Motion Perception
Chapter 8

Lecture 13

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Sensation & Perception (PSY 345 / NEU 325)
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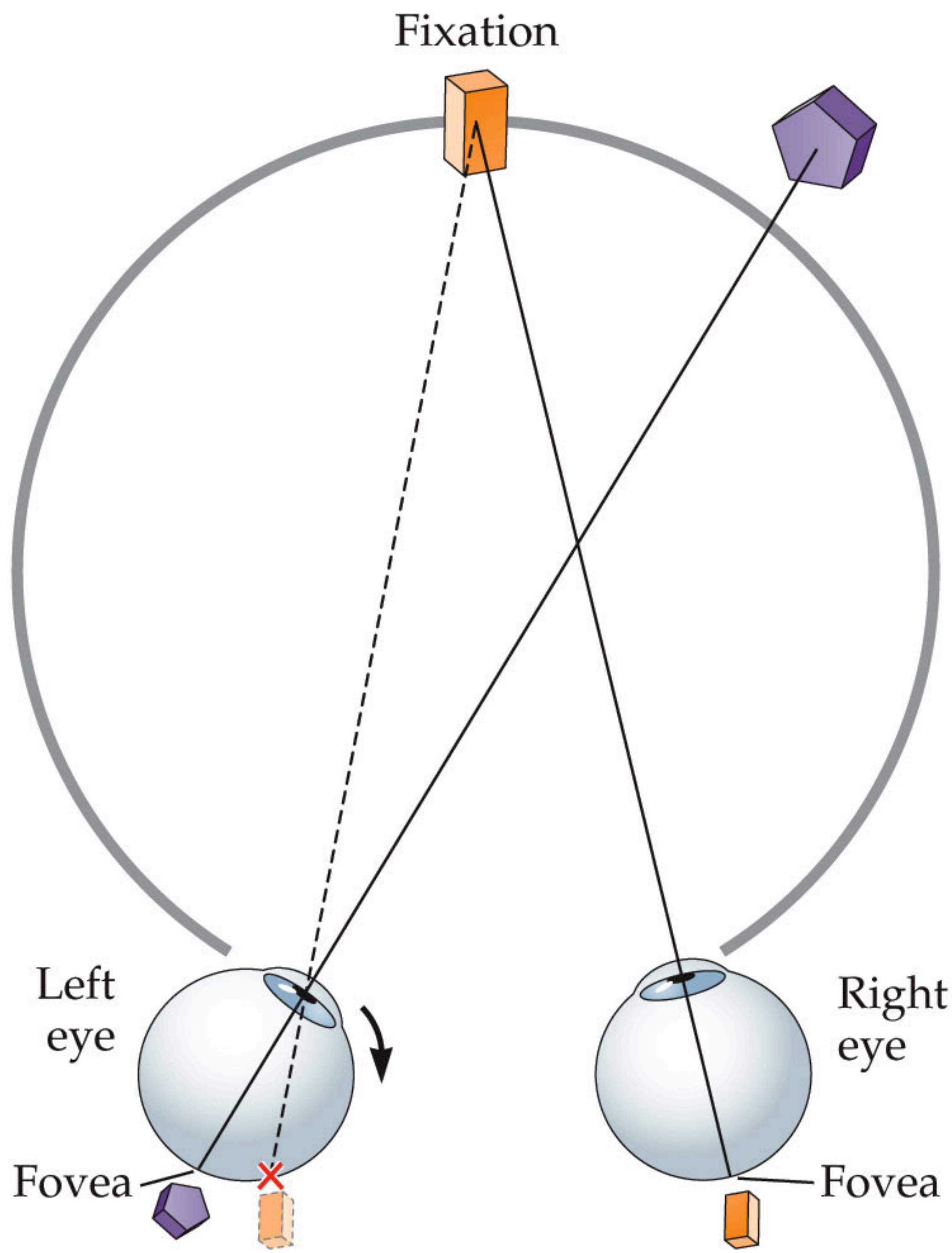
Defects in Stereopsis

Strabismus

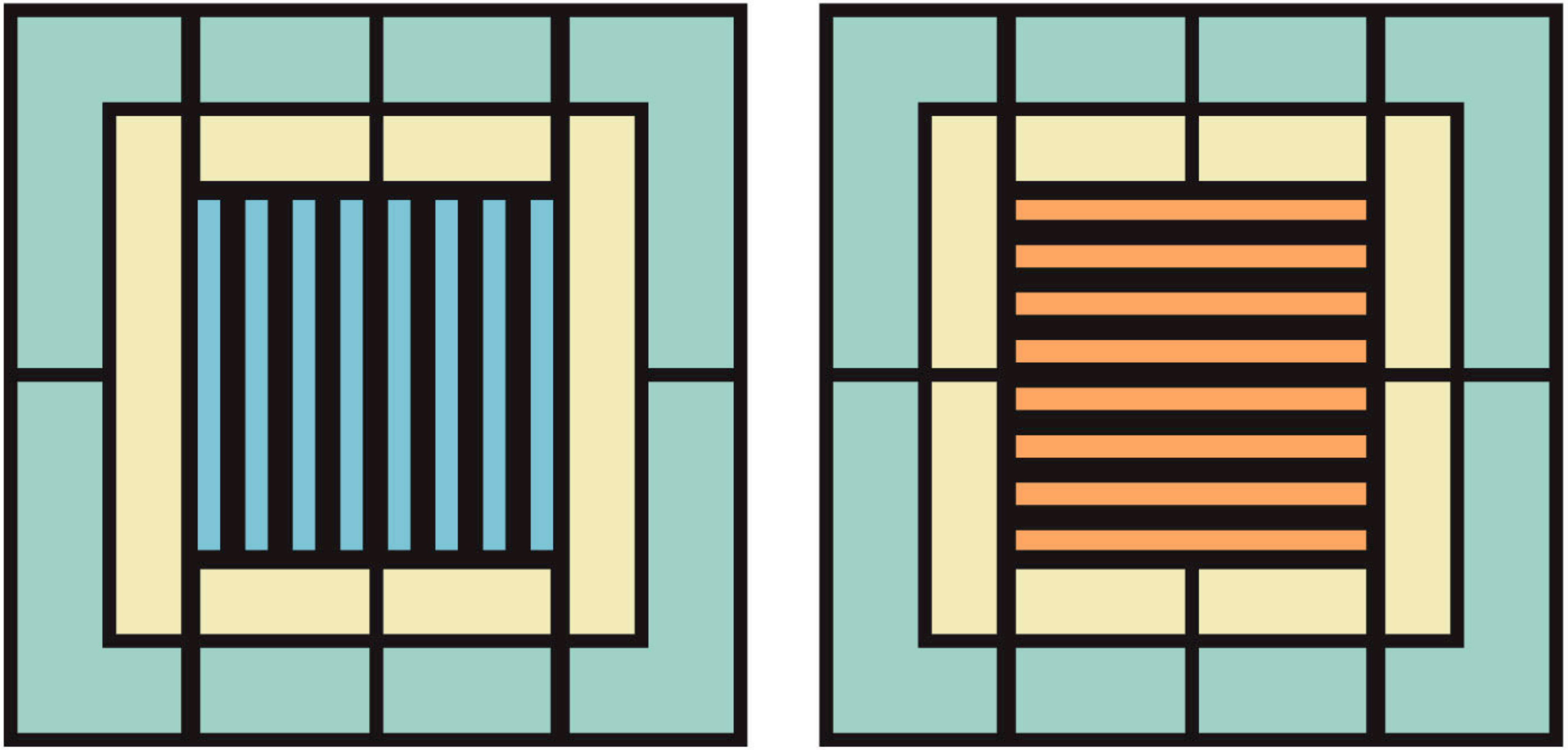
• eyes are not aligned, so different images fall on the fovea

• If not corrected at an early age, stereopsis will not develop

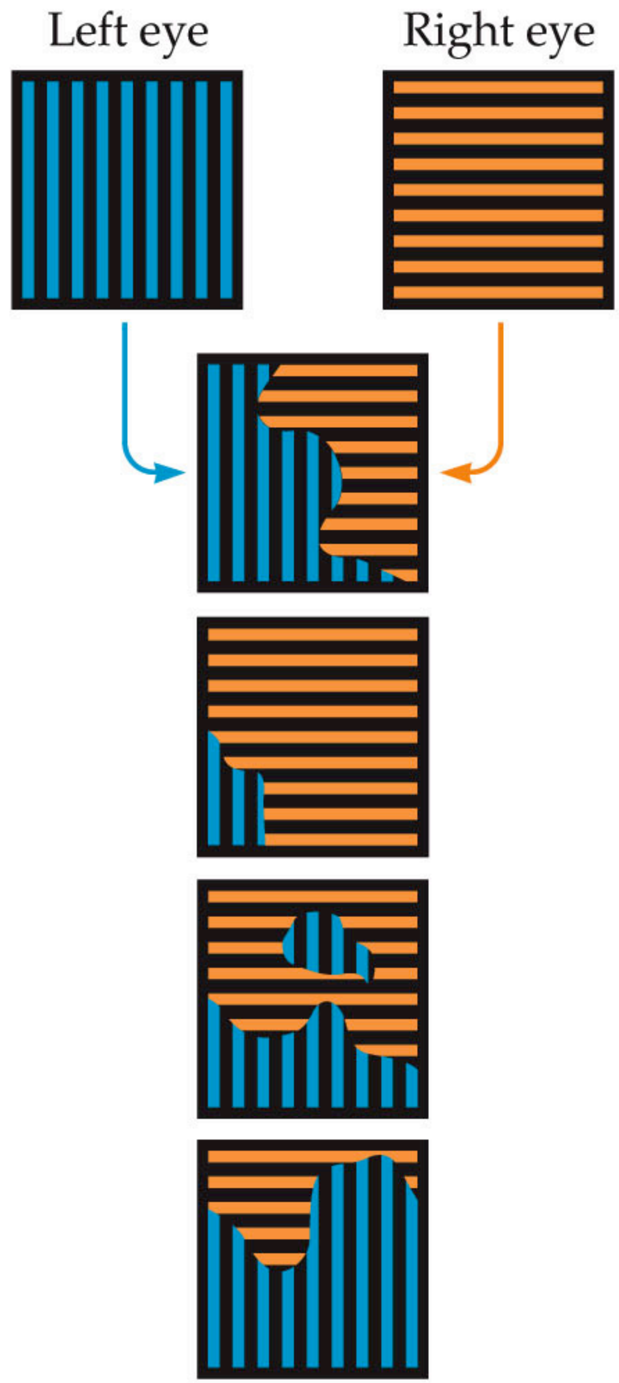
stereoblindness: inability to use binocular disparity as a depth cue.



Binocular Rivalry



Two stimuli battle for dominance of the percept



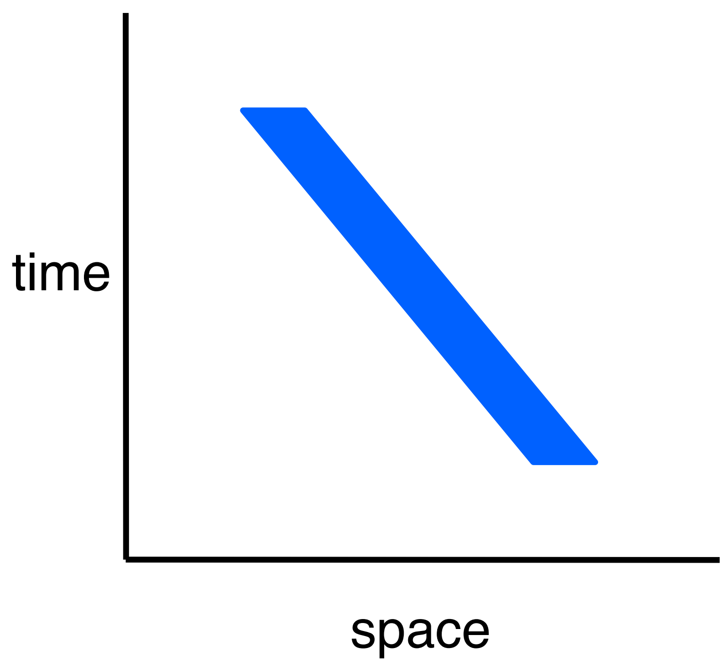
Chapter 6 Summary:

- monocular depth cues
- binocular depth cues (vergence, disparity)
- horopter
- crossed / uncrossed disparities
- free fusing
- random dot stereogram
- stereoscope
- “correspondence problem”
- panum’s fusional area
- strabismus / stereoblindness
- binocular rivalry (in book)

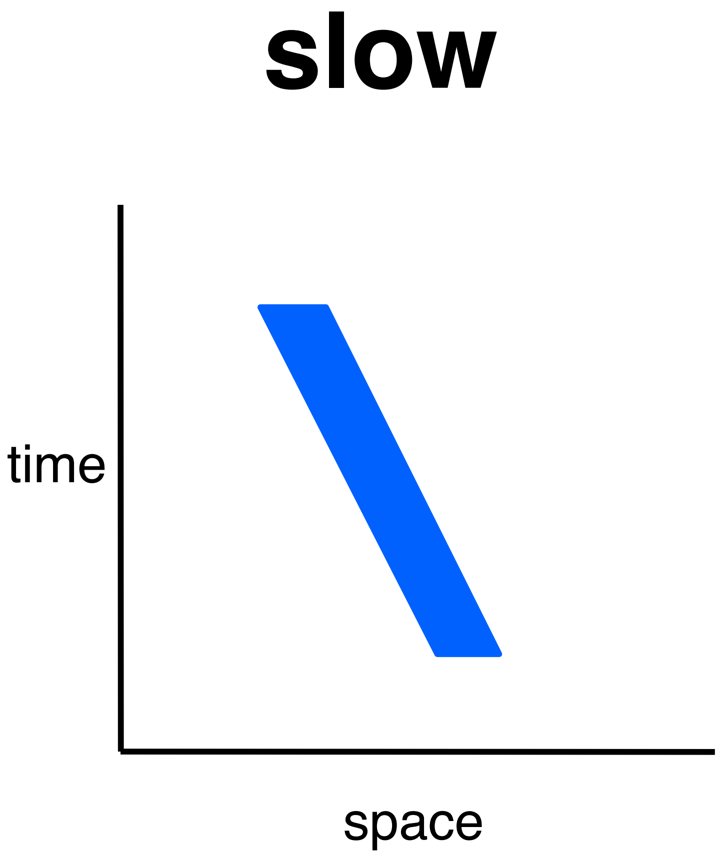
Motion Perception
Chapter 8

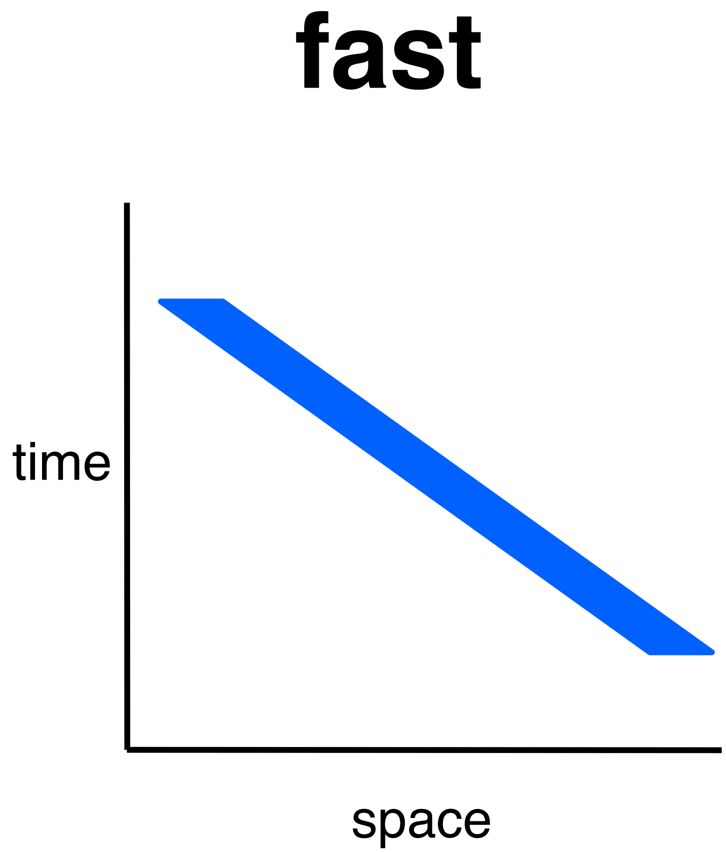
Main point of this chapter:

Motion = Orientation in Space-Time



which motion is faster?

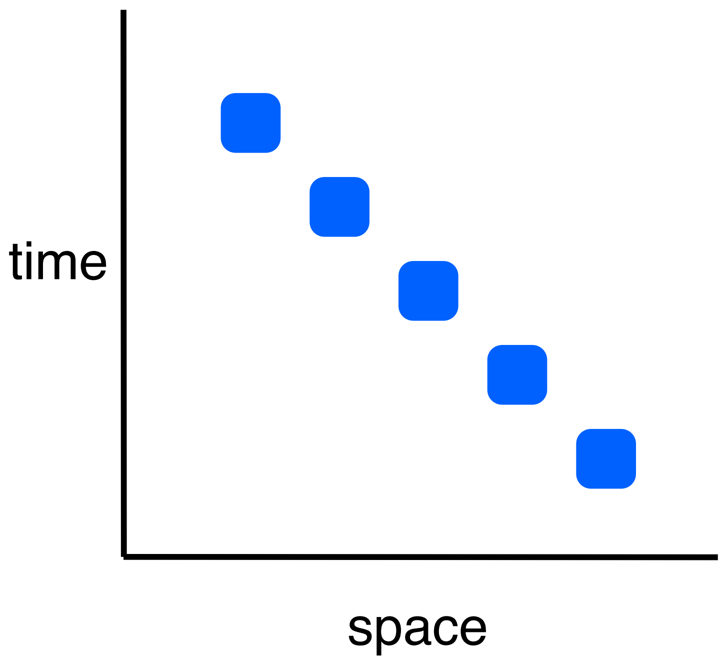




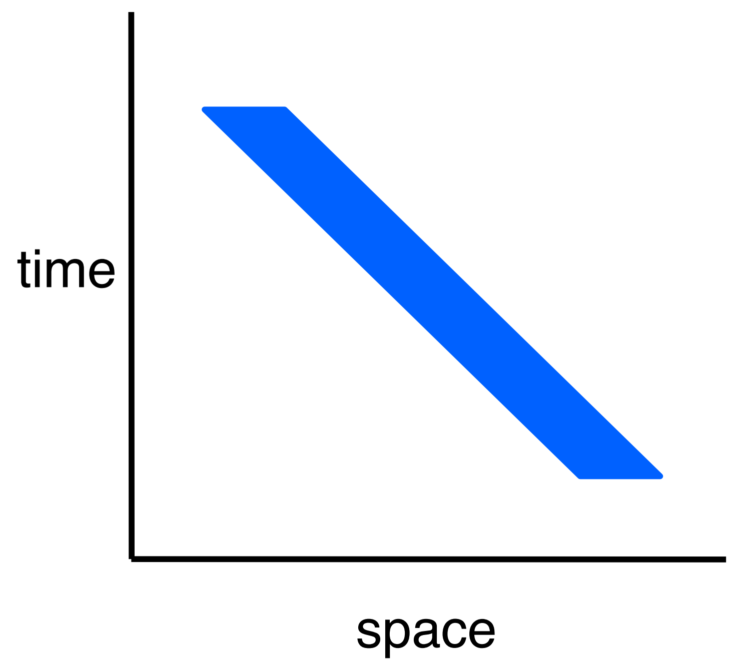
Real vs. Apparent motion

Apparent motion - motion percept that results from rapid display of stationary images in different locations

apparent
(movies, flip-books)



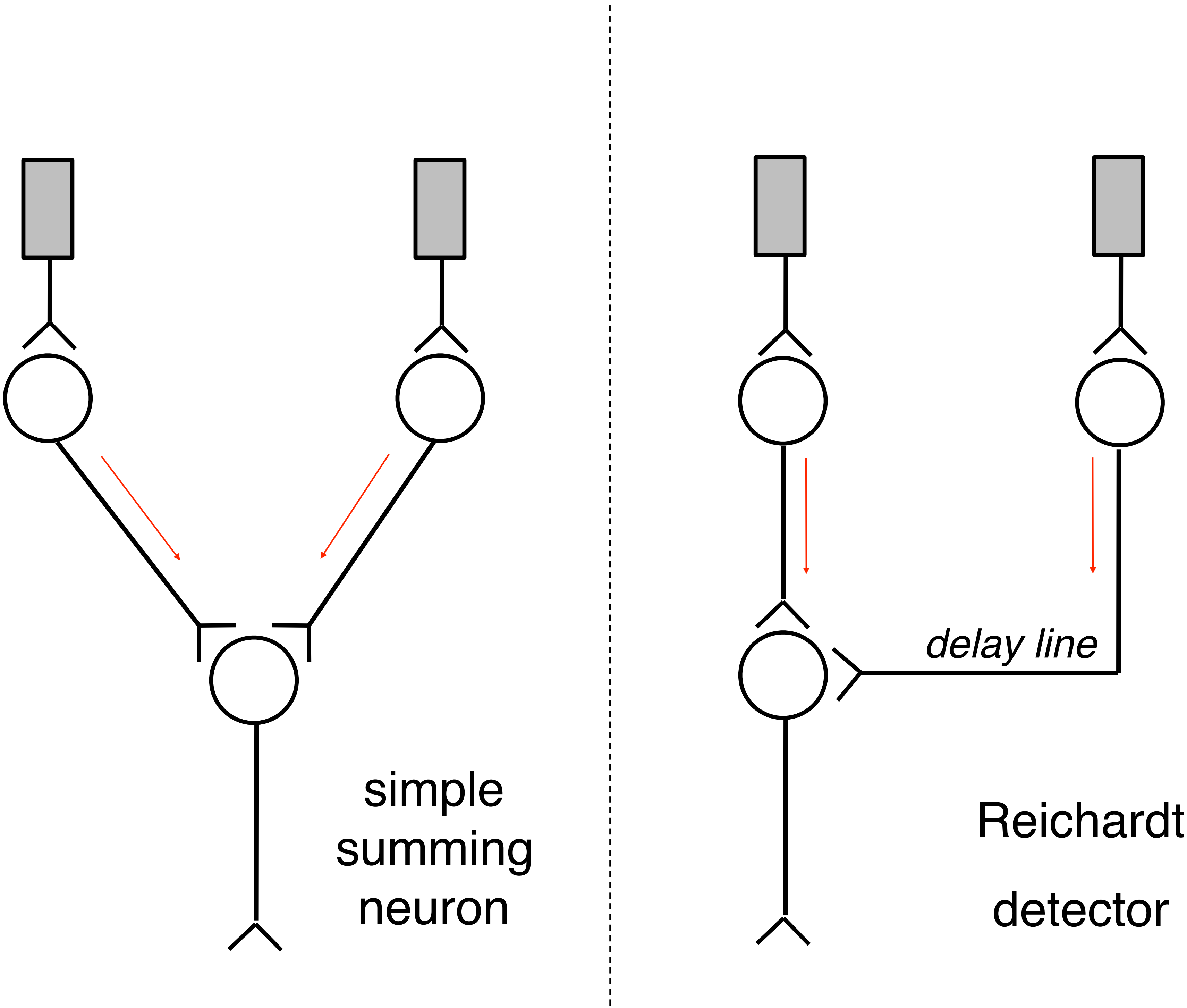
"real"



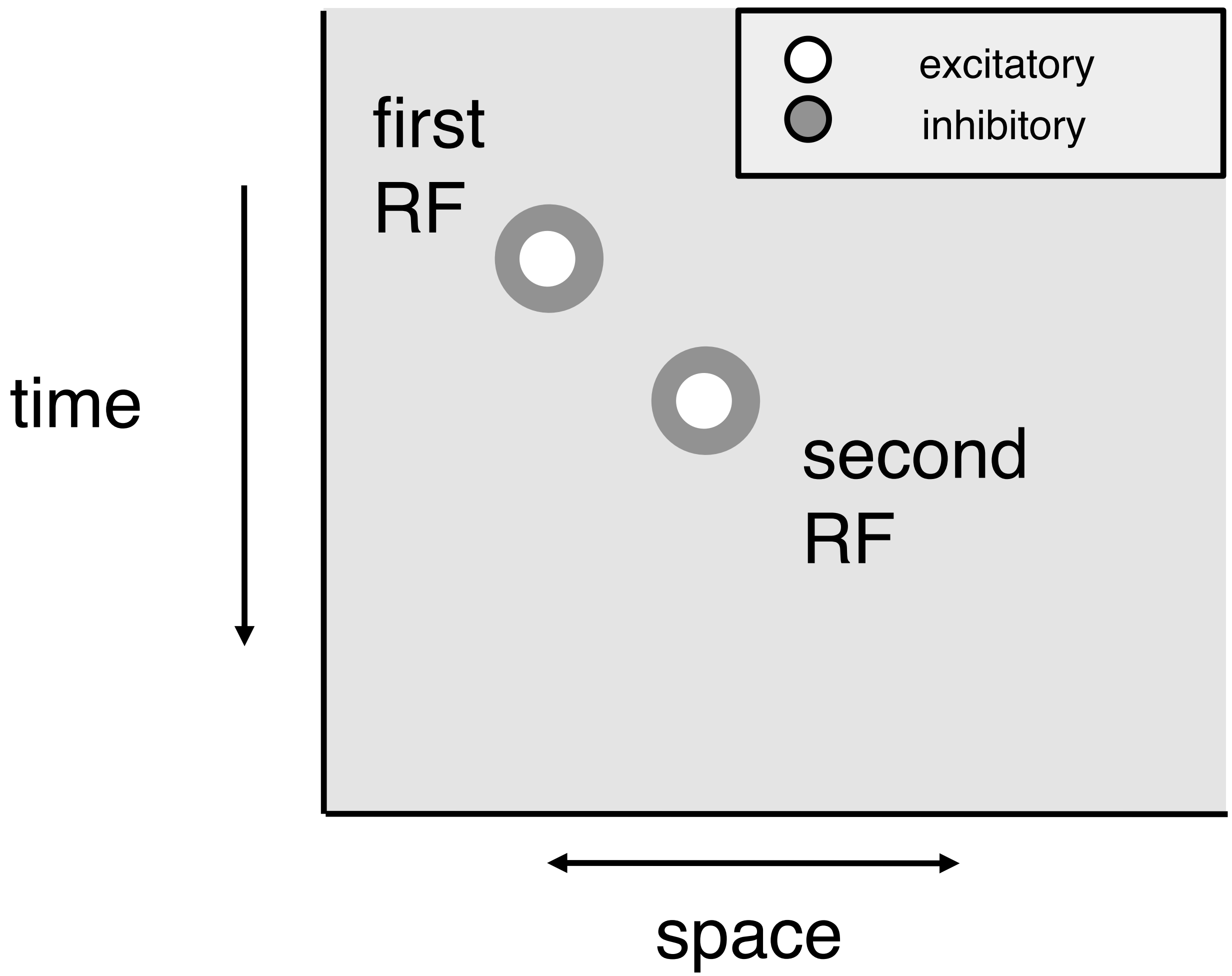
Q: why don't we notice the difference?

How does the nervous system encode motion? What makes a Motion Receptive Field?

Answer: a surprisingly simple neural circuit called a "*Reichardt detector*"

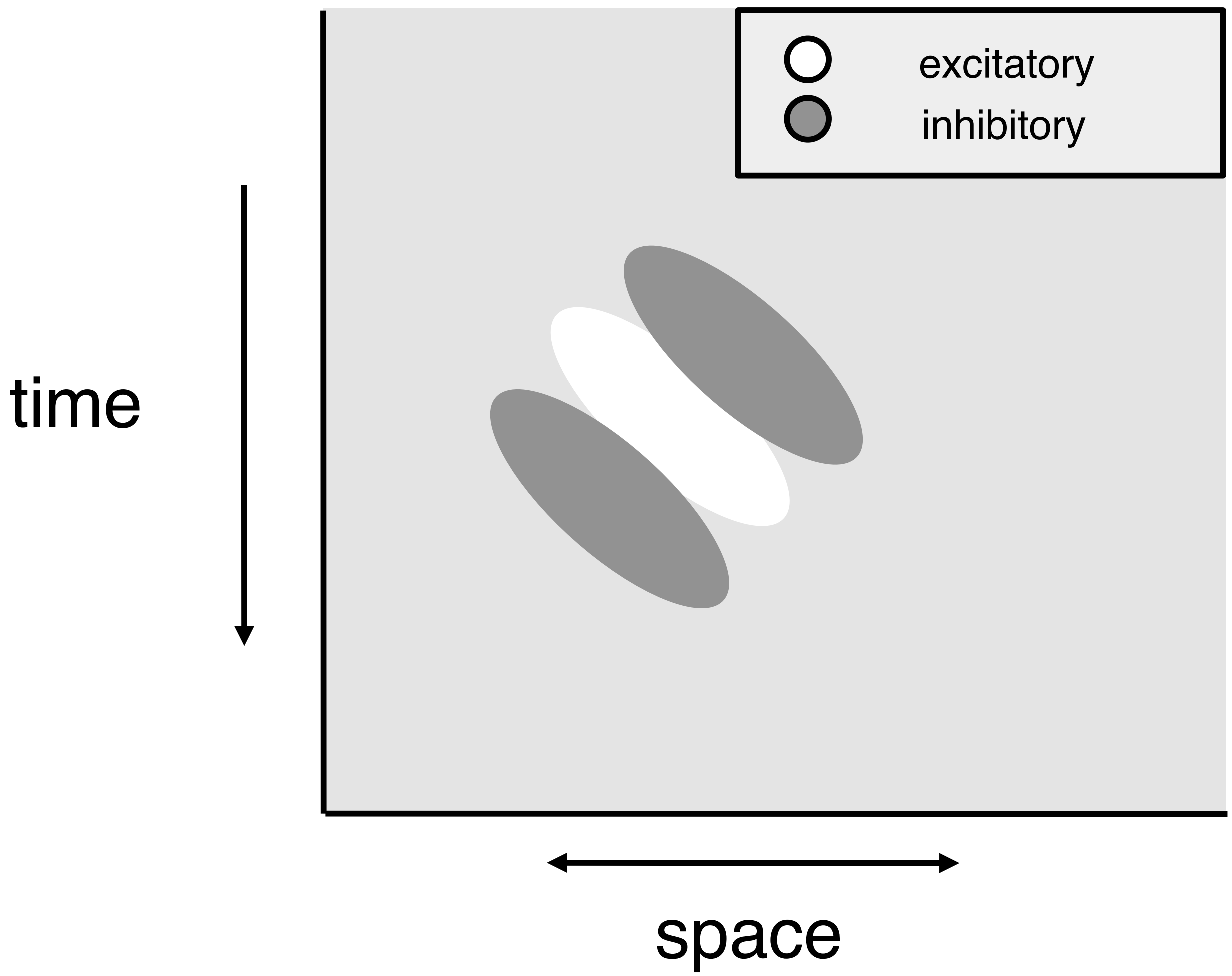

simple summing neuron
delay line
Reichardt detector

Reichardt detector in space-time



2nd neuron has a spatially separated Receptive Field (RF), and a shorter temporal delay

Smoother Reichardt detector



Like an oriented V1 receptive field, but oriented in space-time!

Reichardt detectors respond to real and apparent motion

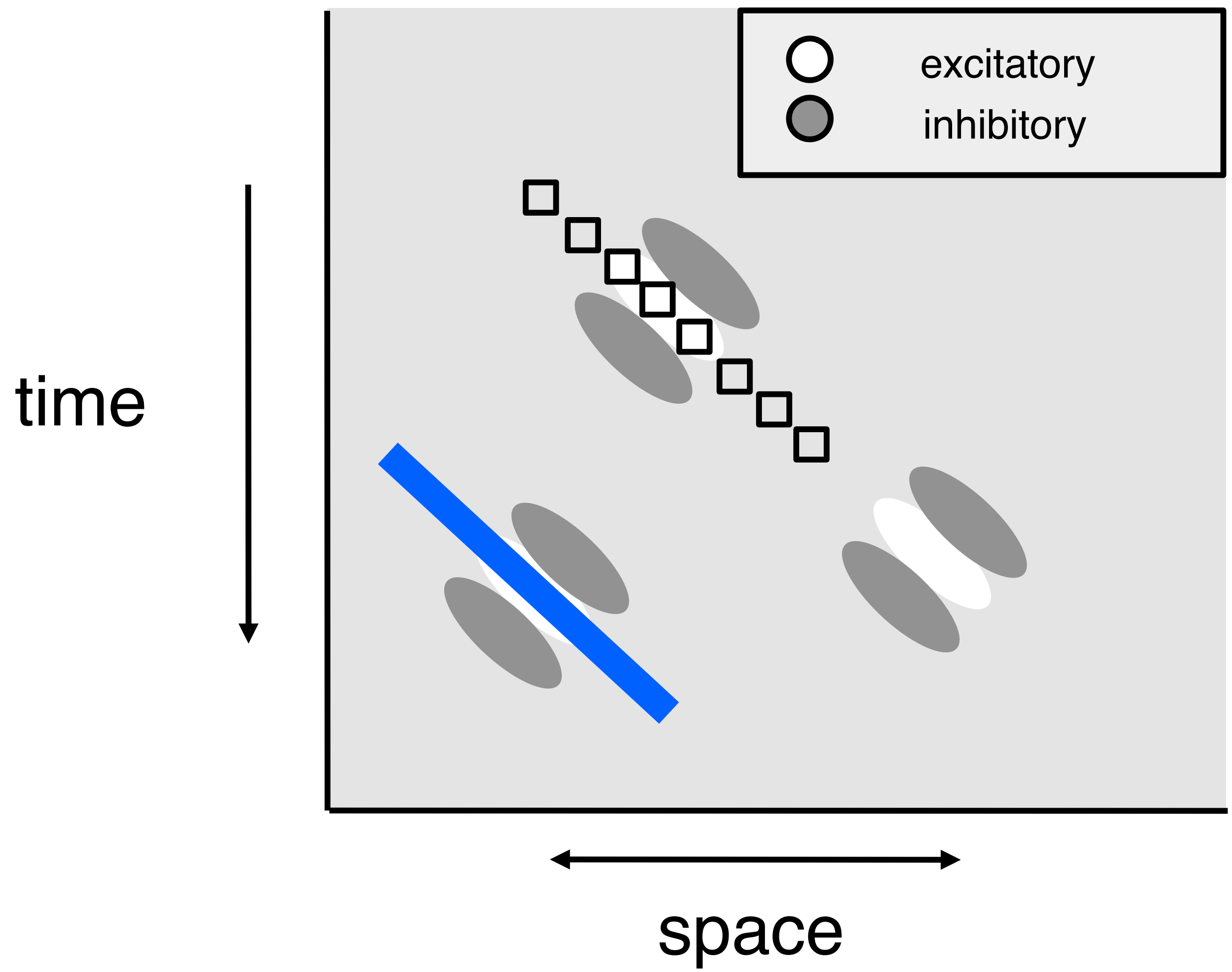


Figure 7.3 Constructing a neural circuit for the detection of rightward motion (Part 1)

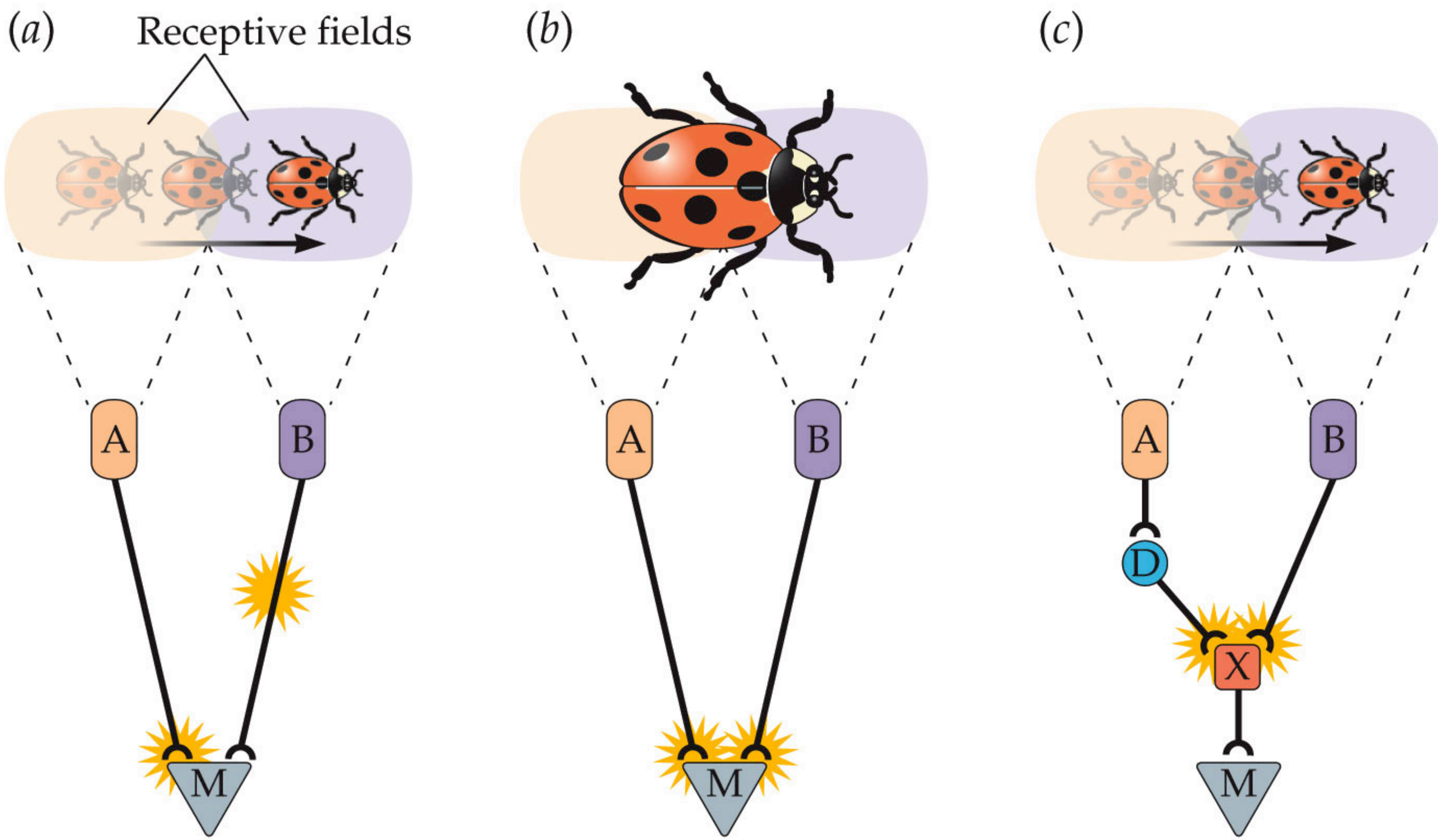
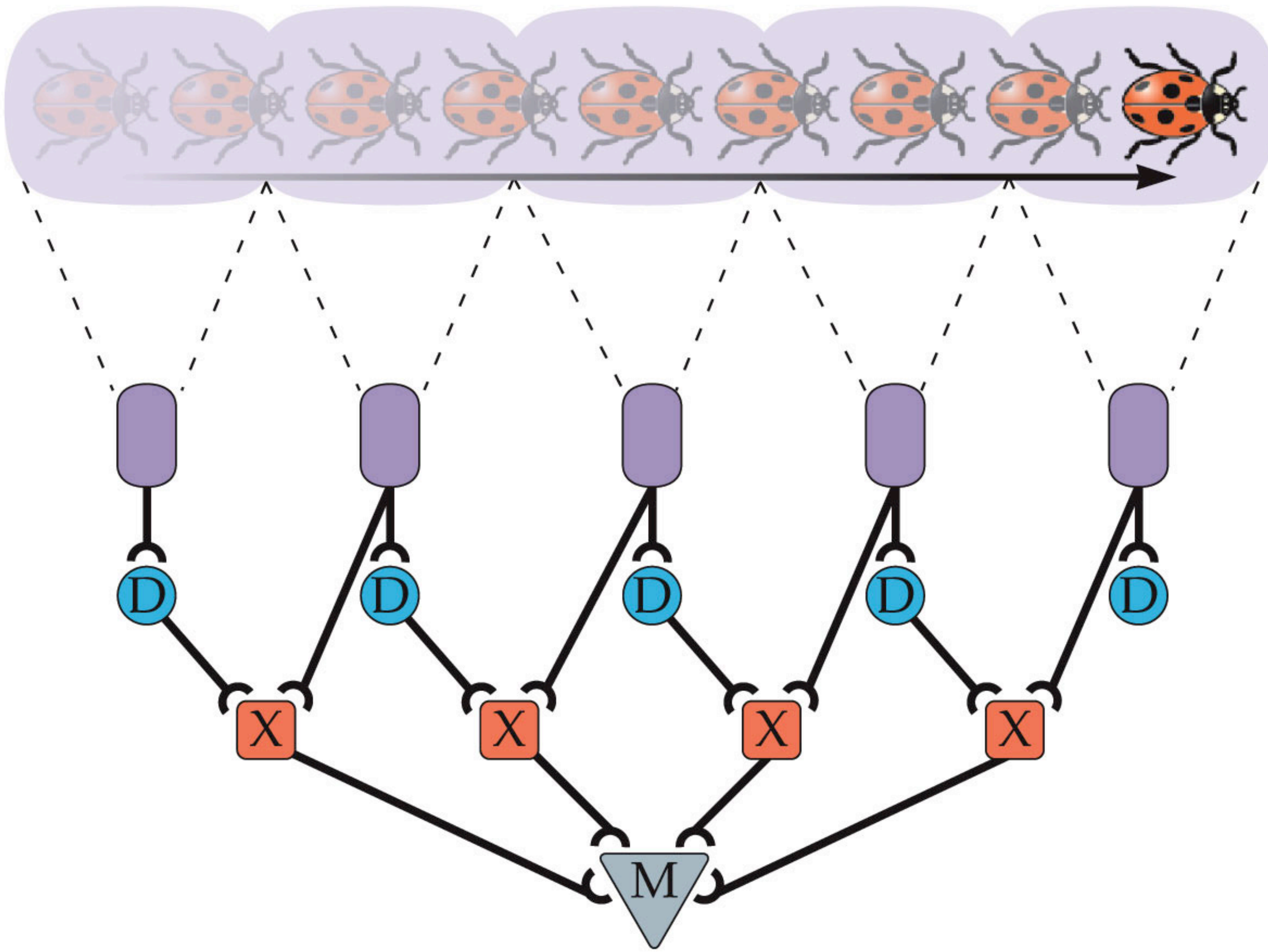
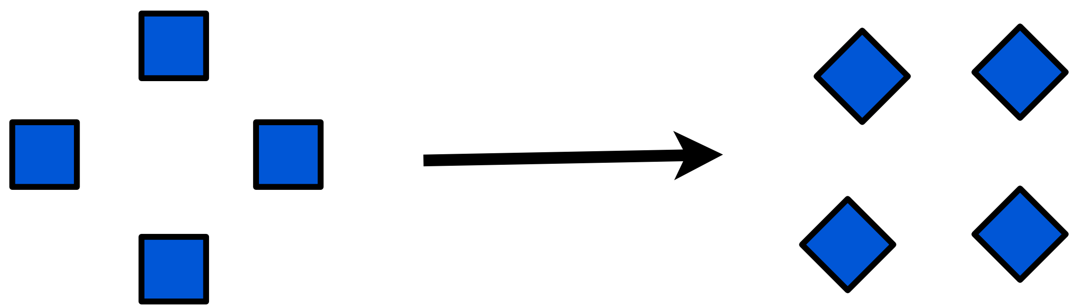


Figure 7.3 Constructing a neural circuit for the detection of rightward motion (Part 2)



Correspondence problem (motion):

• problem of knowing the correspondence between features in successive frames
(which points in frame 1 are the same objects in frame 2?)



Clockwise or Counter-clockwise rotation?

https://oup-arc.com/access/content/sensation-and-perception-5e-student-resources/sensation-and-perception-5e-activity-8-4?previousFilter=tag_chapter-08

(web demo)

- **Aperture problem**:
  when a moving object is viewed through an aperture, the direction of motion may be ambiguous

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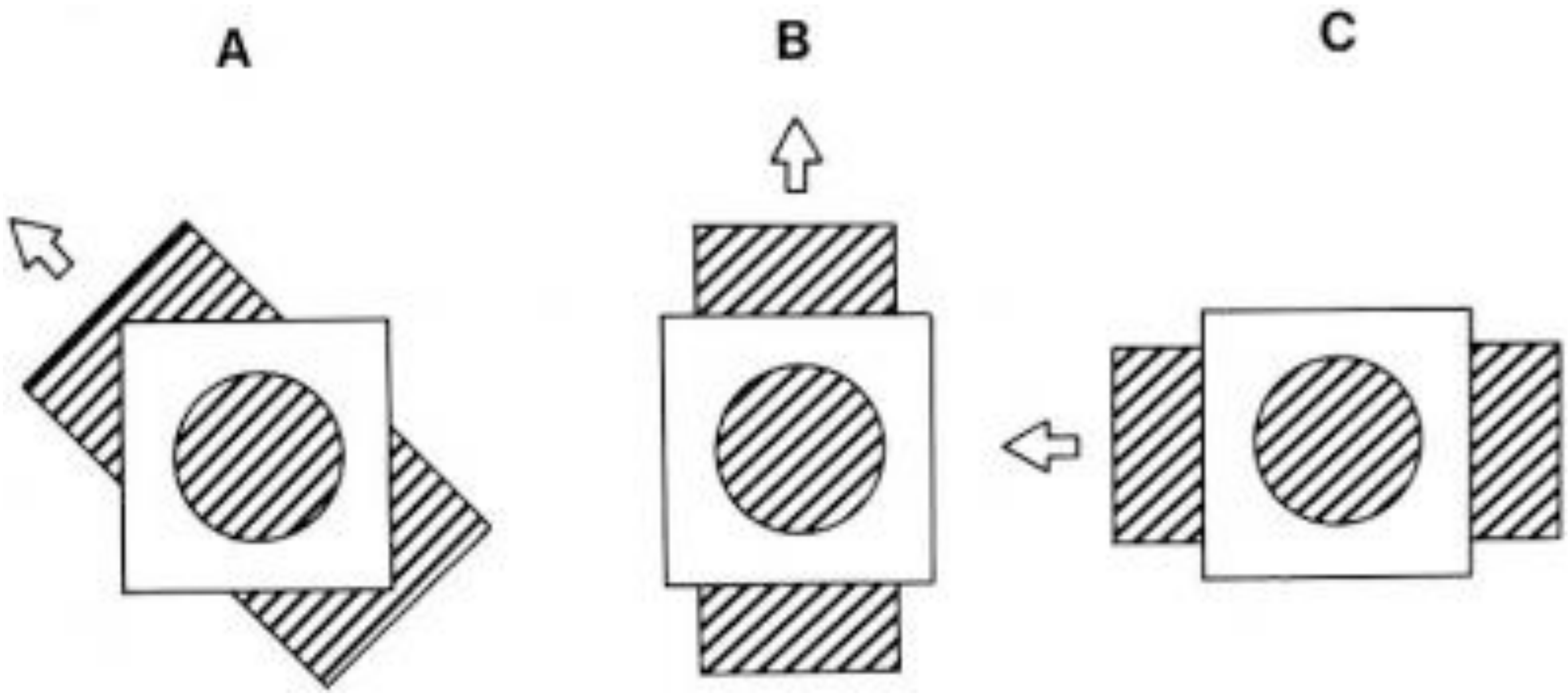

- this is a problem because each *neuron* only sees the scene through a small aperture (its receptive field!)
- how can the brain figure out the “global” direction of motion?

aperture problem / correspondence problem

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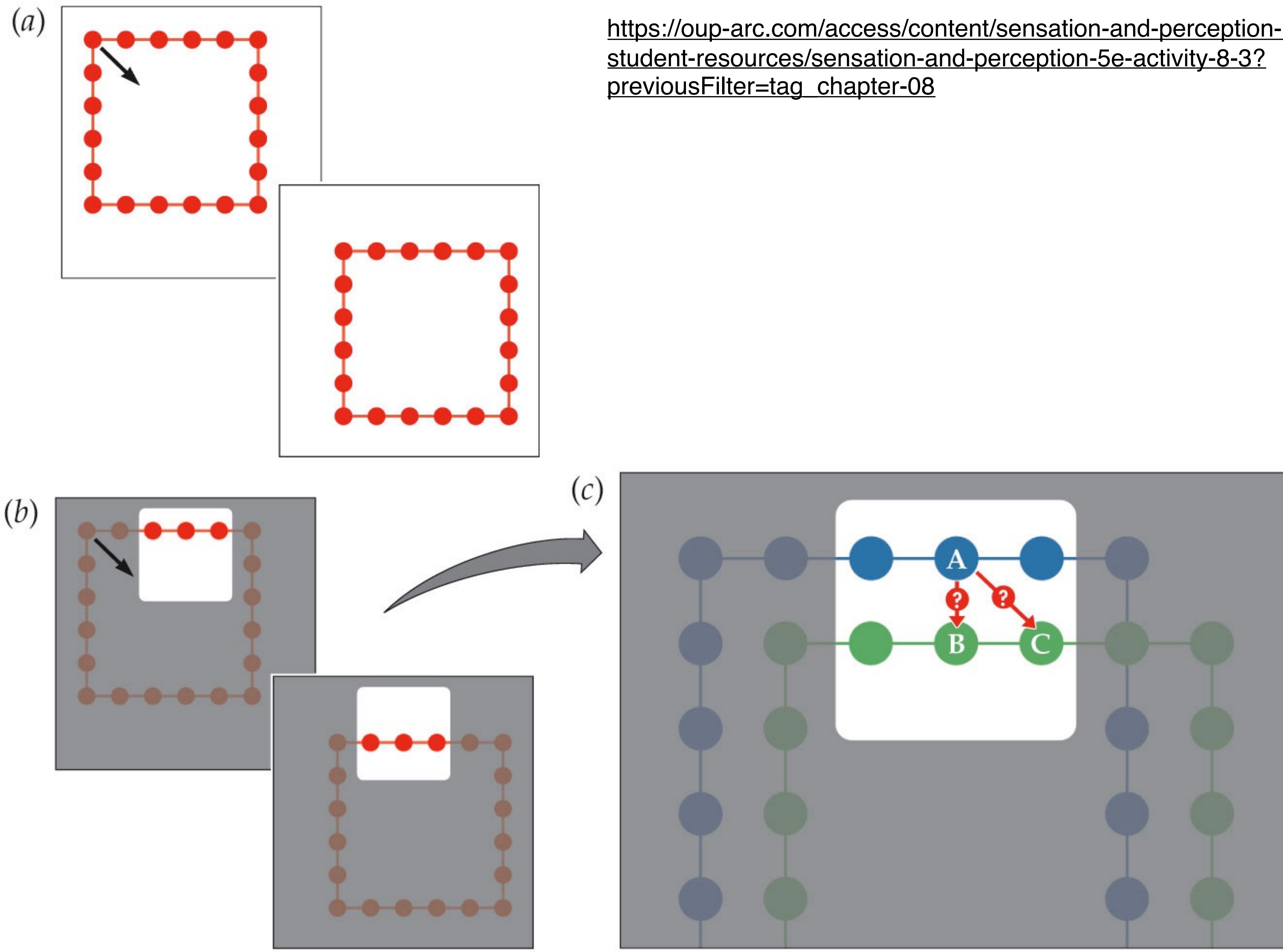
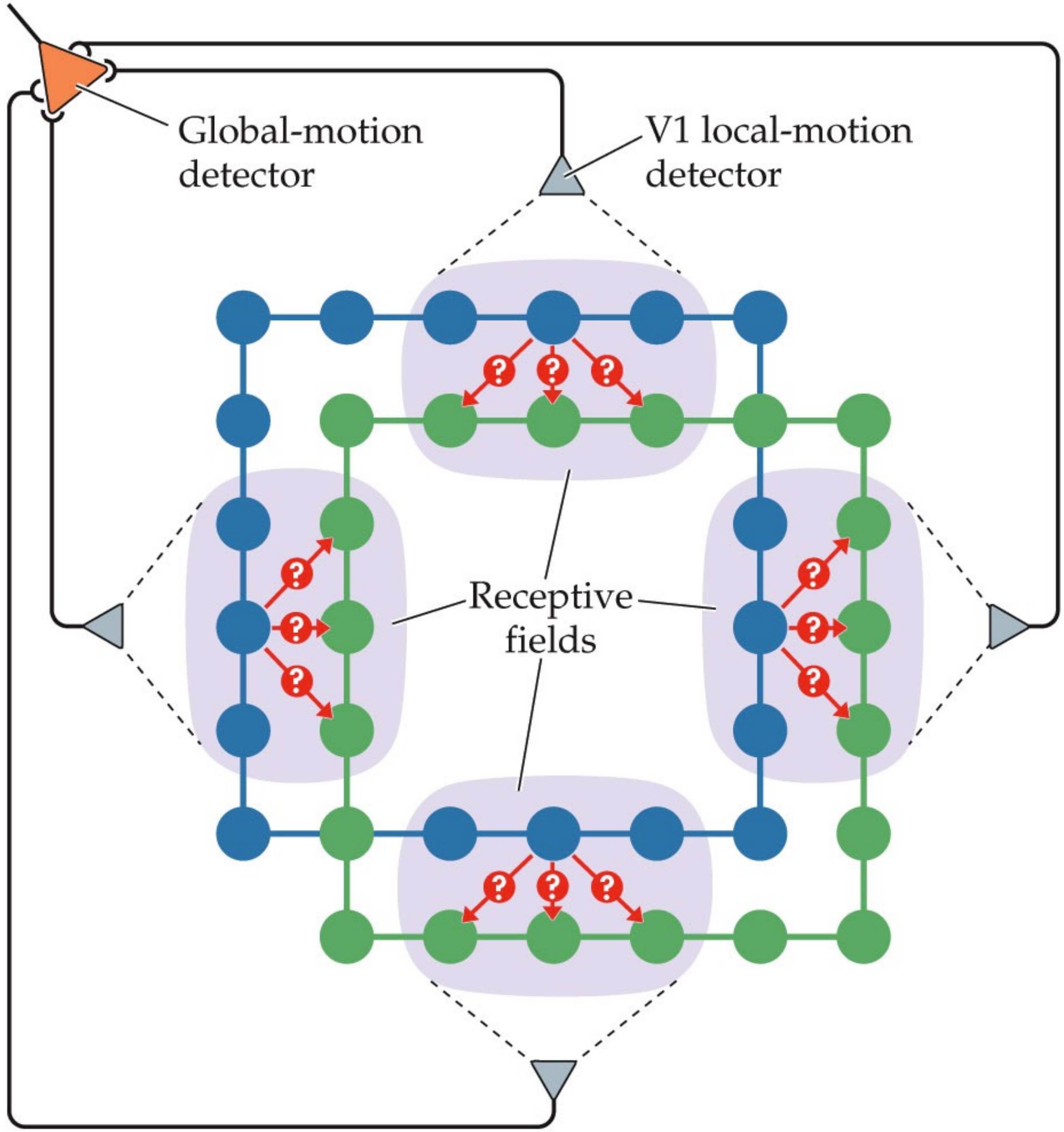
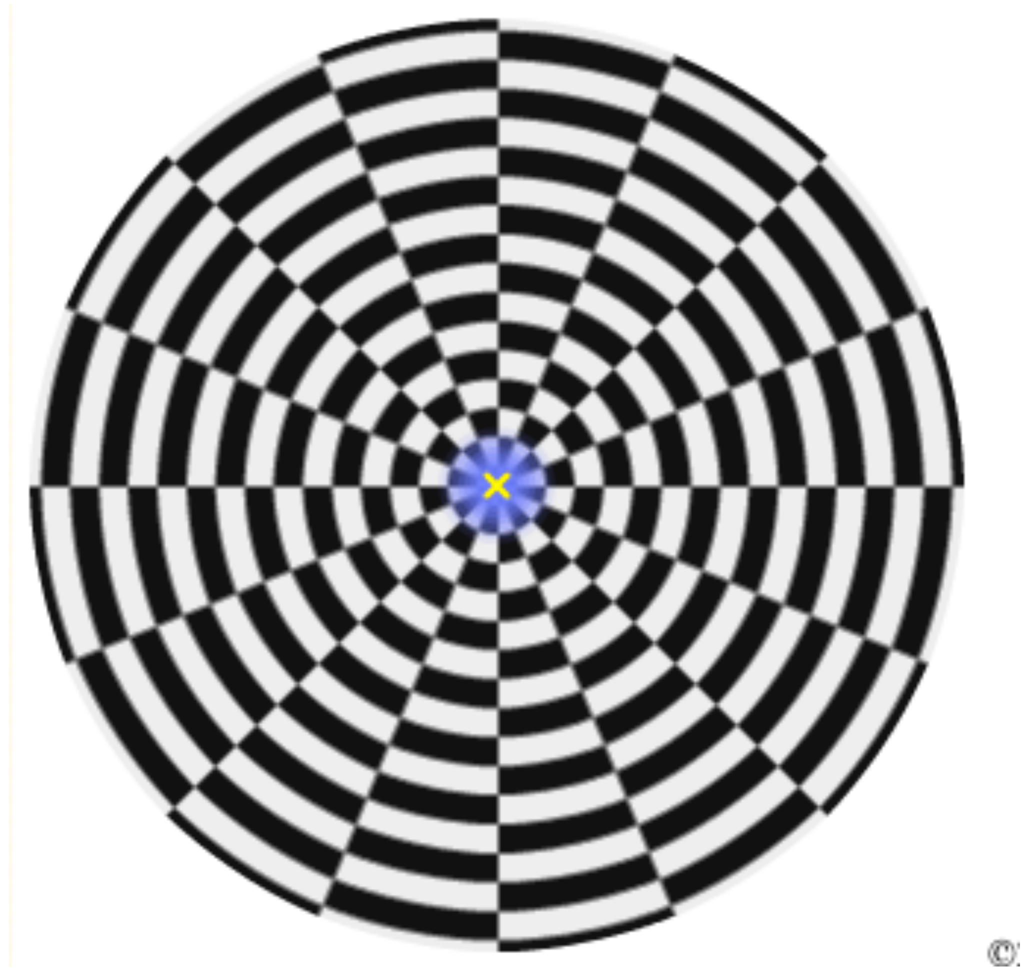


building a global motion detector



Motion aftereffect (MAE): The illusion of motion that occurs after prolonged exposure to a moving stimulus



http://www.michaelbach.de/ot/mot-adapt/index.html

Motion after-effect

- Always gives rise to motion in the *opposite* direction of the adapting motion
- Also known as: **"waterfall illusion"** - stare at a waterfall; stationary objects will then appear to move upwards.
- evidence for "opponent channels" in processing motion

Interocular transfer: The transfer of an effect (such as adaptation) from one eye to another

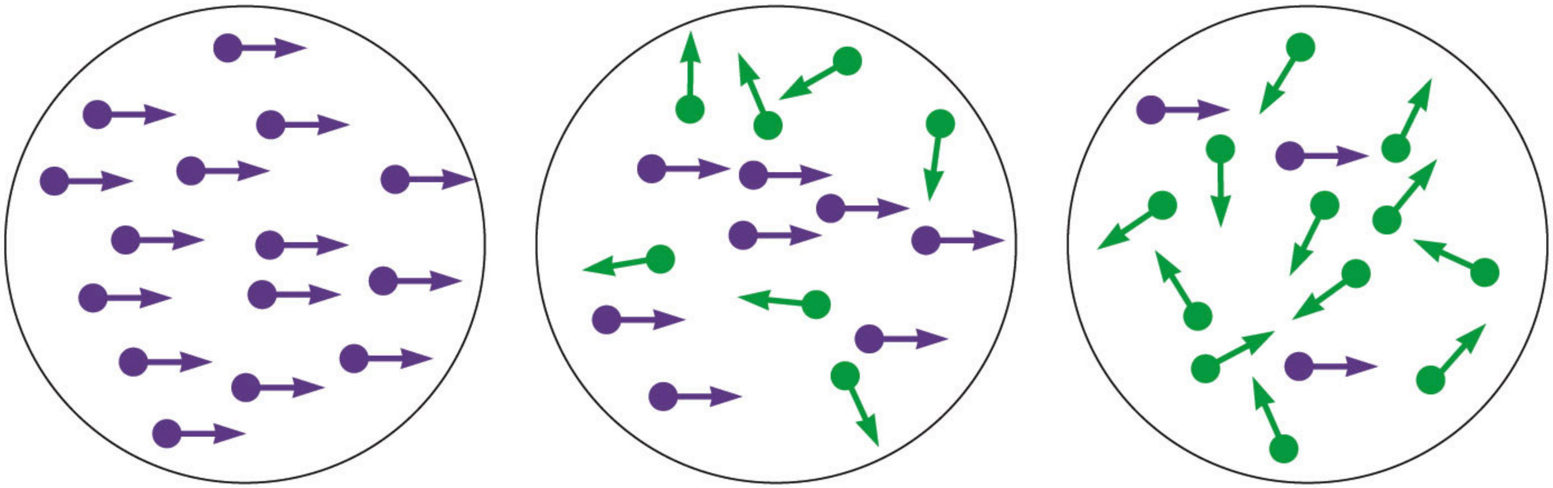
- MAE: exhibits interocular transfer

Q: What does this tell us about where in the brain motion is computed?

- Remember: Input from both eyes is combined in area V1

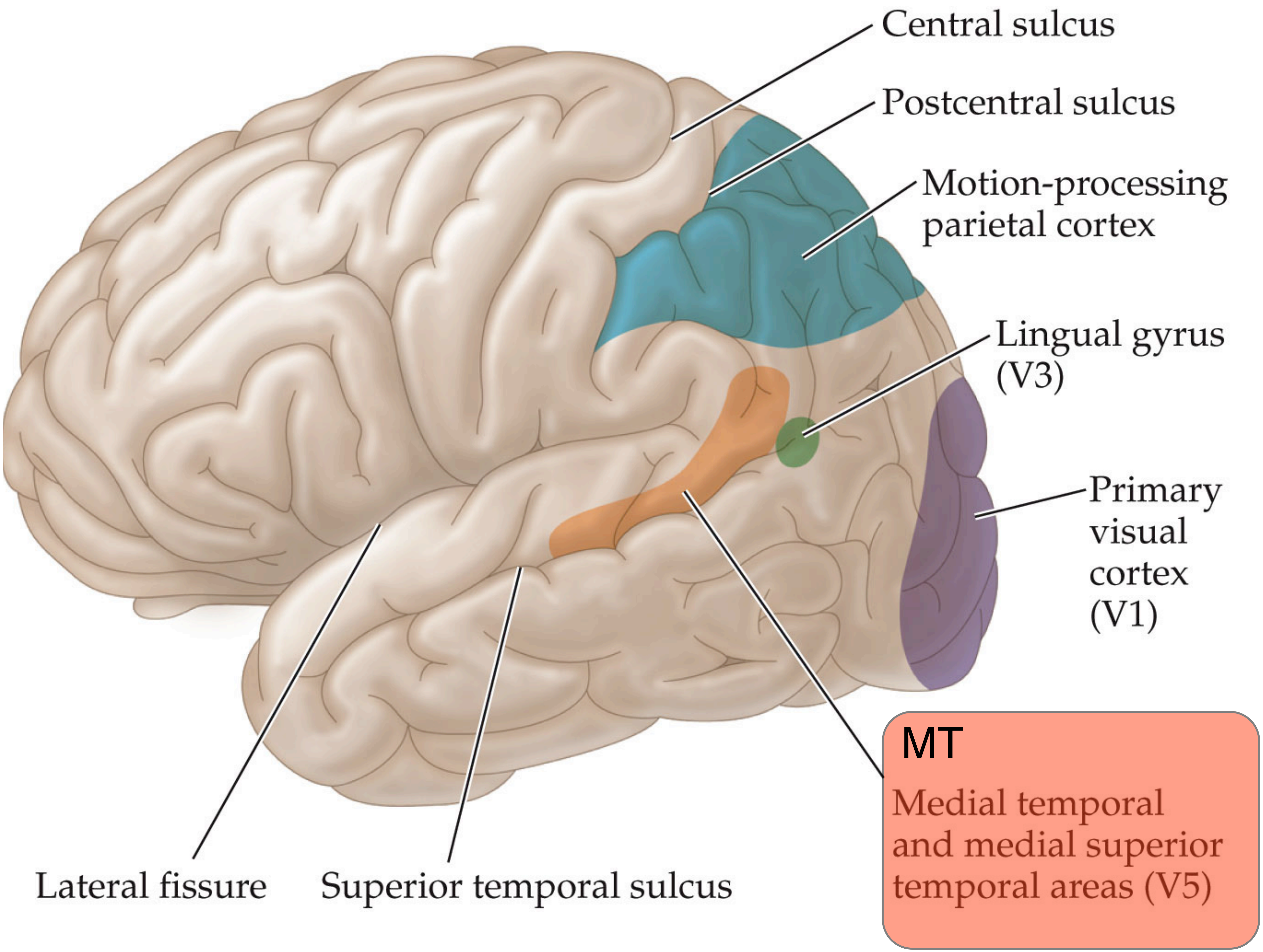
Newsome and Pare (1988) conducted a study on motion perception in monkeys

- Trained monkeys to respond to dot motion displays
- **Area MT** of the monkeys was lesioned
- Result: Monkeys needed about ten times as many dots to correctly identify direction of motion

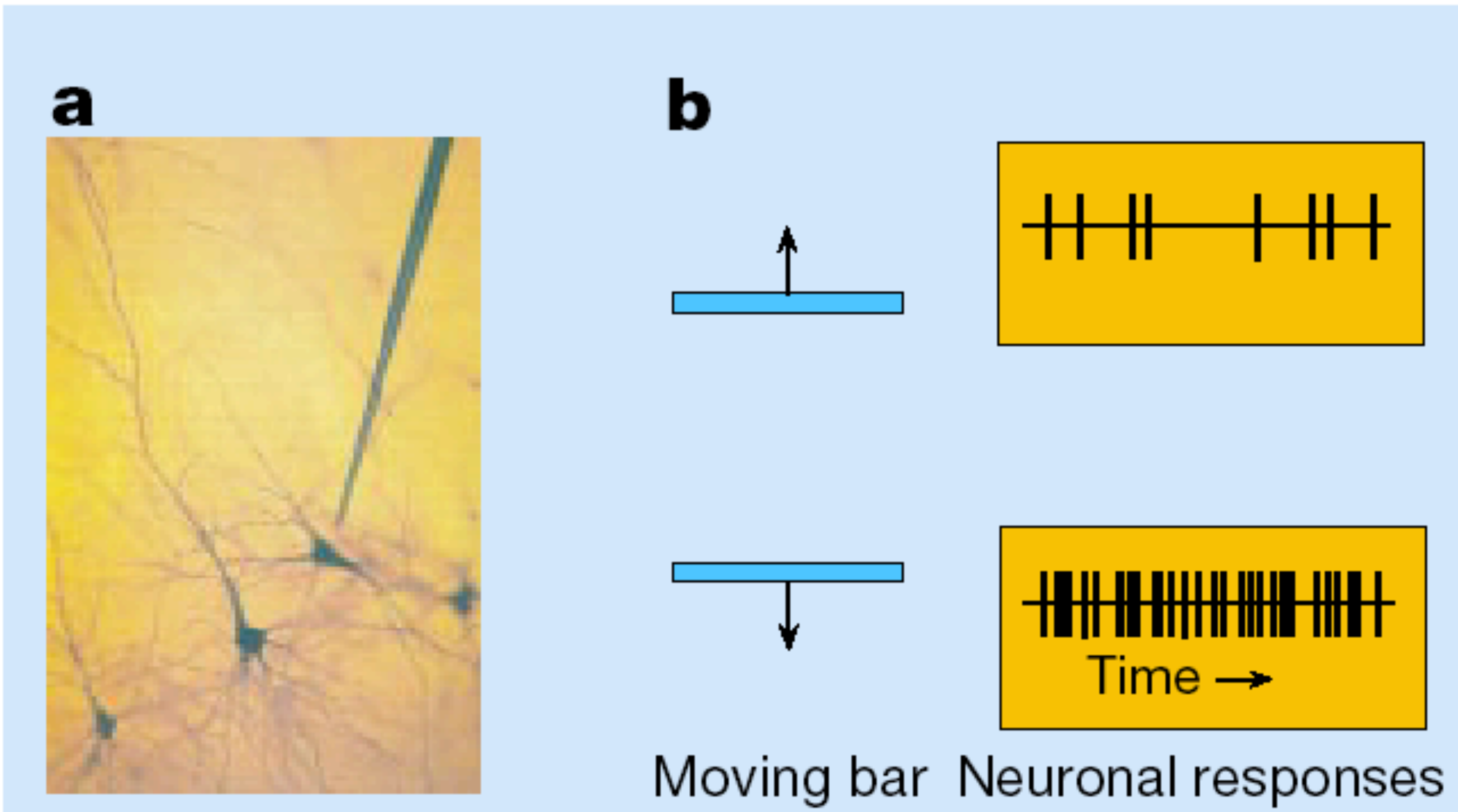


(*a*) 100% (*b*) 50% (*c*) 20%

Figure 7.7 The middle temporal lobe and other regions of the cortex involved in motion perception



Interesting result:
electrical stimulation of area MT => monkeys report seeing motion, even when no motion present!

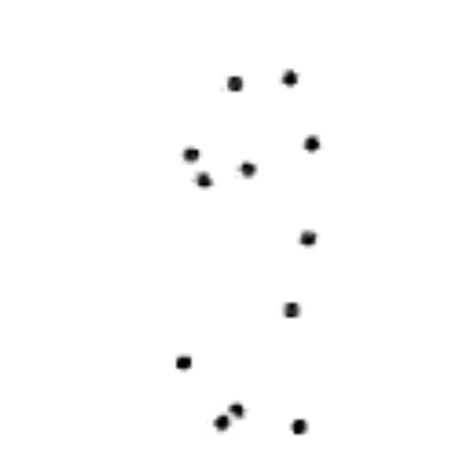


Nichols & Newsome 1999

(to read on your own)

- optic flow
- focus of expansion
- biological motion

Biological motion



non-biological motion

courtesy of R Blake

http://www.psy.vanderbilt.edu/faculty/blake/BM/BioMot.html