

Motion Perception

Chapter 8

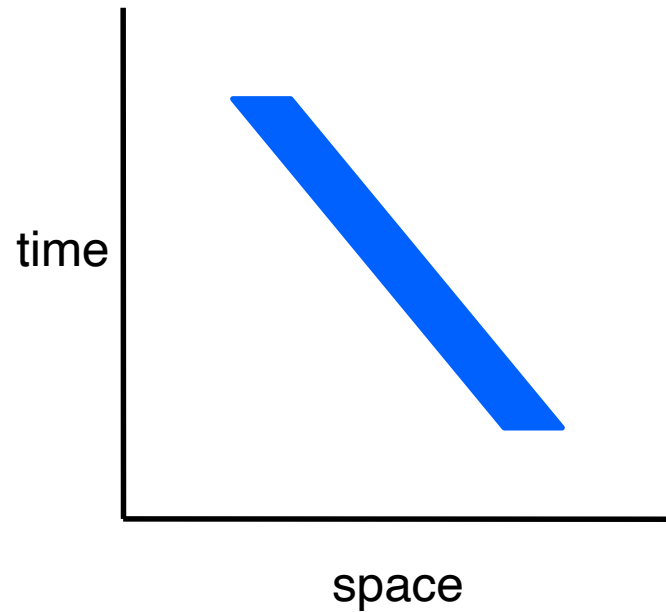
Lecture 14



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Sensation & Perception (PSY 345 / NEU 325)
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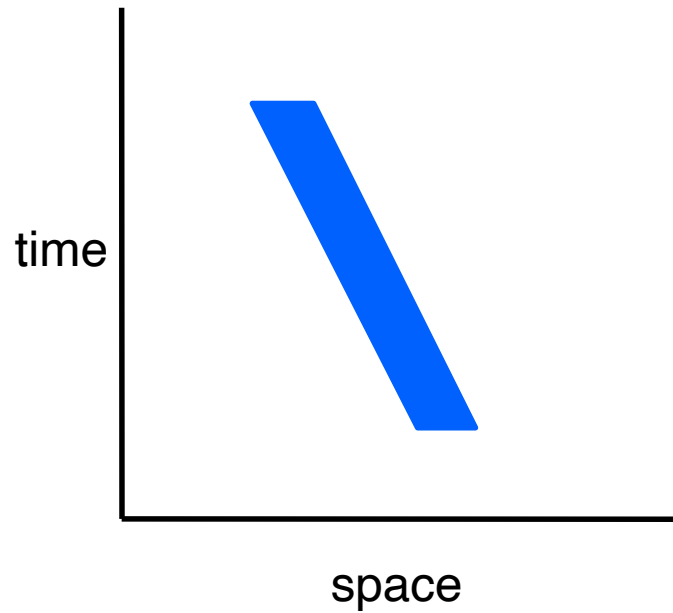
Main point of this chapter:

Motion = Orientation in Space-Time

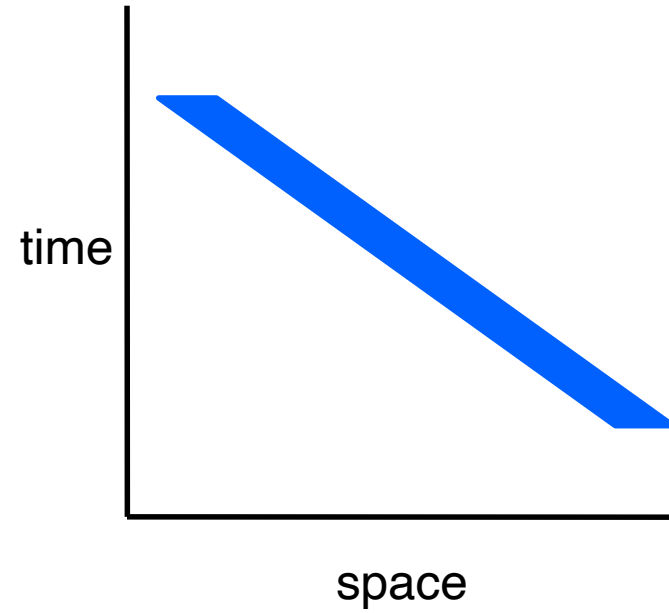


which motion is faster?

slow

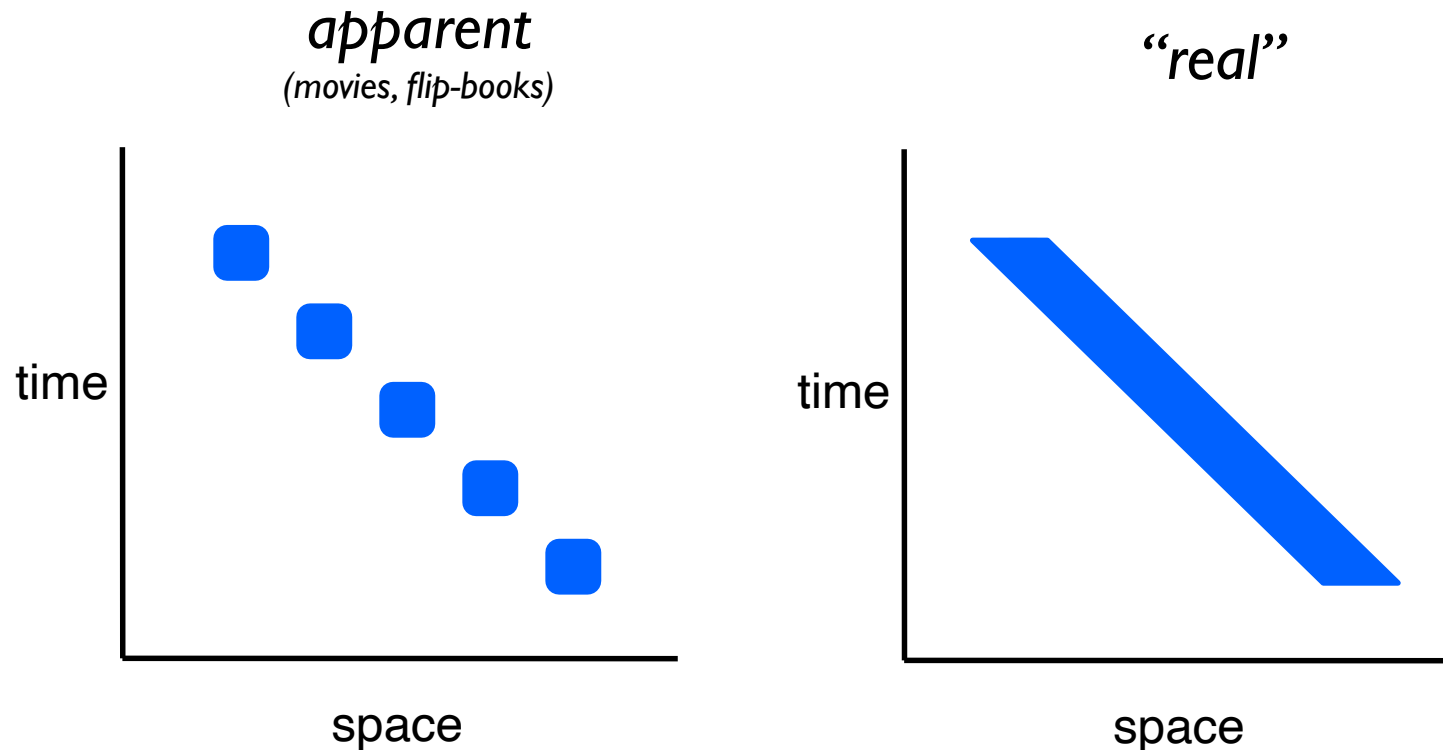


fast



Real vs. Apparent motion

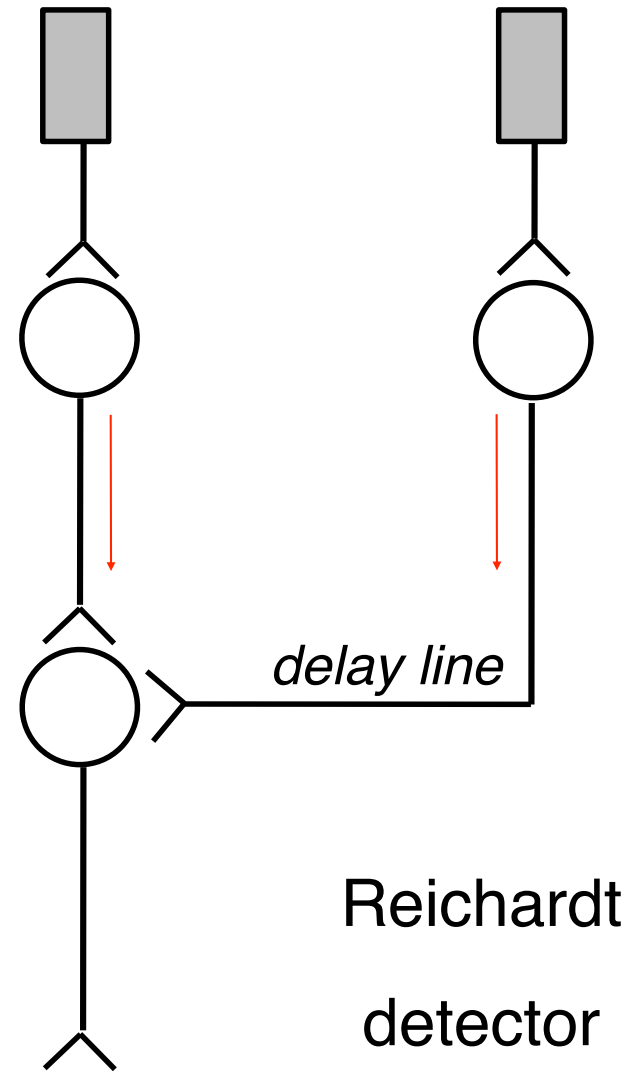
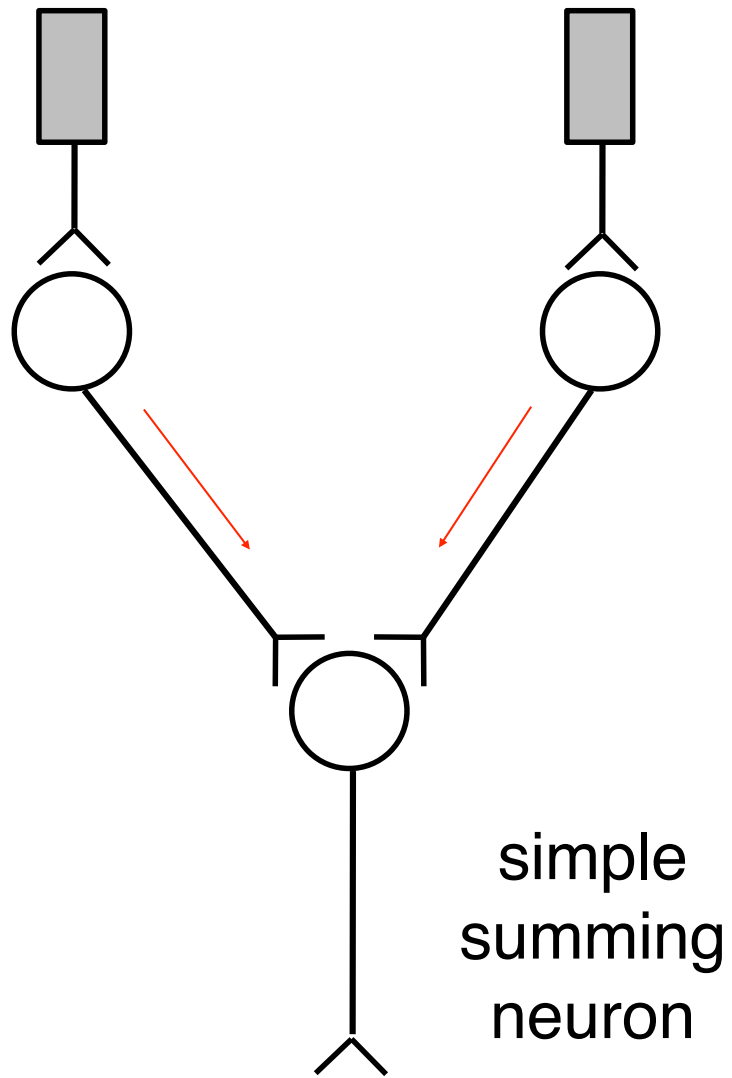
Apparent motion - motion percept that results from rapid display of stationary images in different locations



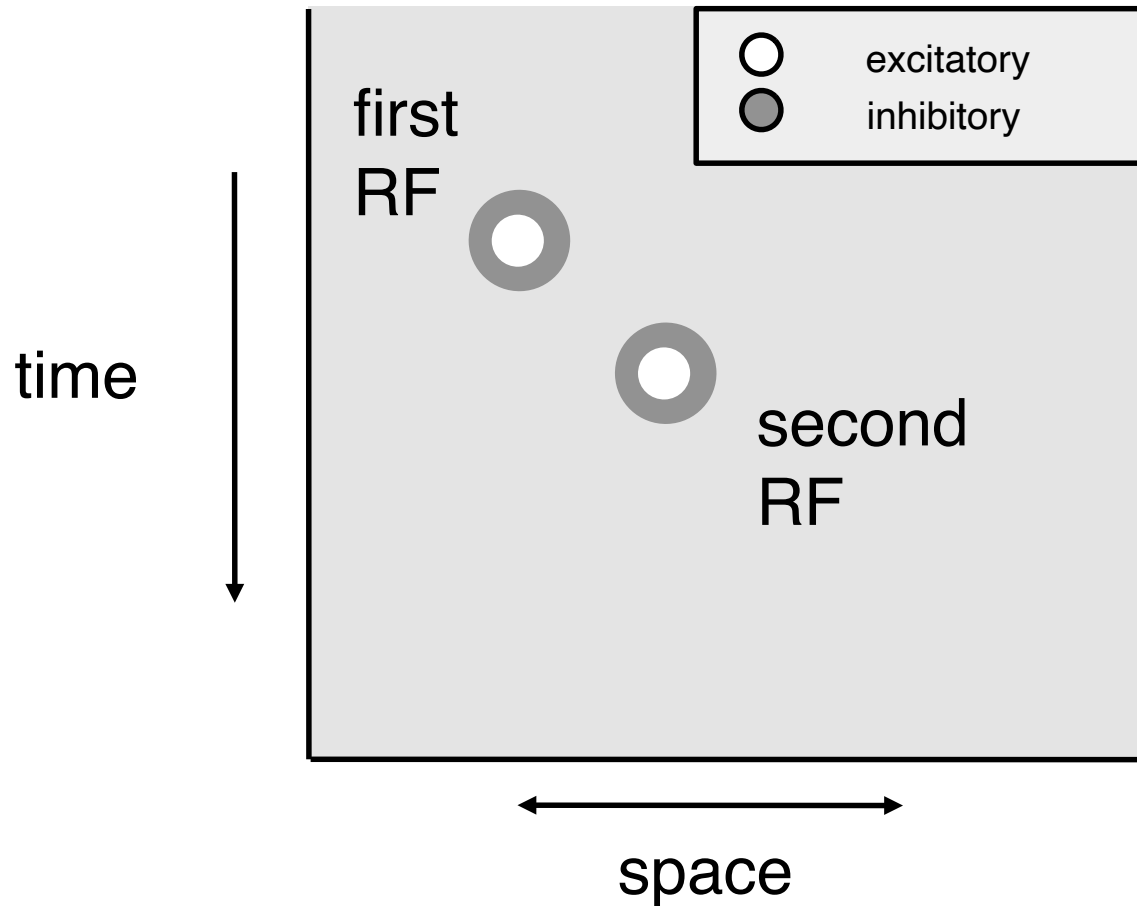
Q: why don't we notice the difference?

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

Answer: a surprisingly simple neural circuit called a “*Reichardt detector*”

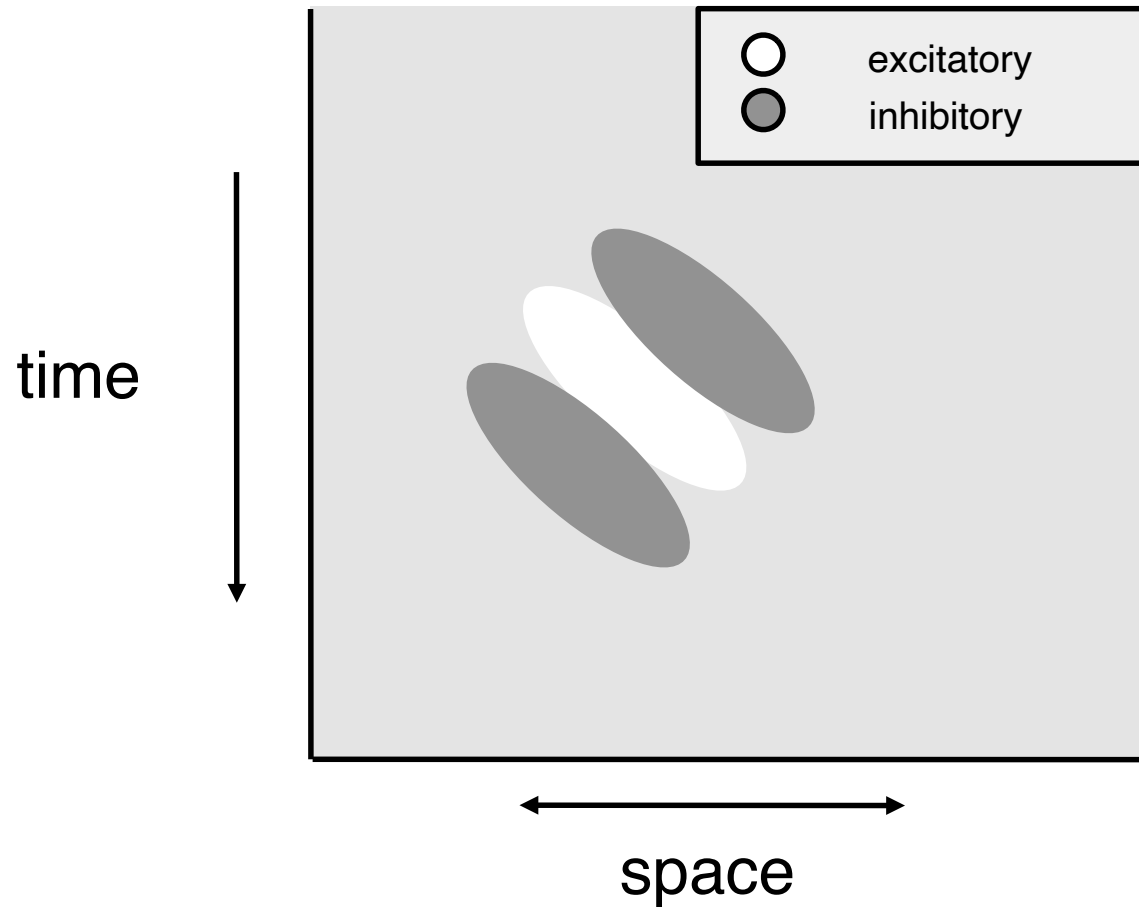


Reichardt detector in space-time



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

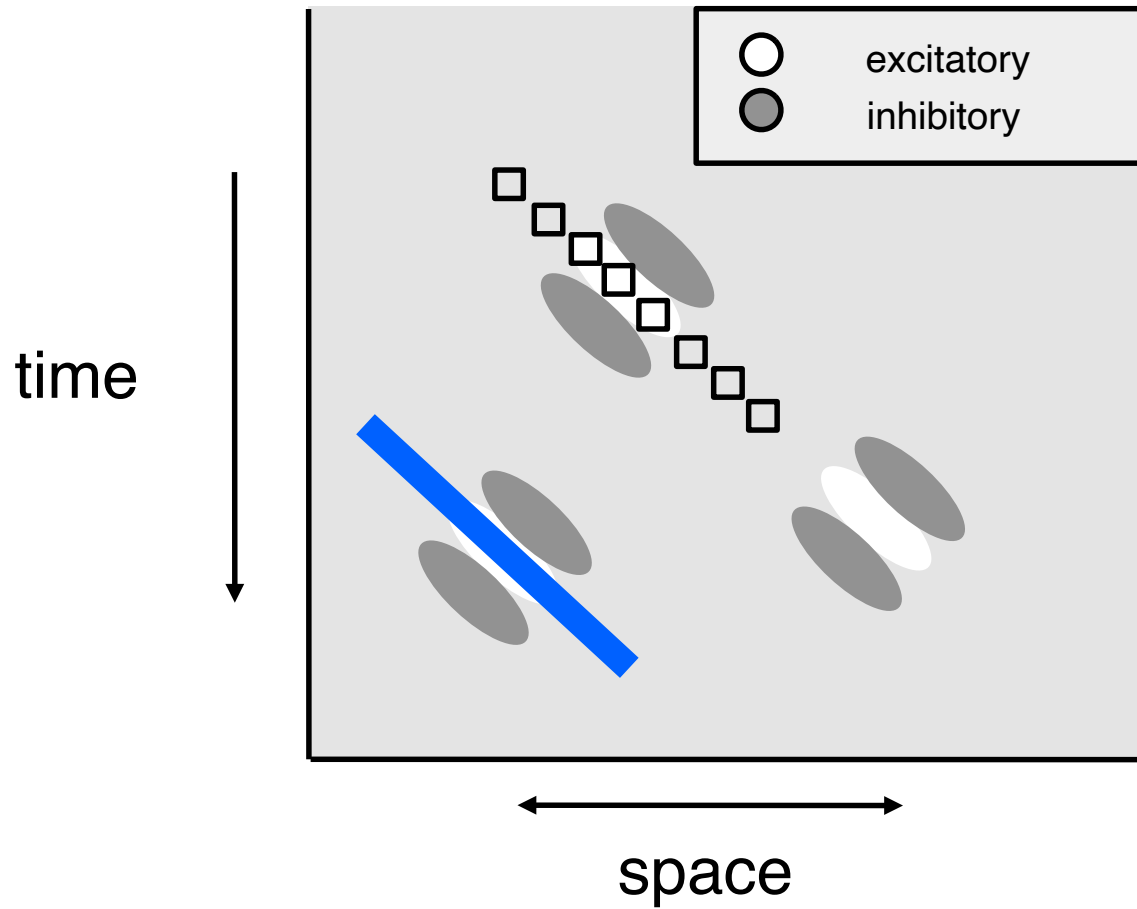


Figure 7.3 Constructing a neural circuit for the detection of rightward motion (Part 1)

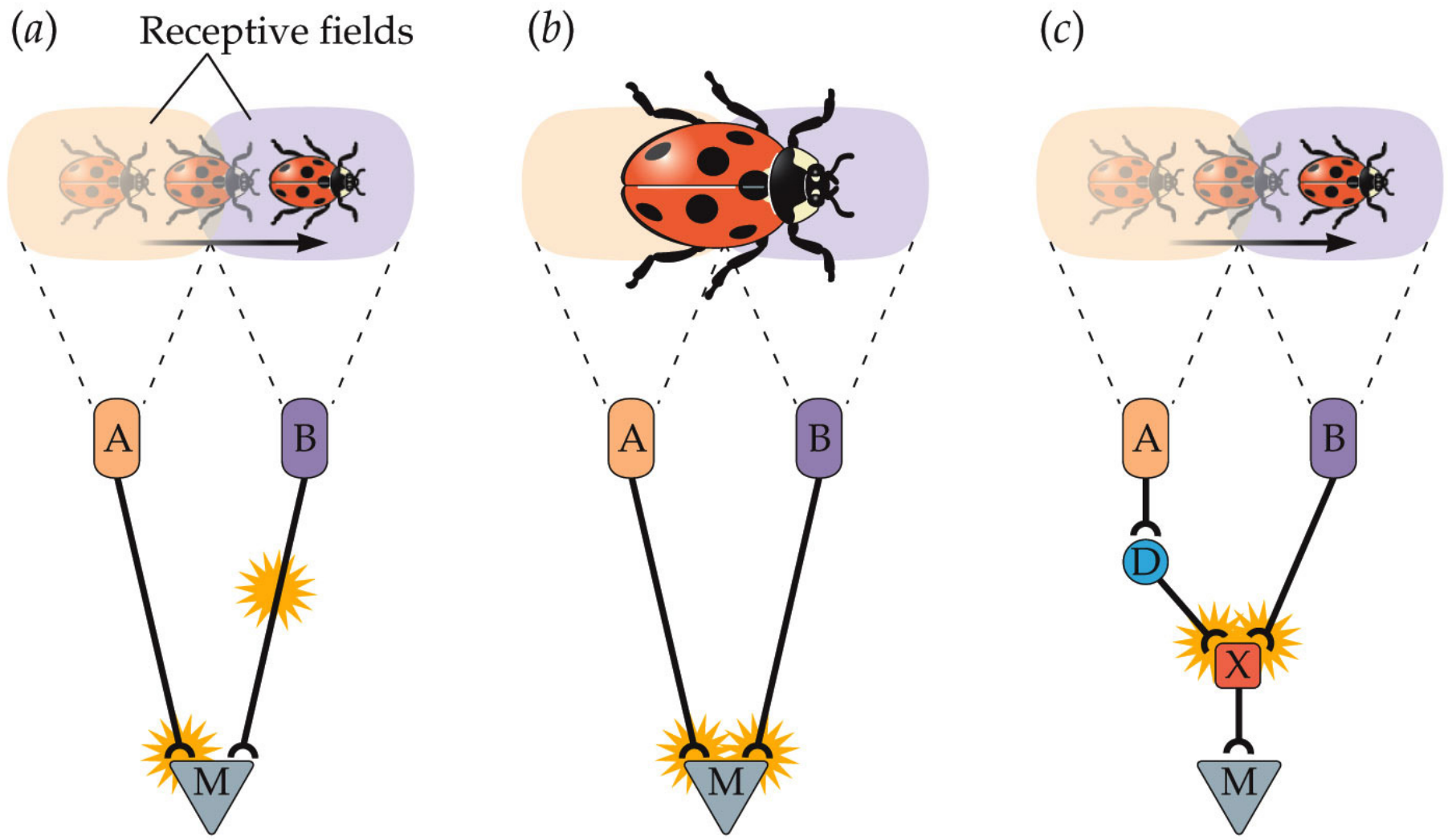
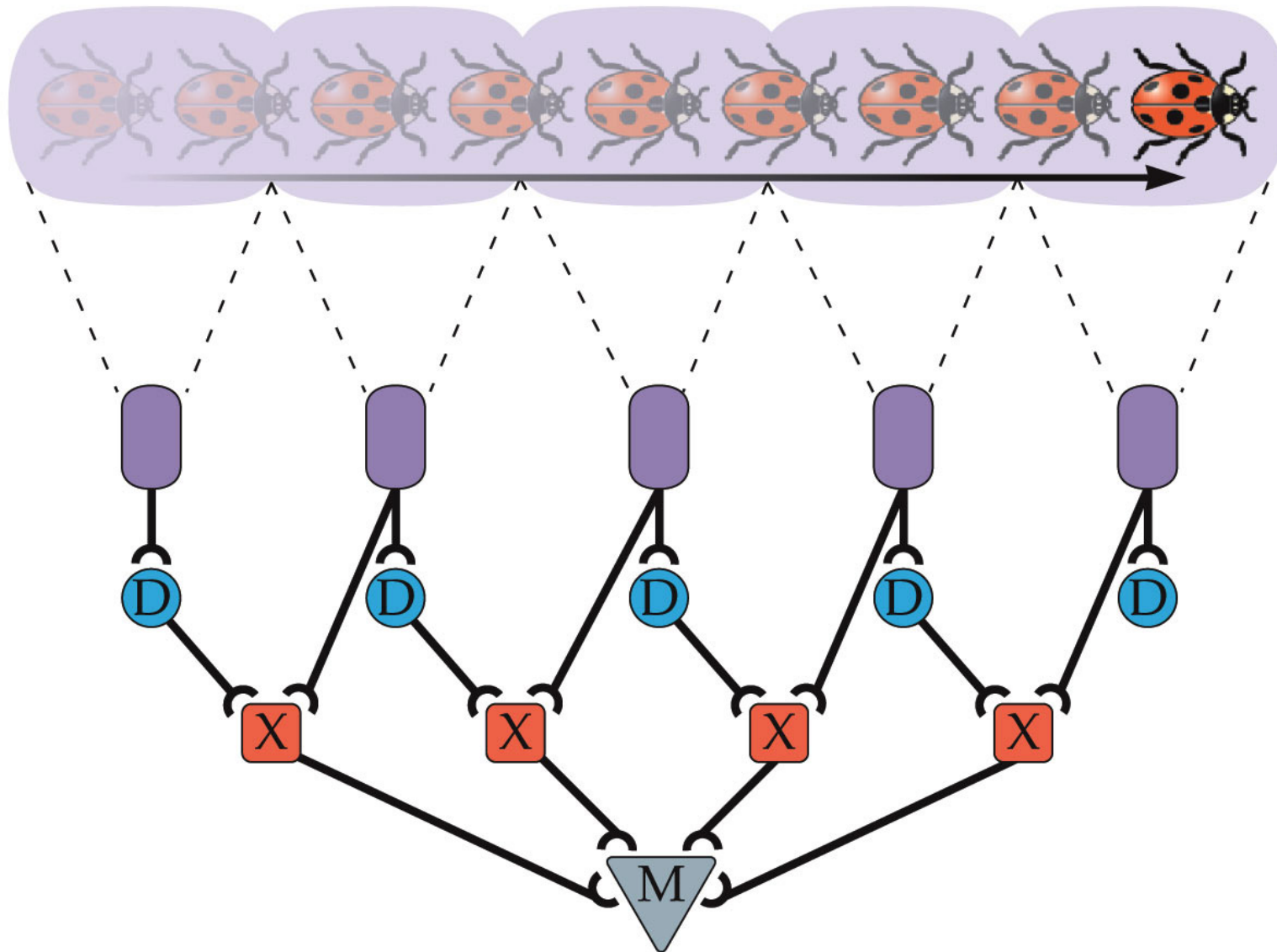


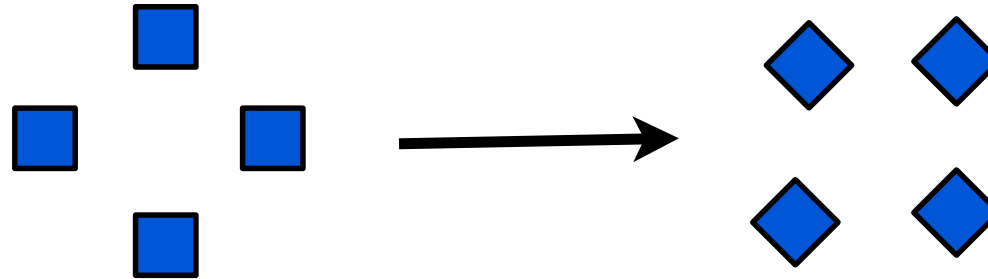
Figure 7.3 Constructing a neural circuit for the detection of rightward motion (Part 2)



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?)



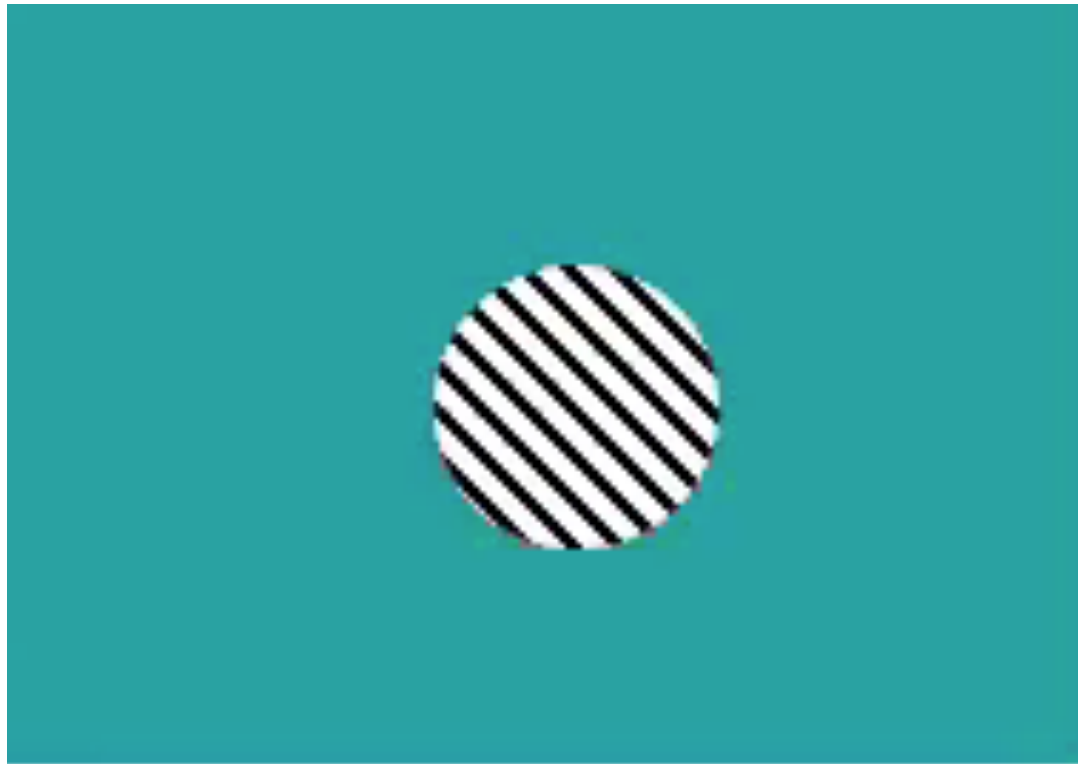
Clockwise or Counter-clockwise rotation?

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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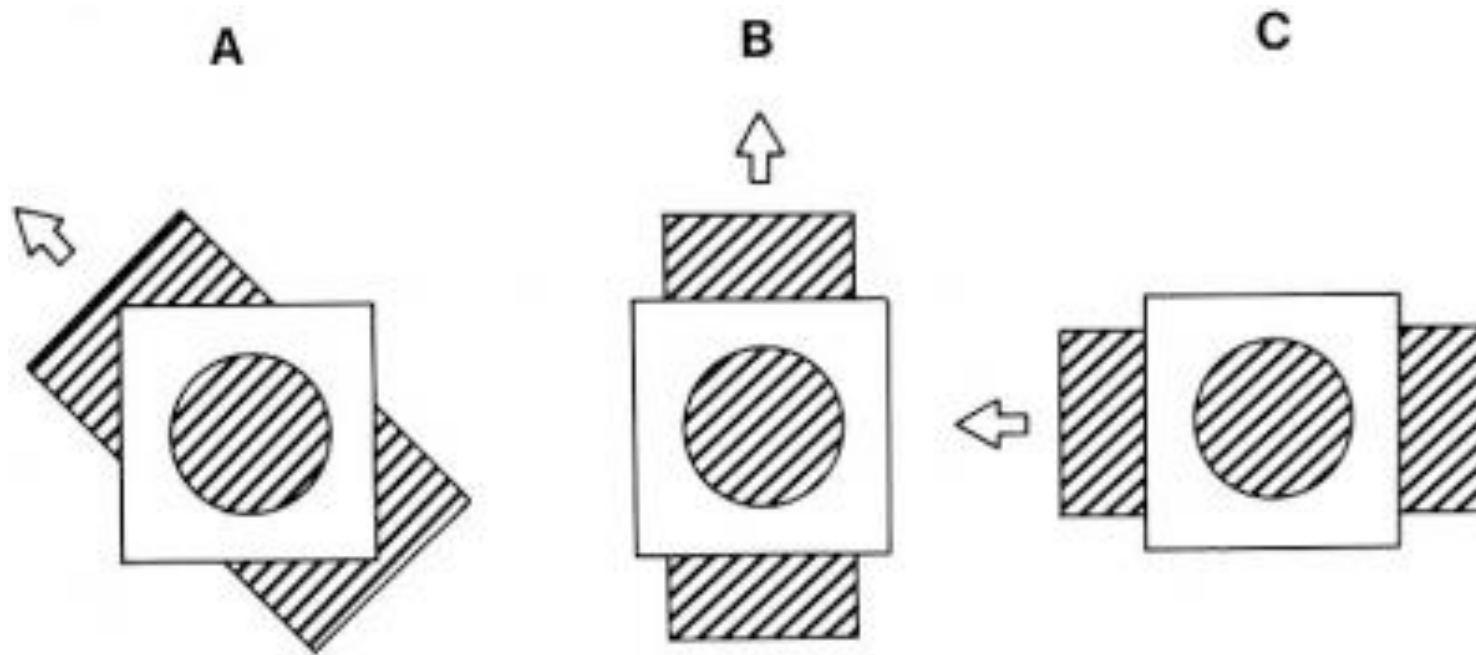


- **Aperture problem:**

when a moving object is viewed through an aperture, the direction of motion may be ambiguous

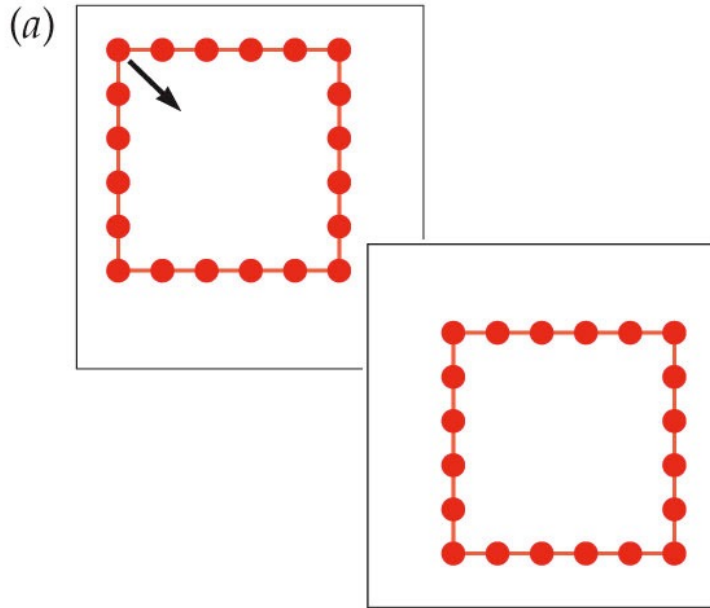


- **Aperture problem:**

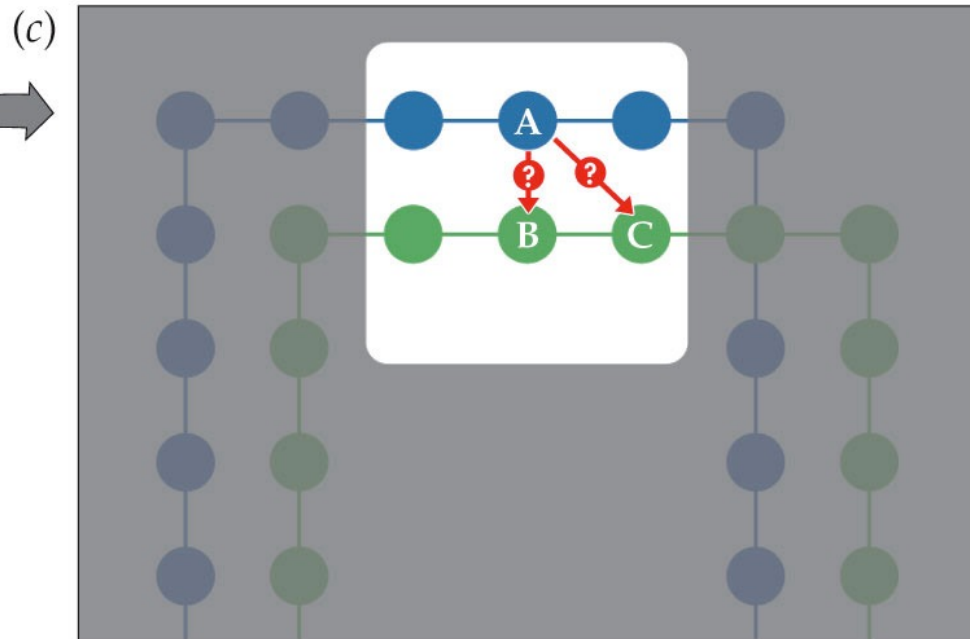
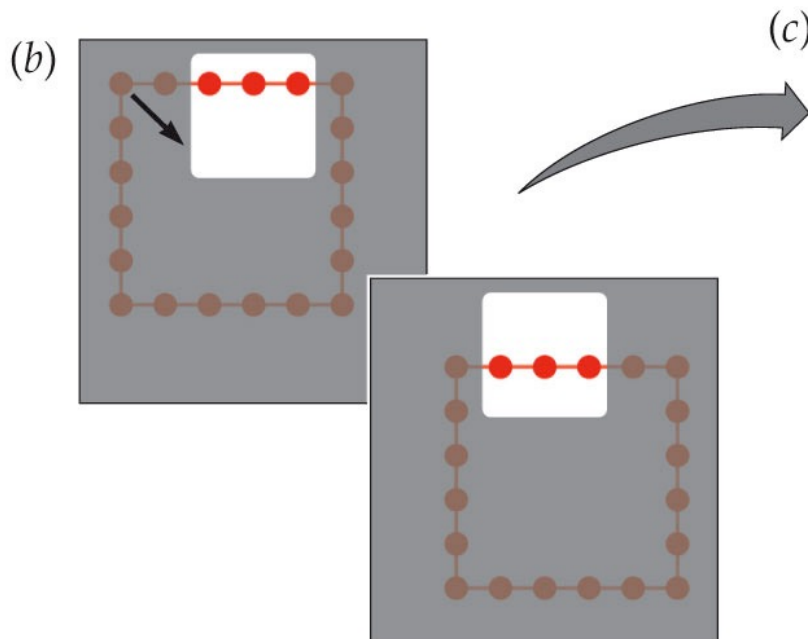


- this is a problem because each *neuron* only sees the scene through a small aperture (its receptive field!)
- how can the brain figure out the “global” direction of motion?

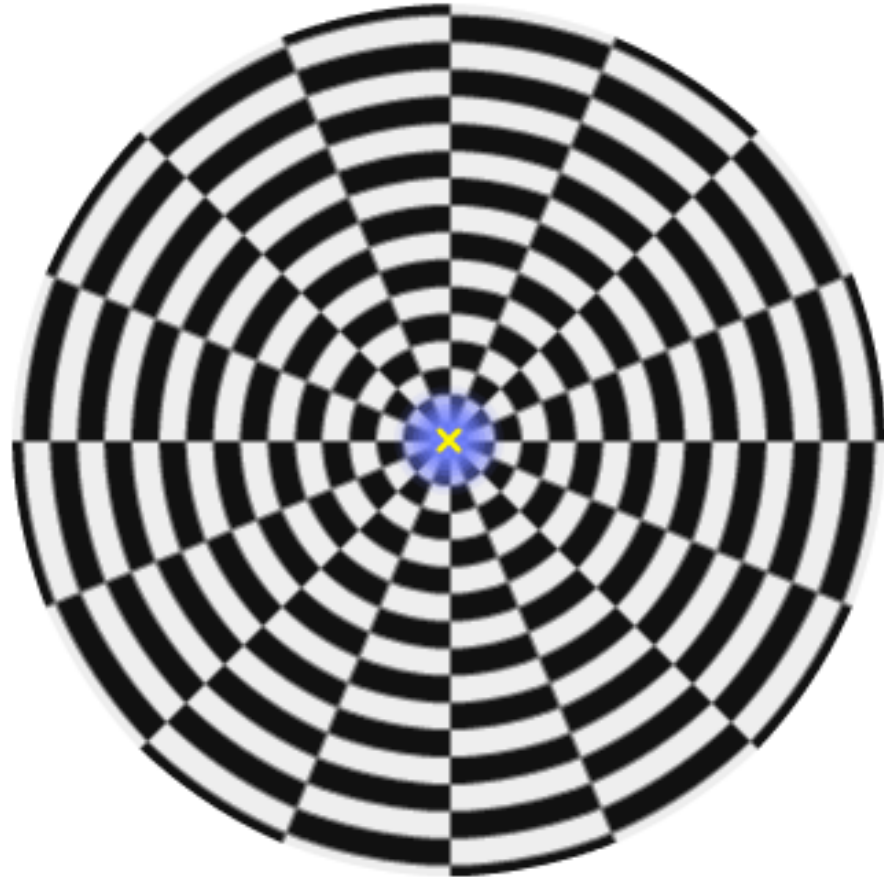
aperture problem / correspondence problem



https://oup-arc.com/access/content/sensation-and-perception-5e-student-resources/sensation-and-perception-5e-activity-8-3?previousFilter=tag_chapter-08



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

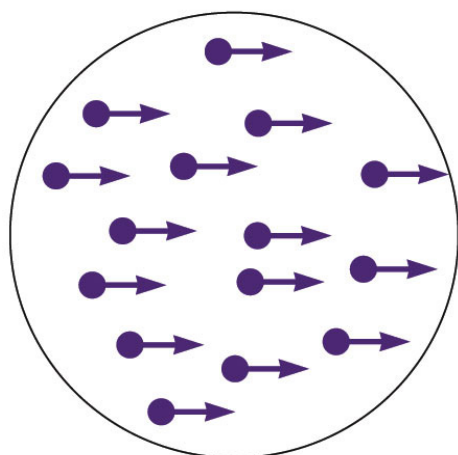
Q: What does this tell us about where in the brain motion is computed?

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

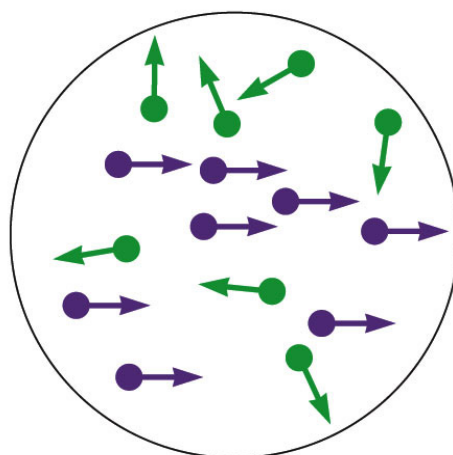
Computation of Visual Motion

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

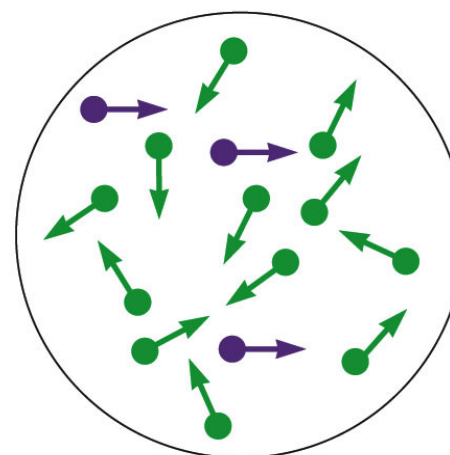
- Trained monkeys to respond to dot motion displays
- **Area MT** of the monkeys was lesioned
- Result: Monkeys needed about ten times as many dots to correctly identify direction of motion



(a) 100%

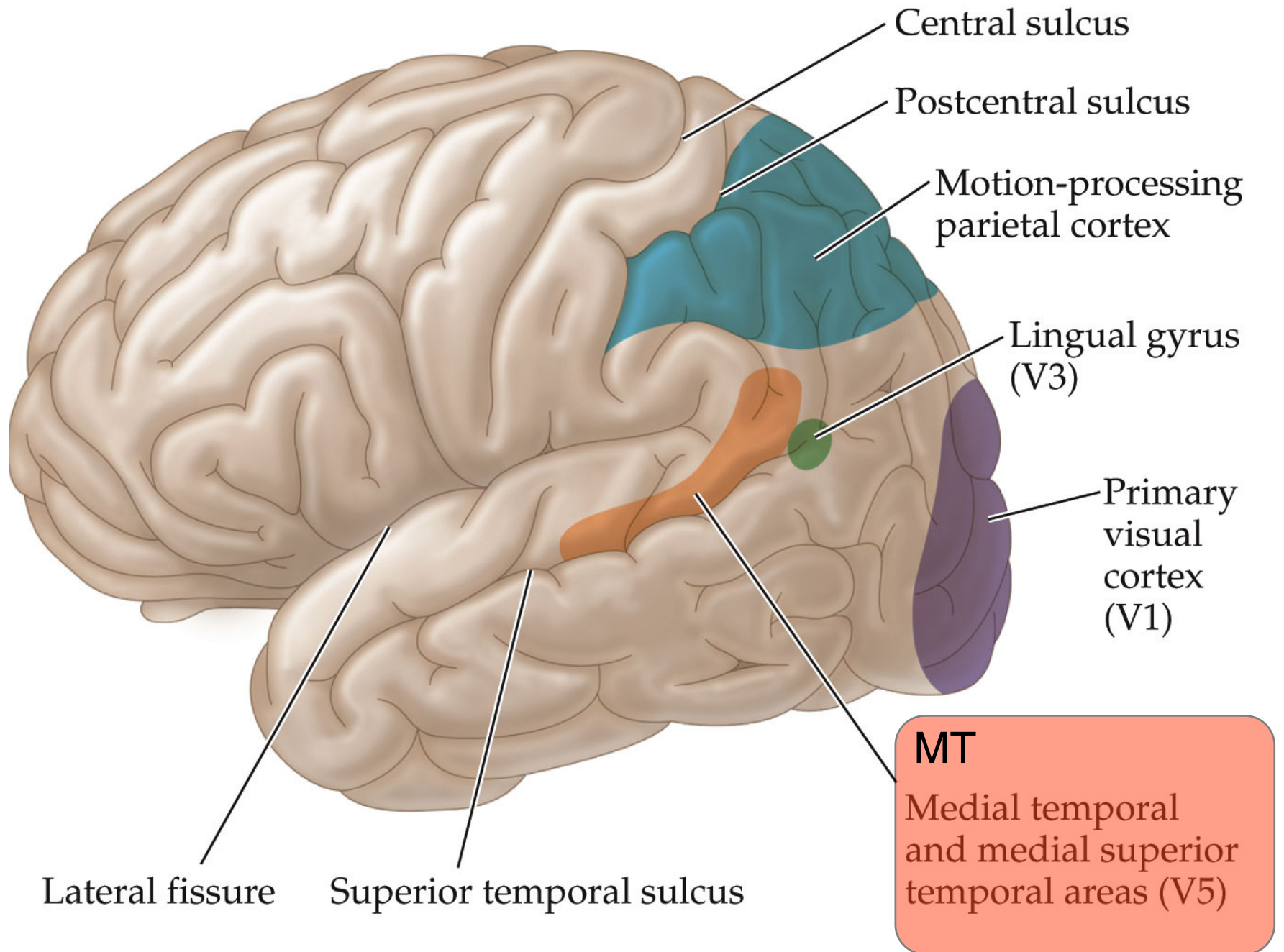


(b) 50%

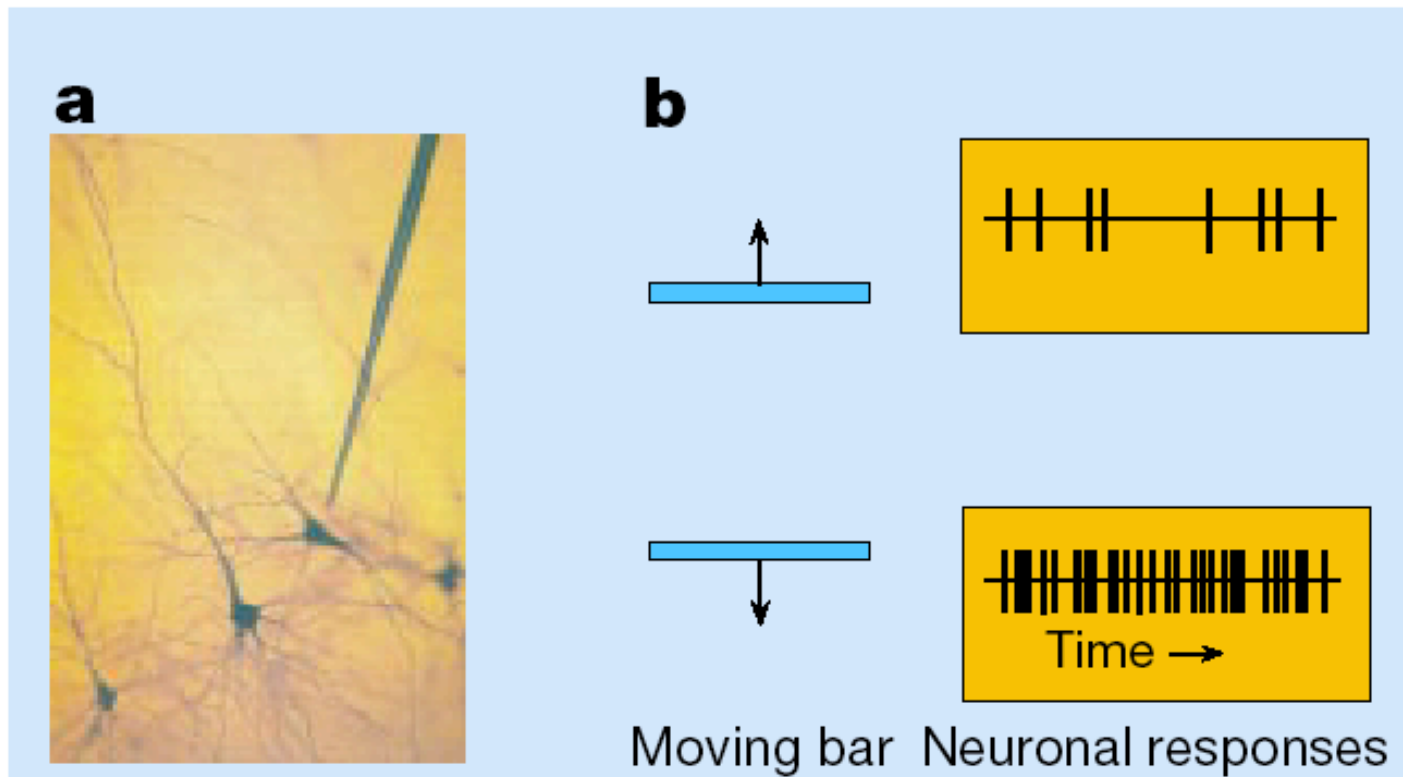


(c) 20%

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



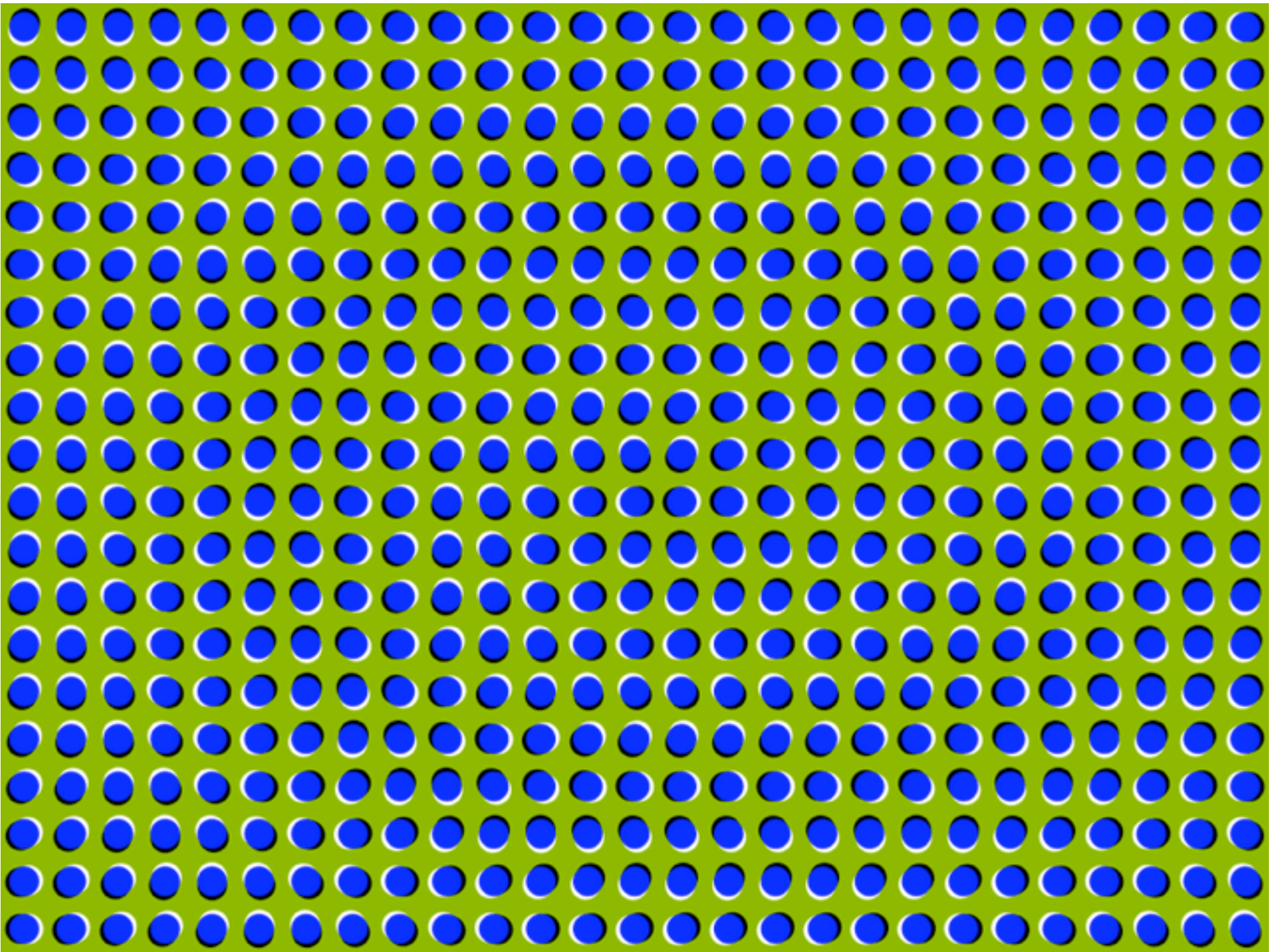
non-biological motion

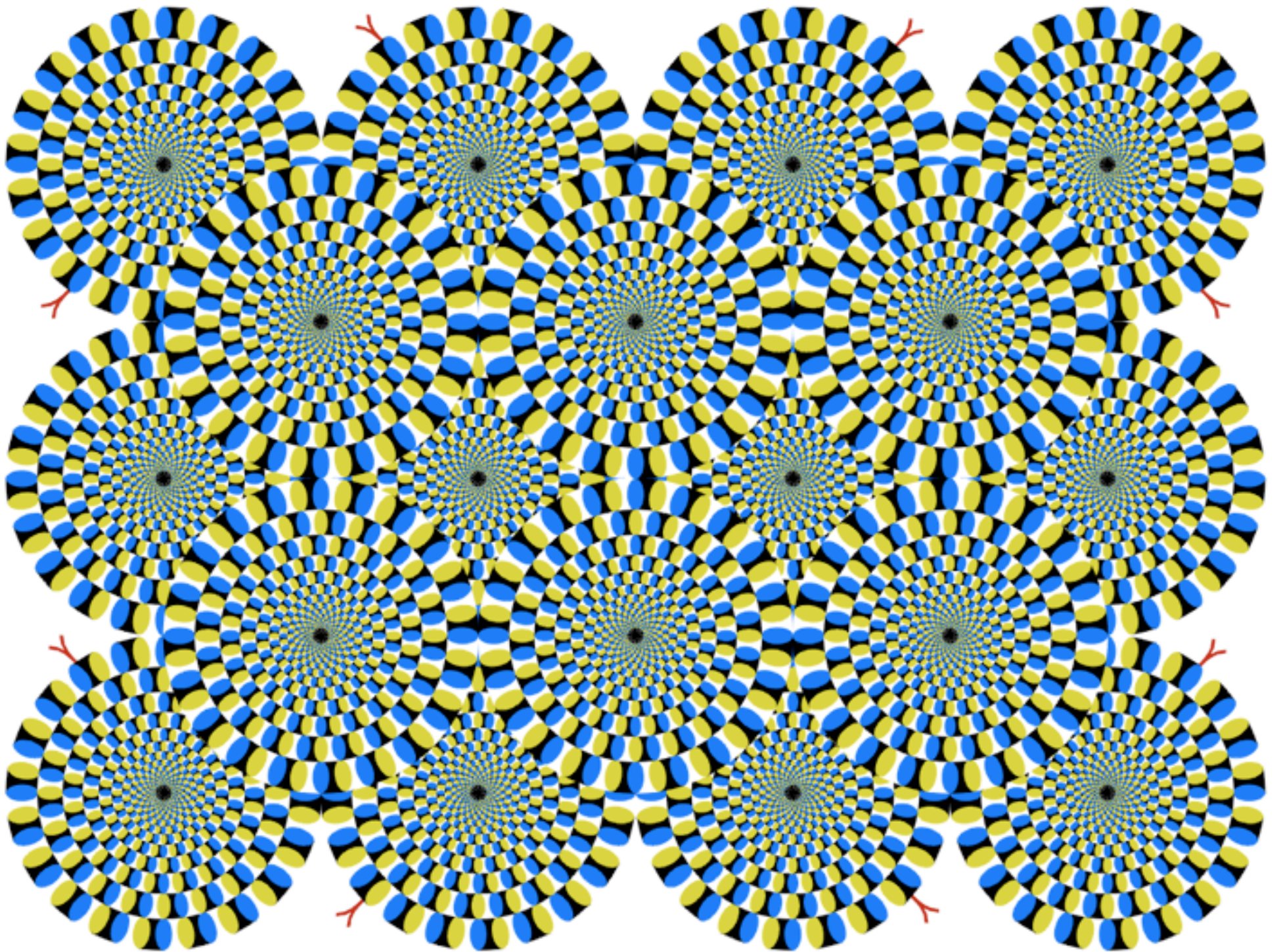
courtesy of R Blake

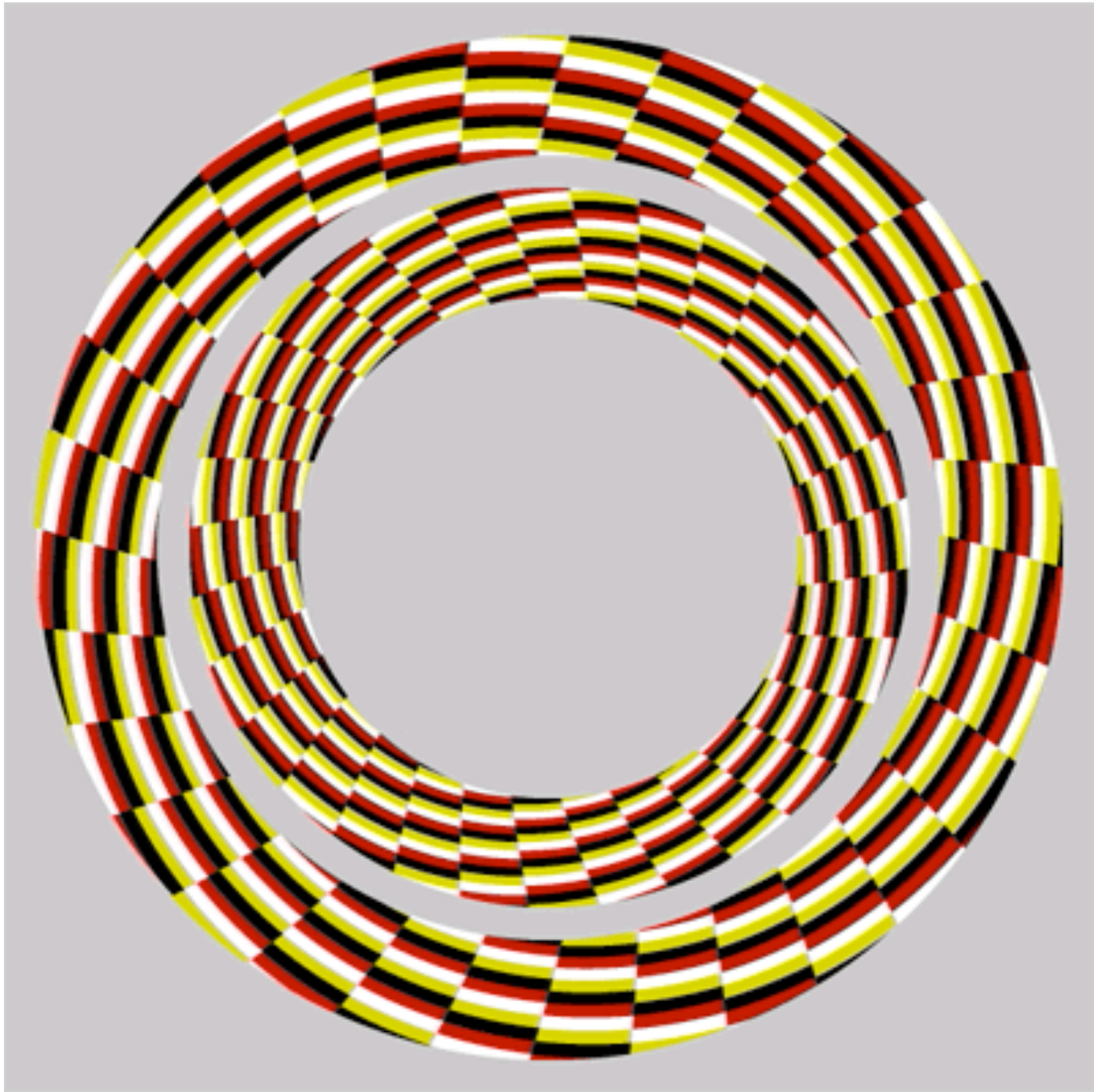
<http://www.psy.vanderbilt.edu/faculty/blake/BM/BioMot.html>

Motion Illusions:

- **Illusory motion:** Even static images can give you a percept of motion
- Still not understood, but believed to involve stimulation of Magnocellular pathway during eye movements







Motion Illusions:

- **wagon wheel illusion** - wheels in movies appear to spin backwards due to the multiple solutions to the correspondence problem ('aliasing').

http://www.michaelbach.de/ot/mot_wagonWheel/index.html

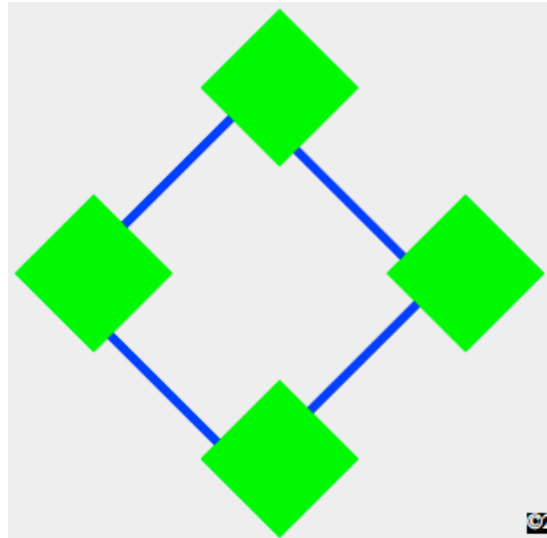


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- spinning wheel
- apparent motion
- sampled at: 24 frames /sec

Motion binding

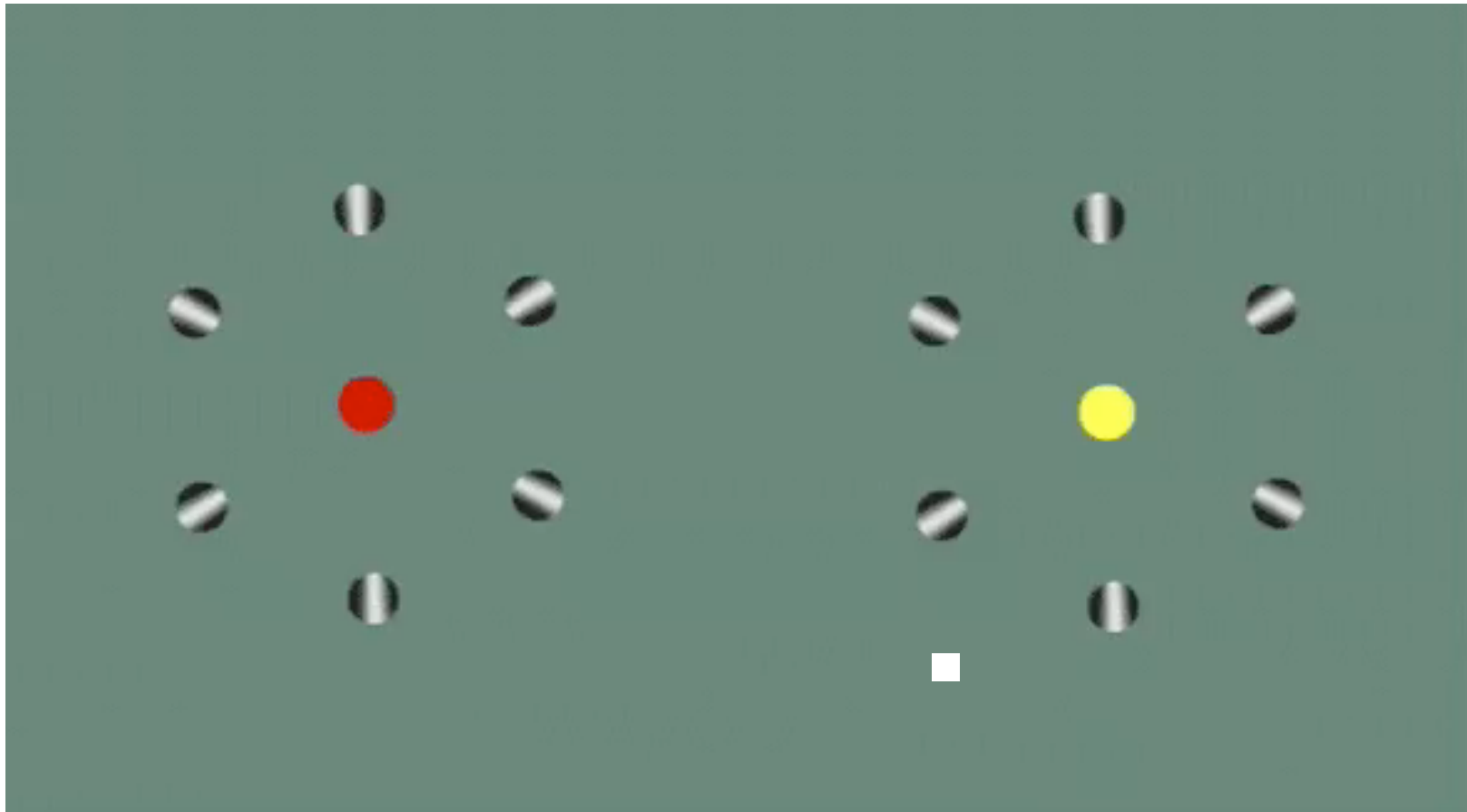
- how do local motions get combined to form a percept of global motion?



http://www.michaelbach.de/ot/mot_motionBinding/index.html

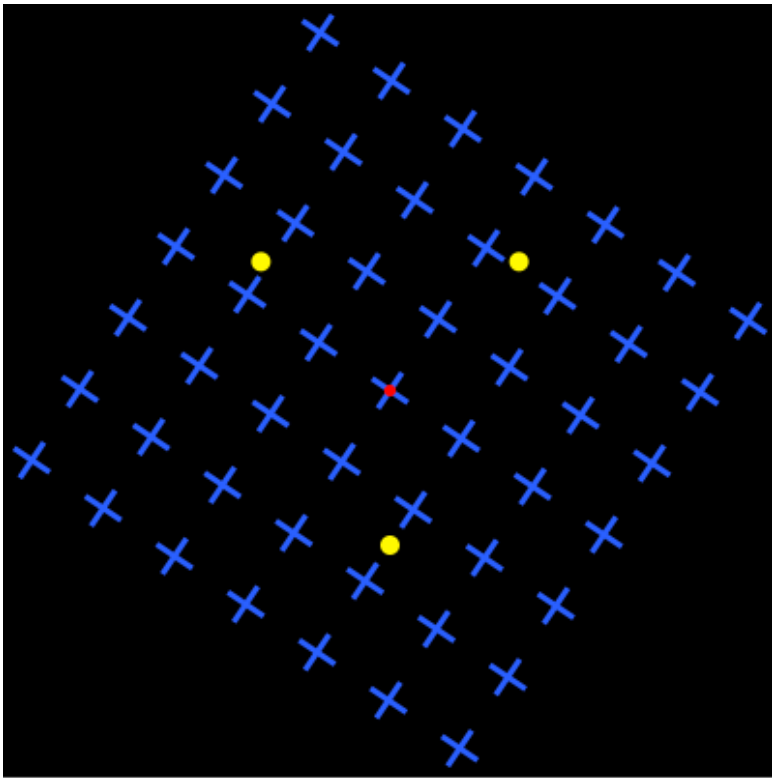
Local vs. Global Motion

- how do local motions get combined to form a percept of global motion?



Motion Illusions:

- **motion induced blindness**



- no known explanation (as yet)
- theory: related to brain's ability to “fill in” defects in the visual field (like the blind spot).

New & Scholl (2008)

<http://www.michaelbach.de/ot/mot-mib/index.html>

Summary of concepts:

- apparent vs. real motion
- aperture problem
- correspondence problem
- Reichardt detector
- motion = “orientation in space-time”
- motion processing pathway (area MT)
- motion after-effect (“waterfall illusion”)
- inter-ocular transfer
- optic flow
- biological motion
- eye movements (saccades, smooth pursuit, vergence, reflex)
- saccadic suppression (“blindness” during saccades)
- comparator - compensating for eye movements
- illusory motion
- motion binding
- local vs. global motion

Next time