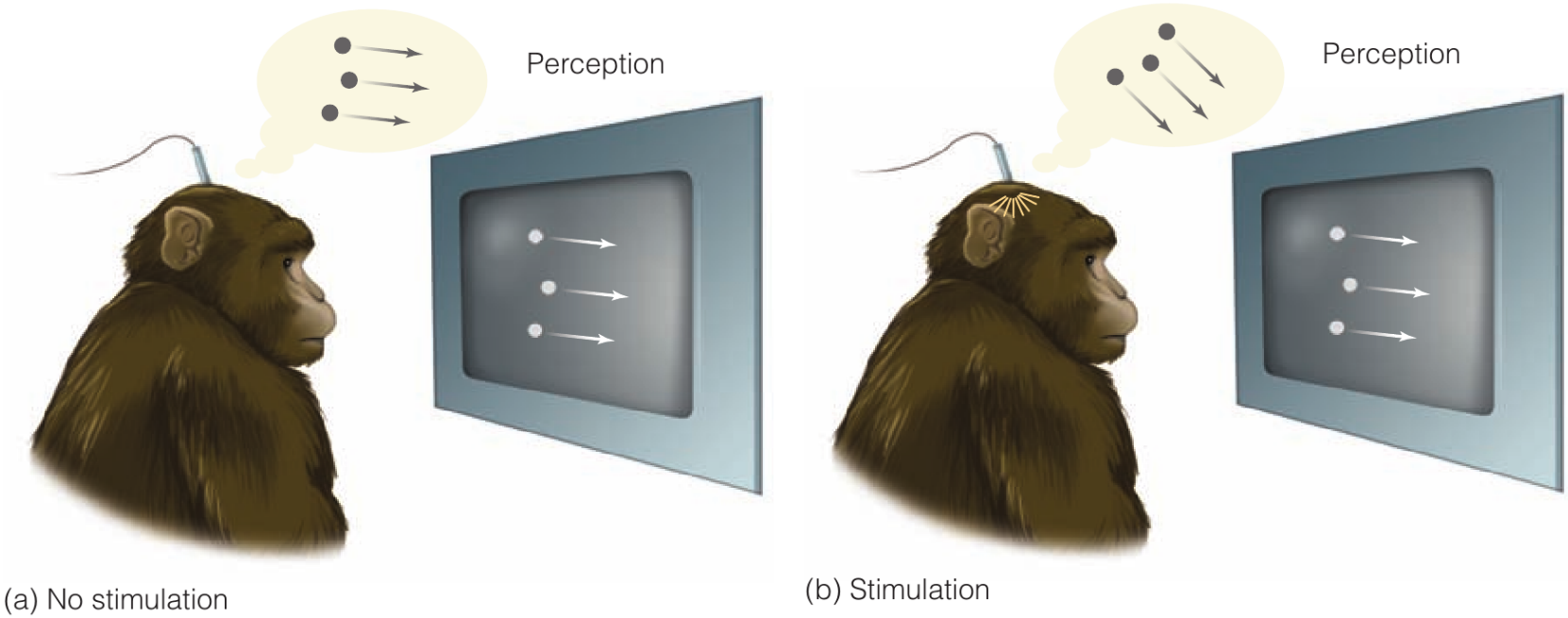
Newsome et al. (1989)

# Relationship to Physiology



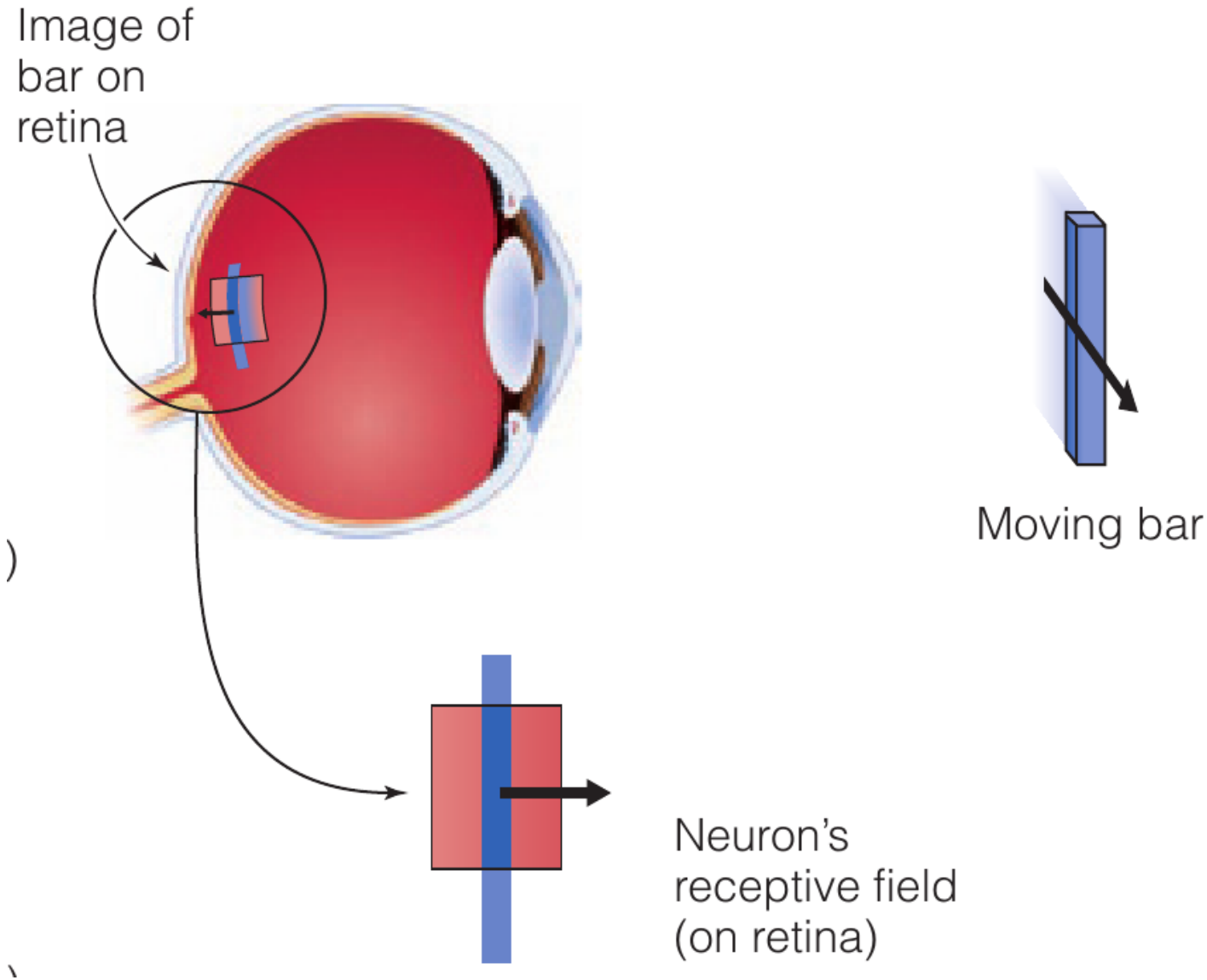

(Monkeys must be trained for months to indicate the direction)

# 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



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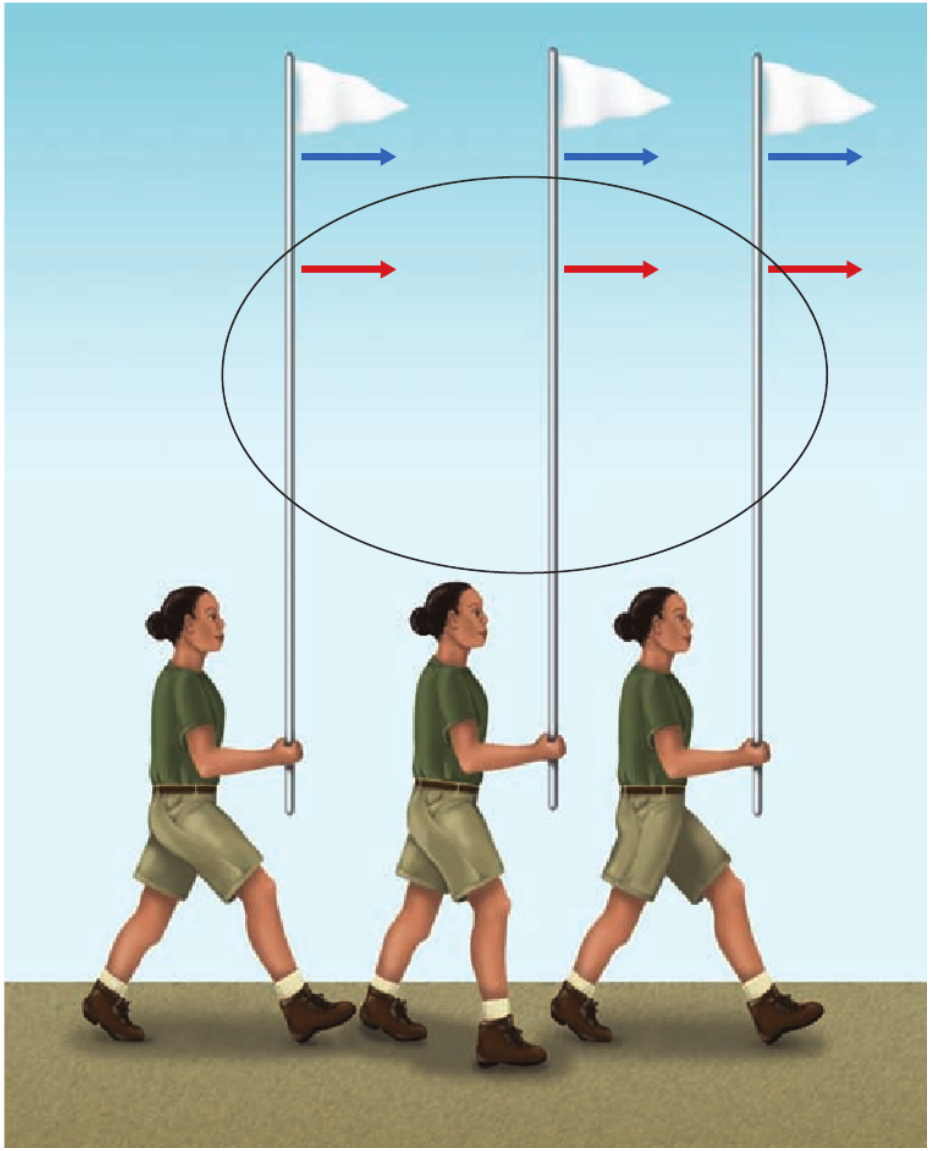
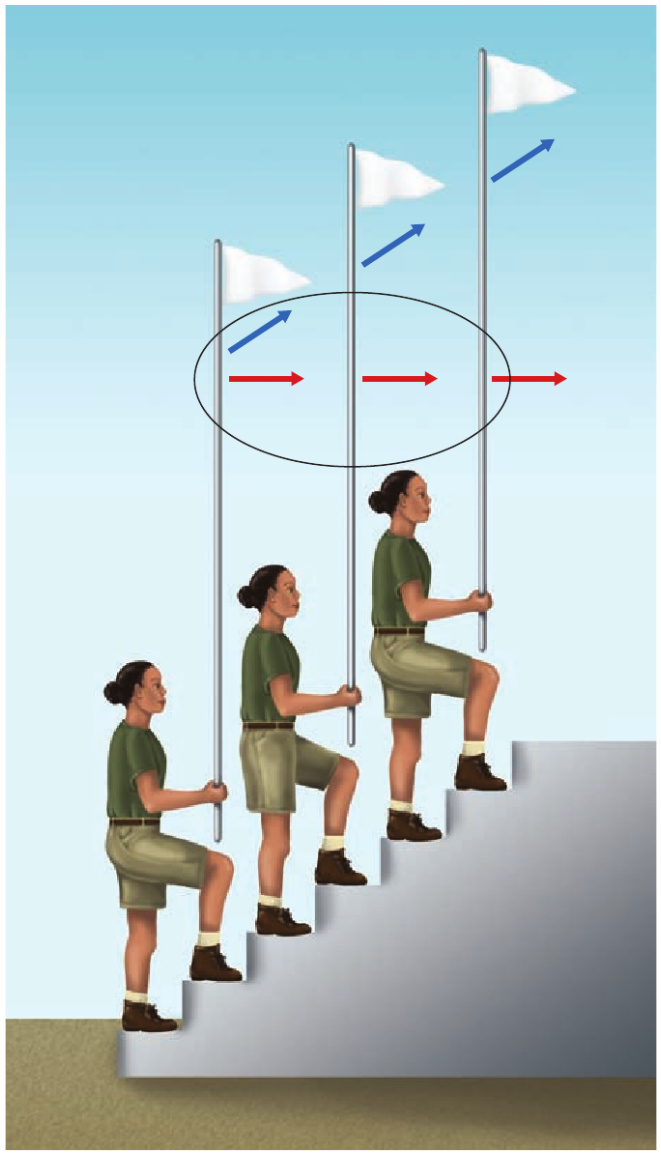
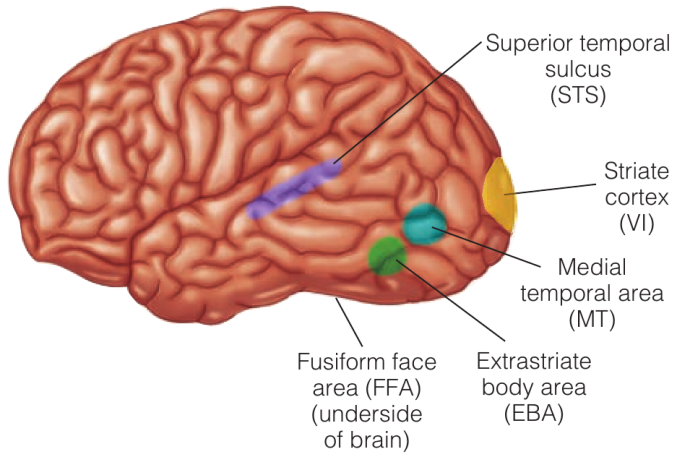


# Physiology: The Aperture Problem



# Medial Temporal Area: Pooling Responses




Neurons in Medial Temporal Area

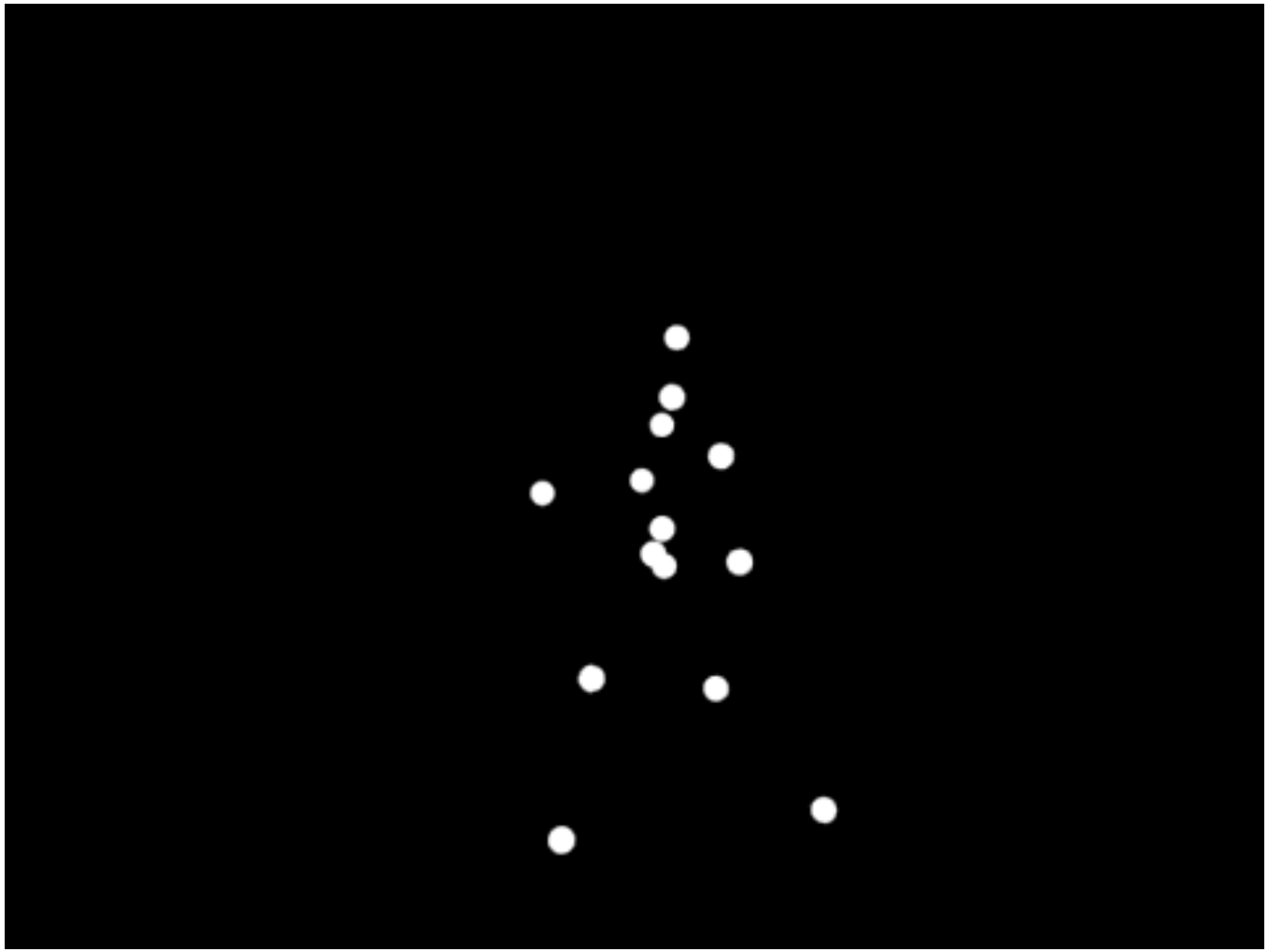
- up to 70msec orientation of the bar
- after 140msec real movement
- use object edge detectors in Striate Cortex

Pack and Born (2001)

# Perceiving Biological Motion

## Point-light walker

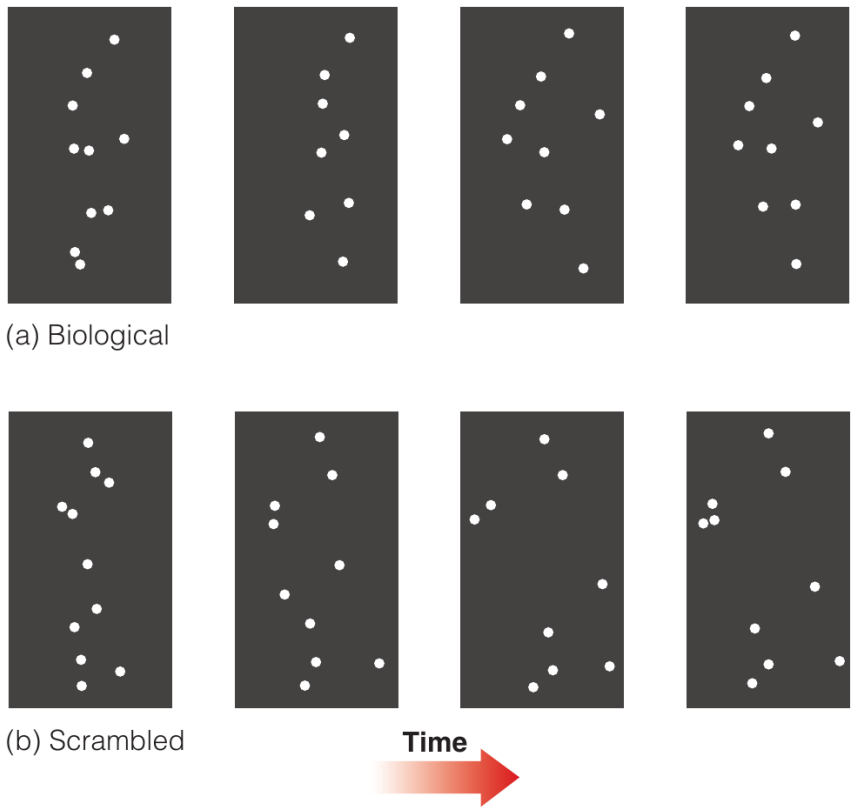
# Point-light Walker Example



http://youtu.be/r0kLC-pridI

# Brain Activation to Biological Motion

Stimulating Superior Temporal Sulcus (STS) disrupts biological motion perception

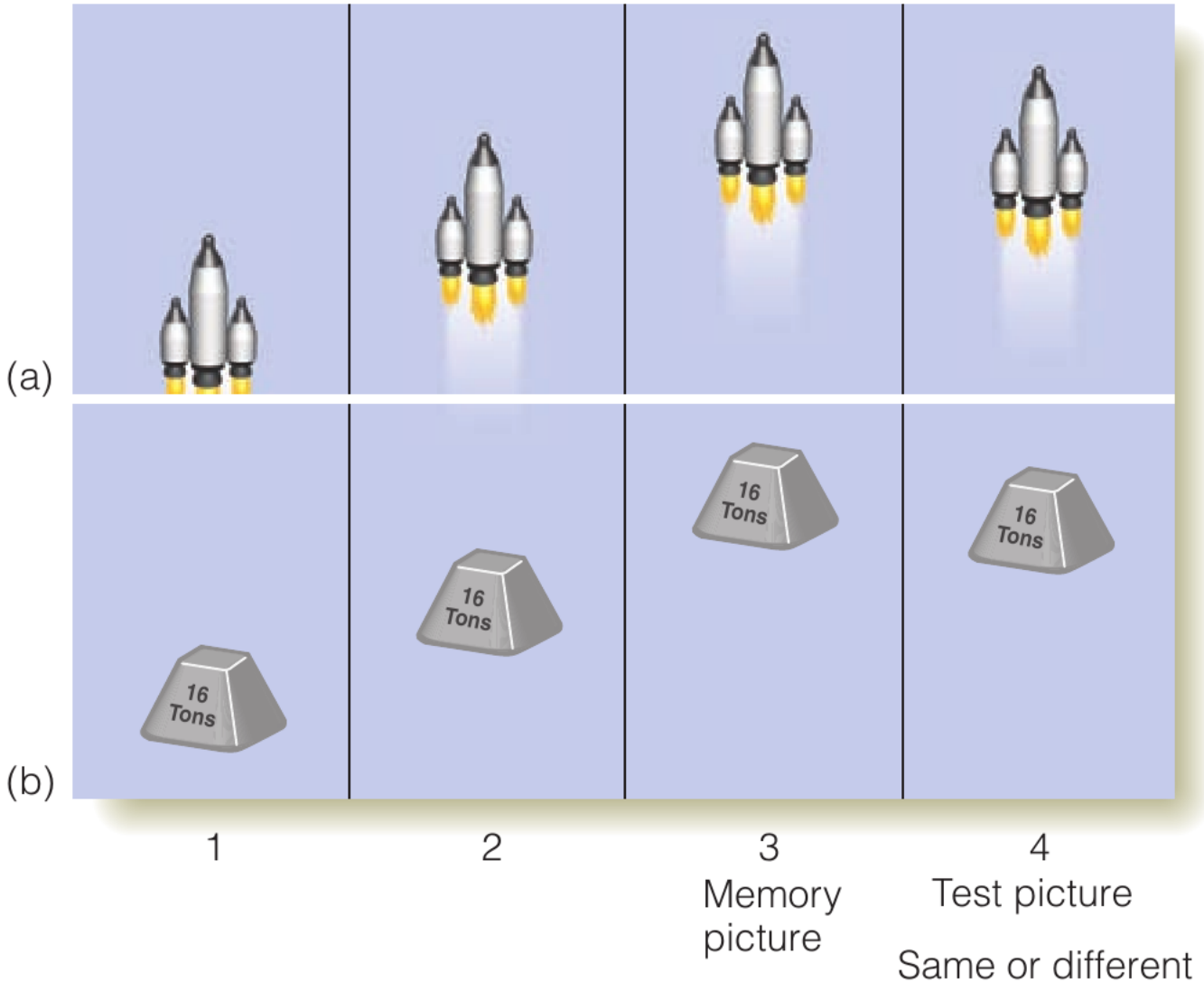



Grossman et al. (2005)

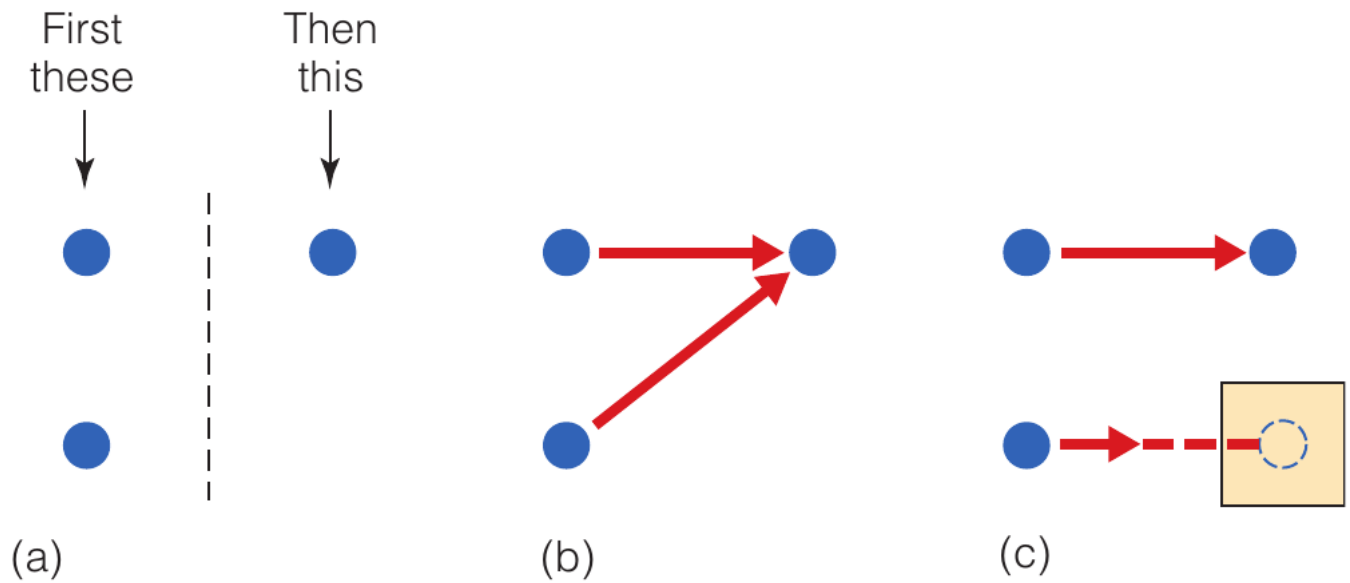
# Beyond the Stimulus: Implied Motion

## Knowledge based motion perception

representational momentum (Reed and Vinson, 1996)



# Implied and Apparent Motion




Ramachandran and Anstis (1986)