Motion perception and pursuit eye movements

Topics:

1. The responses of neurons to motion in various brain regions.
2. Mechananisms for creating motion-selective neurons.
3. The effects of brain lesions on motion perception.
4. Structure from motion.
5. Apparent motion.
6. Metacontrast and brightness masking.
7. Optokinetic nystagmus
8. The accessory optic system
9. Summary

Neuronal responses to motion in cortex

Method for stimulating V1 RFs with moving targets

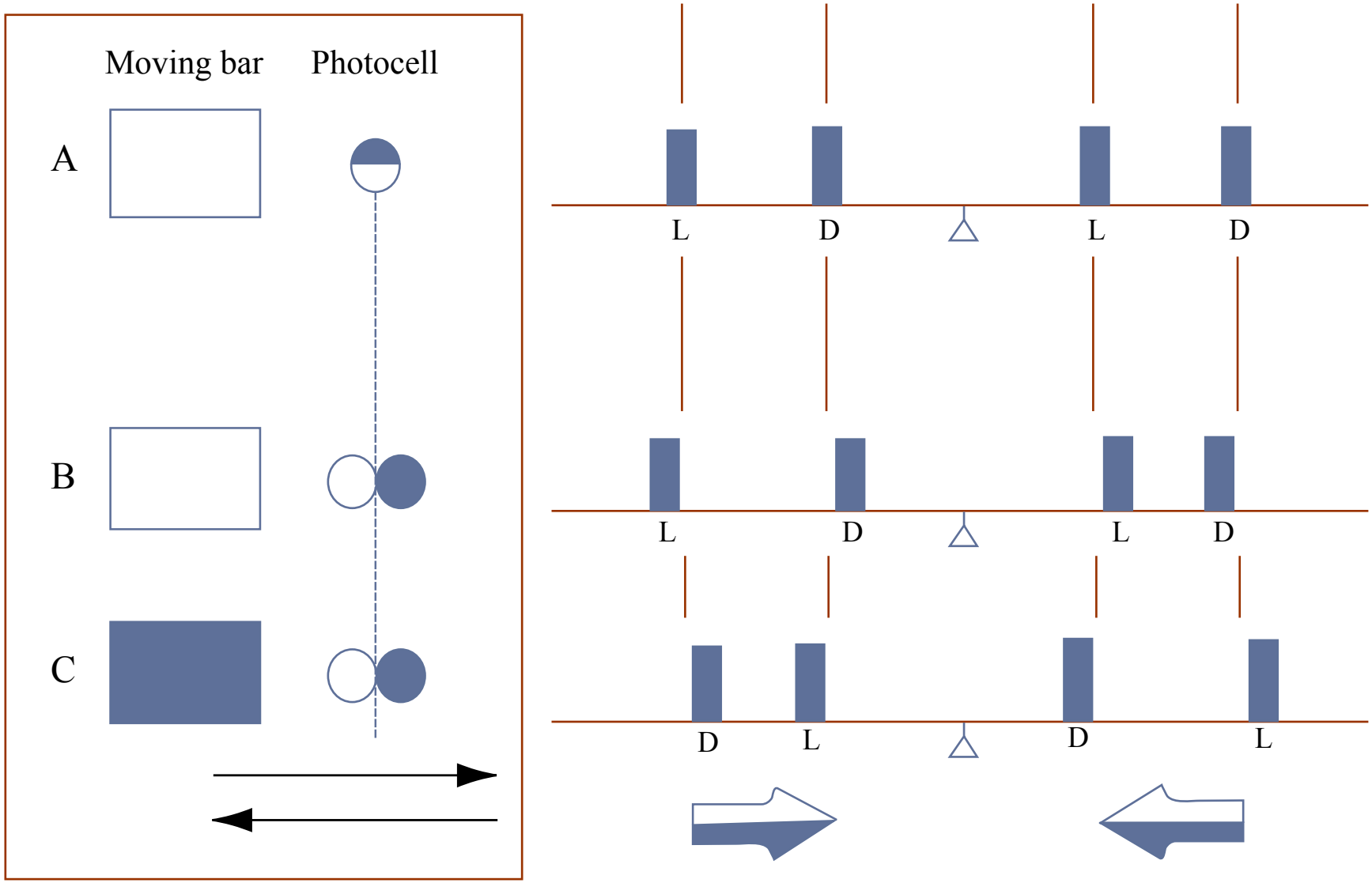
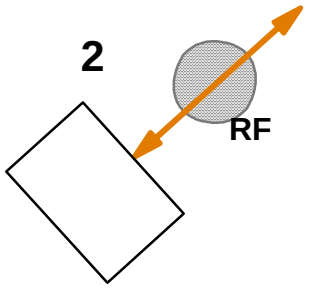
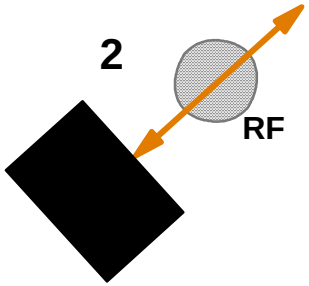
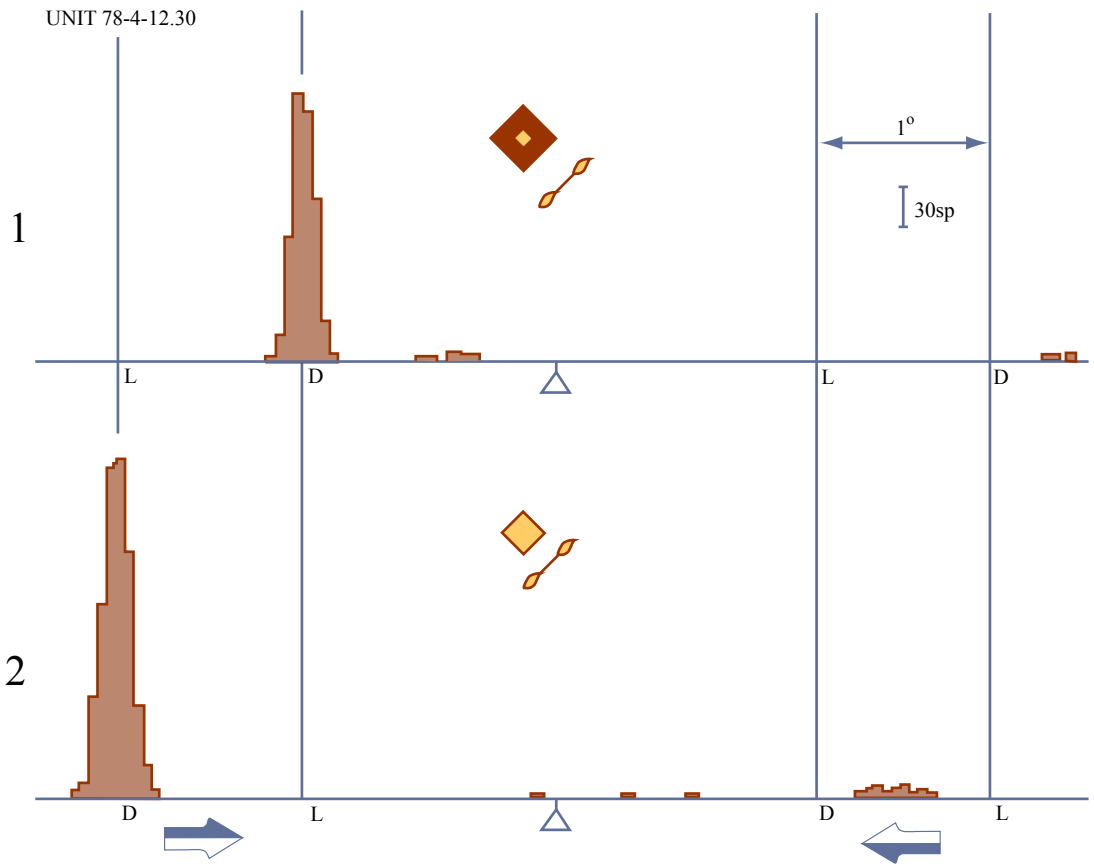


Image by MIT OpenCourseWare.

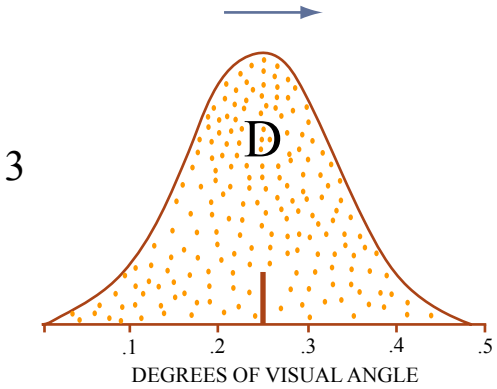
Response of an S1 cell in striate cortex to drifting bars



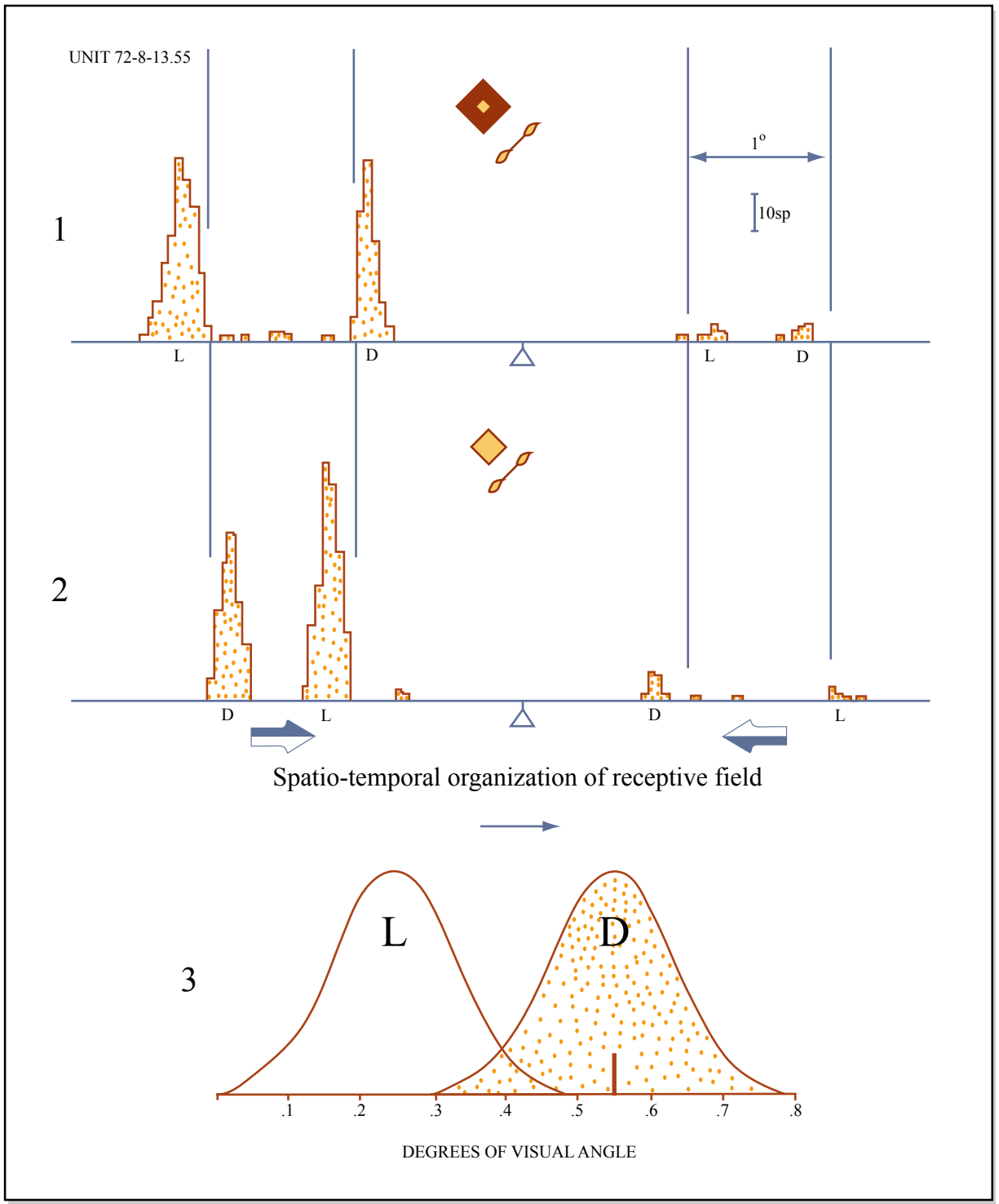




Spatio-temporal organization of receptive field



Response of an S2 cell in striate cortex to drifting bars



Response of an S2 cell in striate cortex to drifting bars

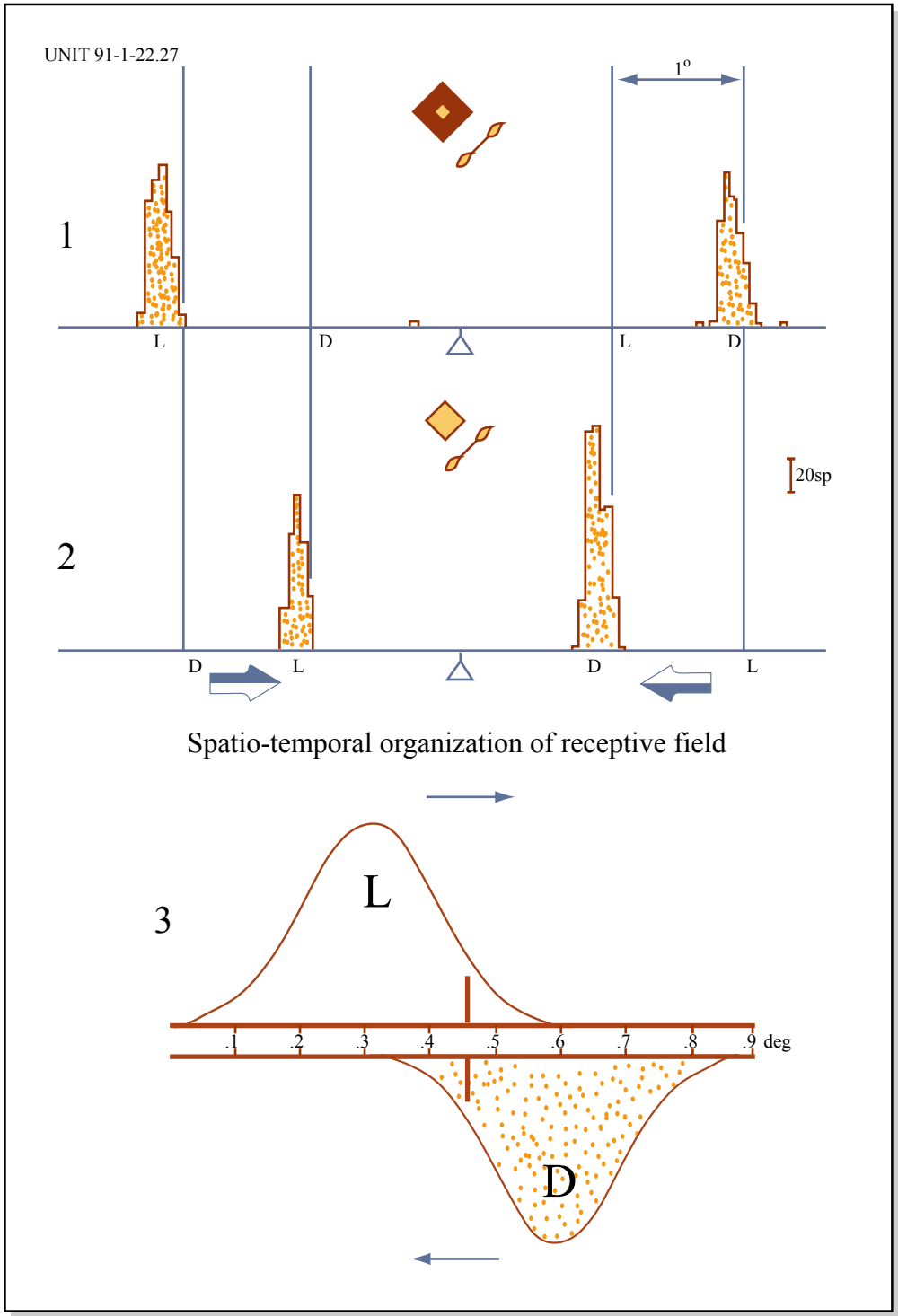
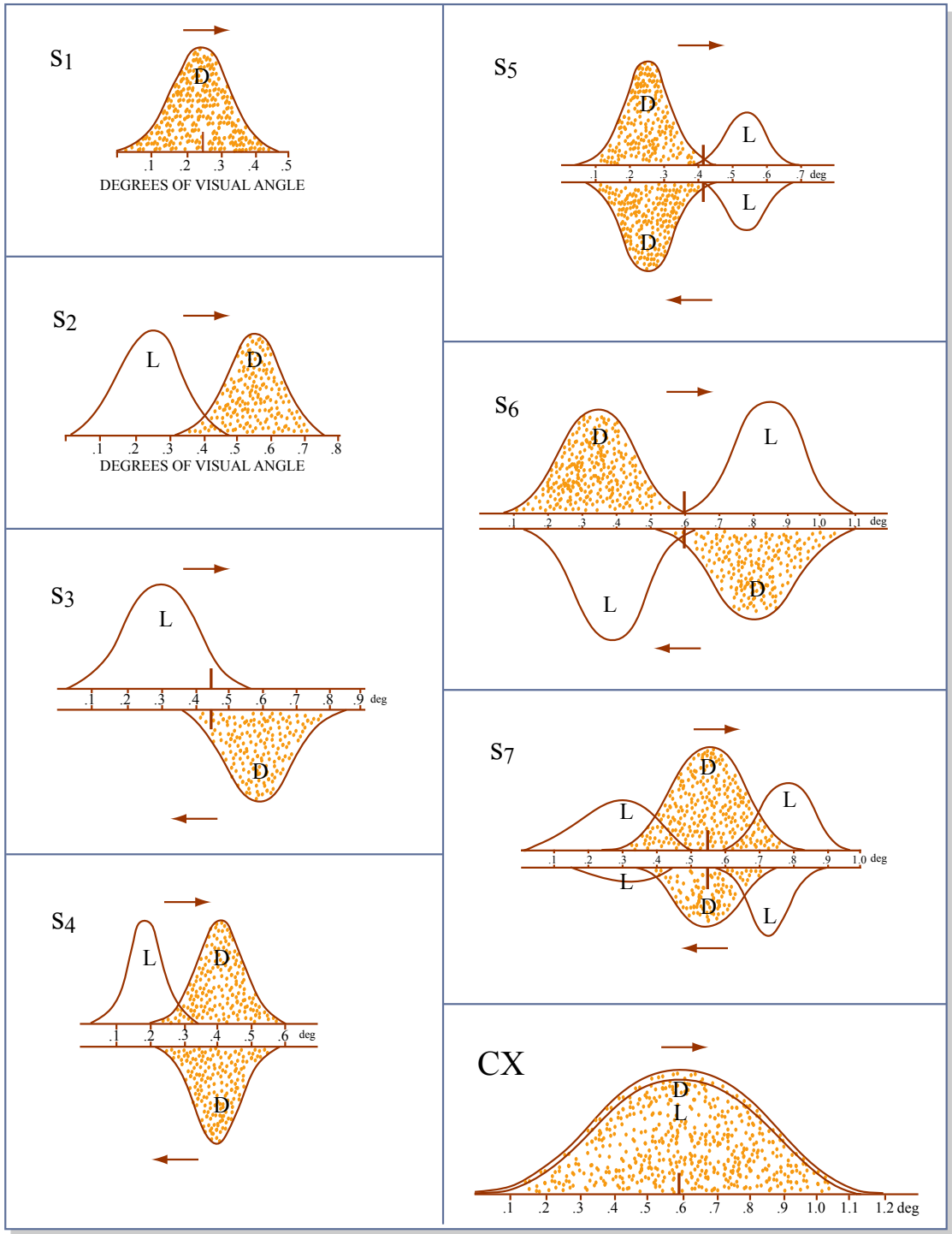


Image by MIT OpenCourseWare.

Summary of cell types in V1

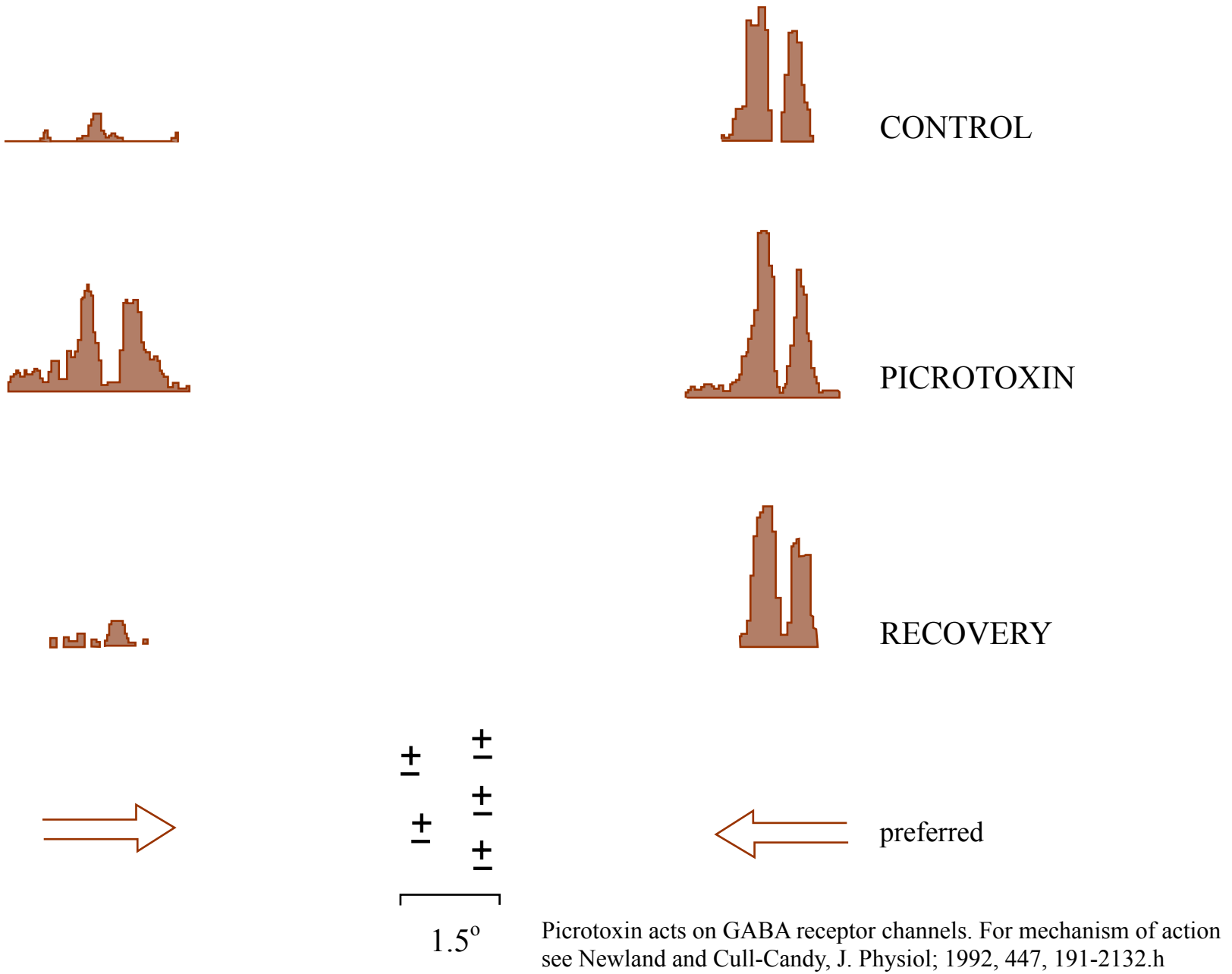


Neuronal responses to motion in MT and MST

Figure removed due to copyright restrictions.

Please refer to lecture video.

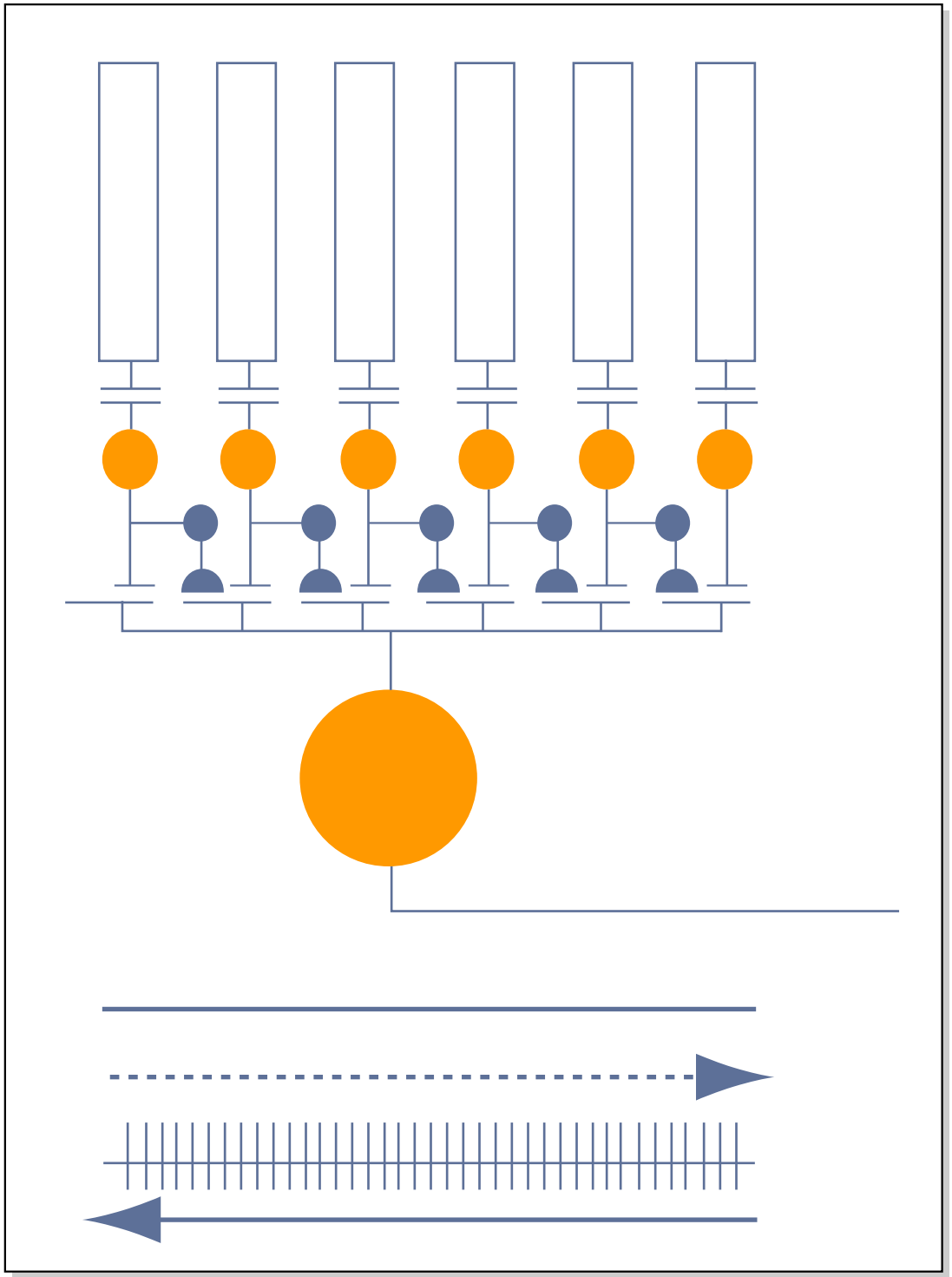
The effect of picrotoxin on direction selectivity in retina



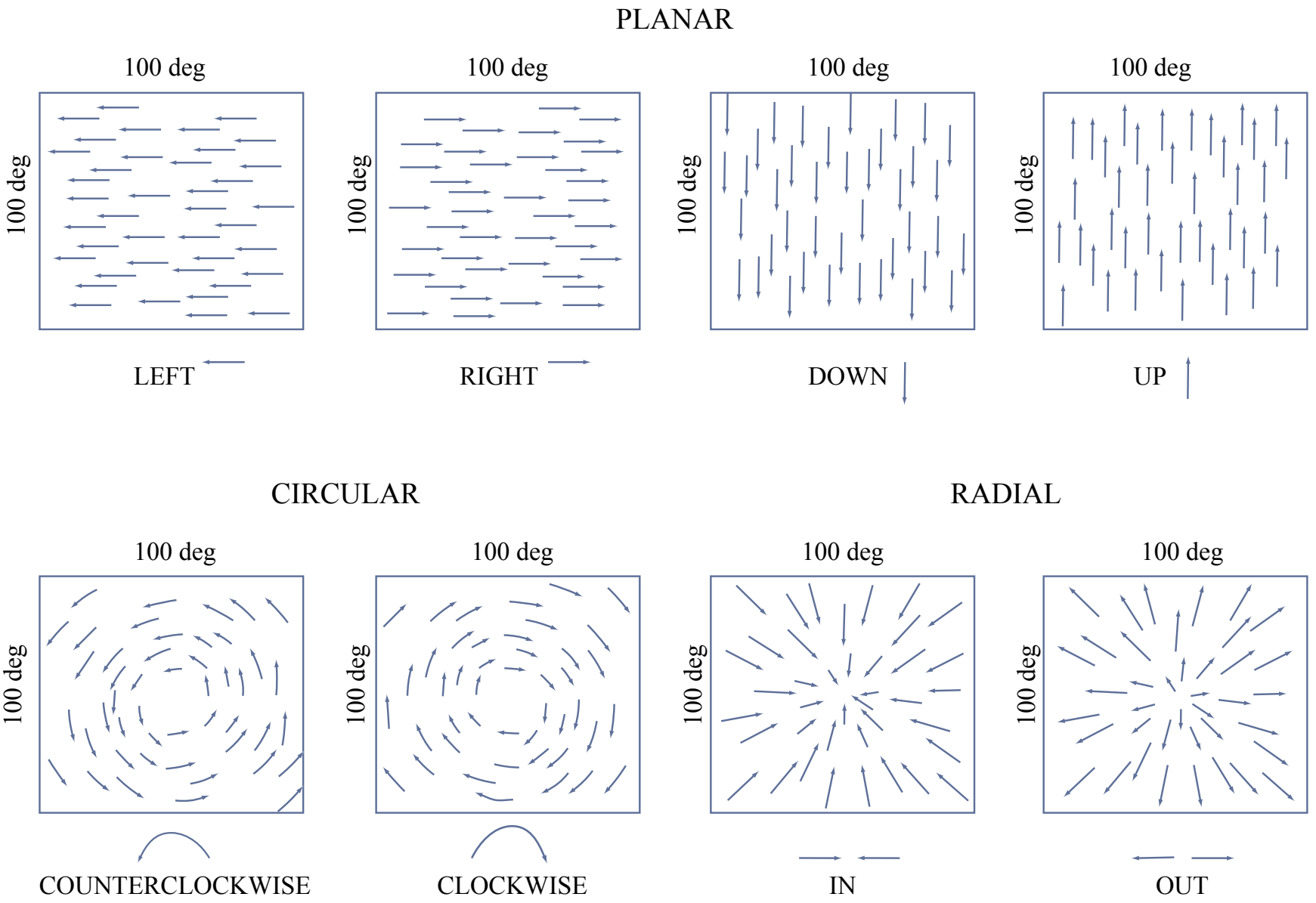
Picrotoxin acts on GABA receptor channels. For mechanism of action see Newland and Cull-Candy, J. Physiol; 1992, 447, 191-2132.h

Simple inhibitory model with spatial specificity

spatially specific inhibition



A conceptual scheme for types of motion



Neuronal responses in MST to various types of motion

Figure removed due to copyright restrictions.

Please see lecture video or Figure 4 from Duffy, Charles J., and Robert H. Wurtz. "Sensitivity of MST Neurons to Optic Flow Stimuli. I. A Continuum of Response Selectivity to Large-field Stimuli." *J Neurophysiol* 65, no. 6 (1991): 1329-45.

Specificity of directional attributes in MST

40% of the cells respond to all three types of motion

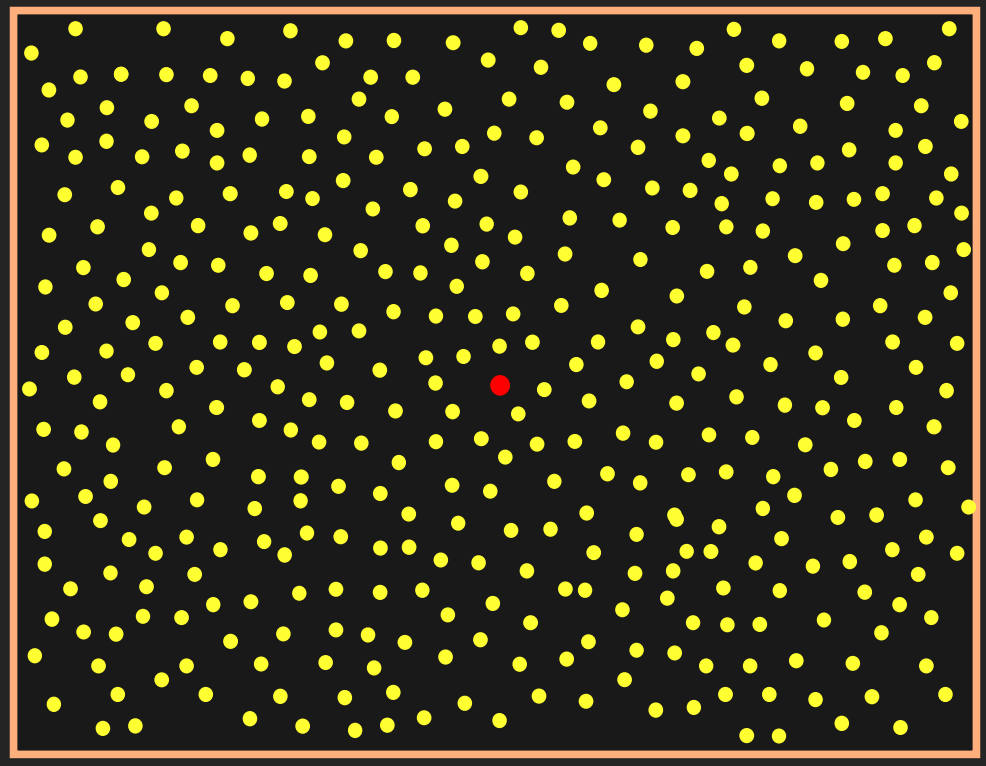
30% of the cells respond to two types of motion

20% of the cells respond to one type of motion

Neural mechanisms of directional specificity

The effects of lesions on motion perception

Motion detection



Motion detection in in intact, V4 and MT blocked regions

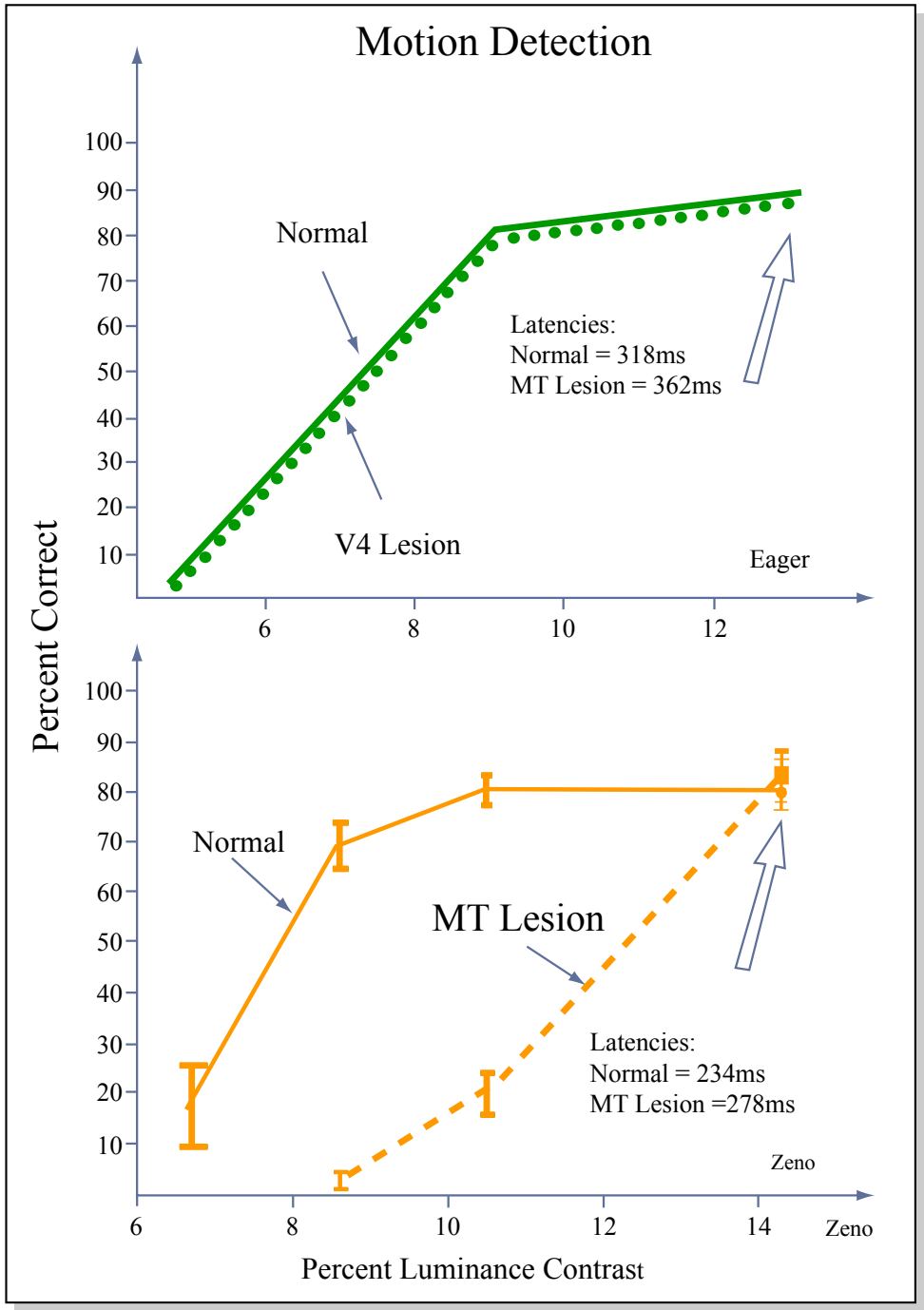
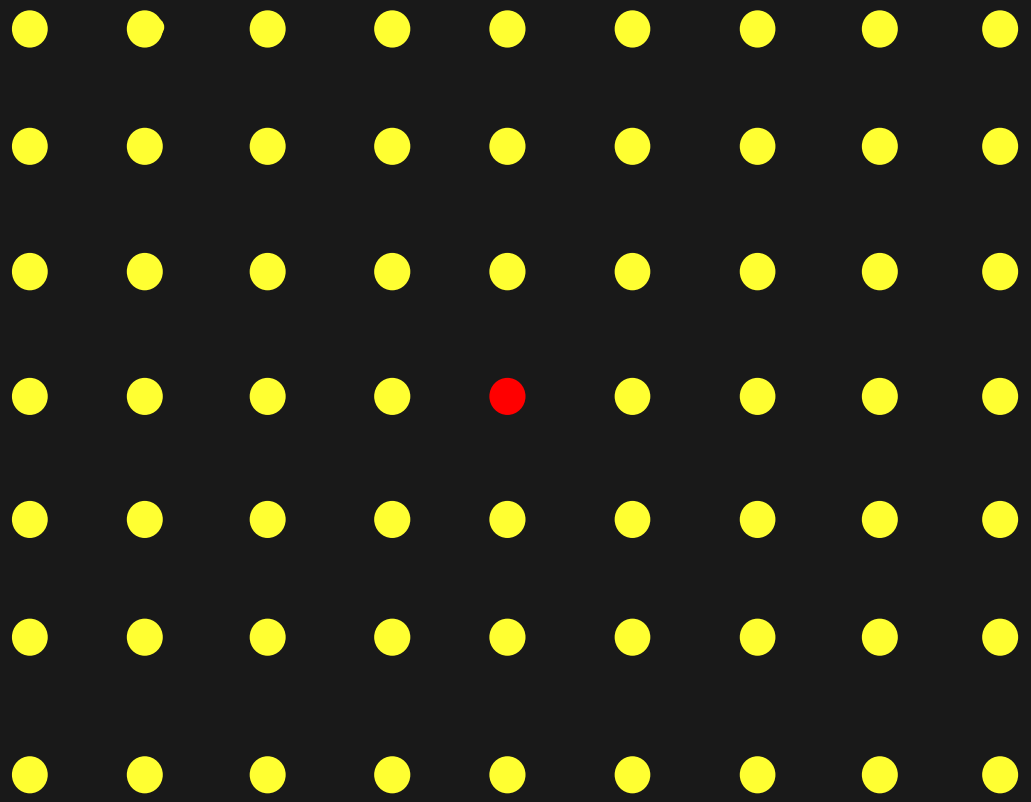
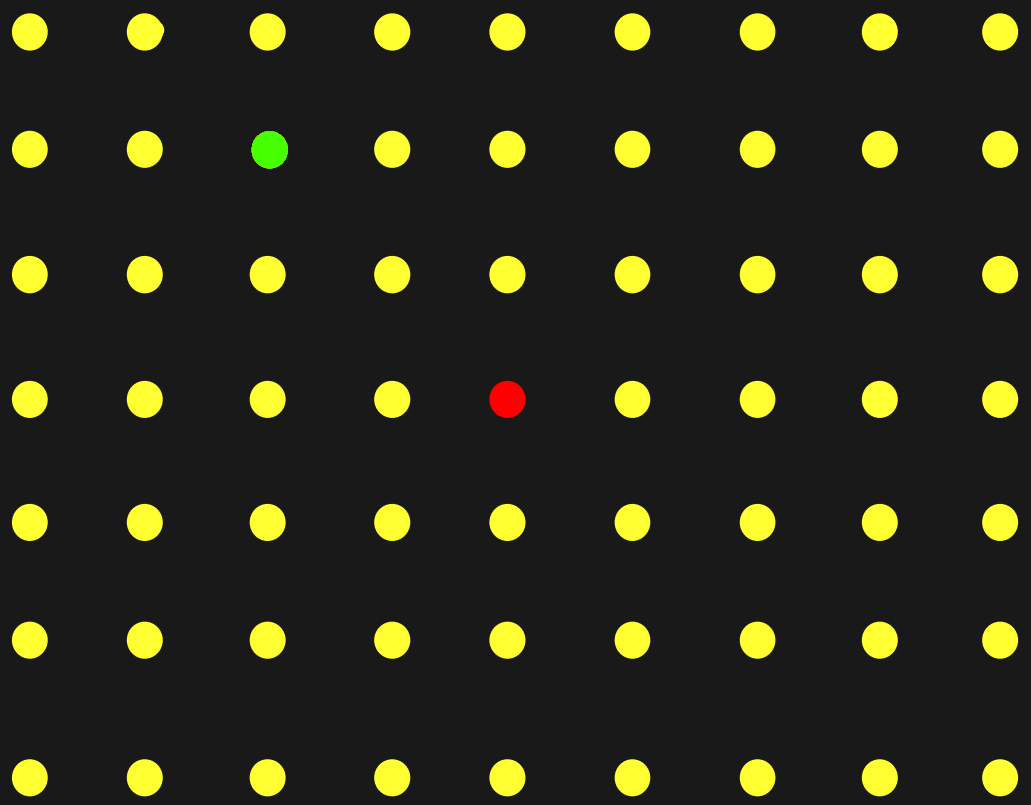
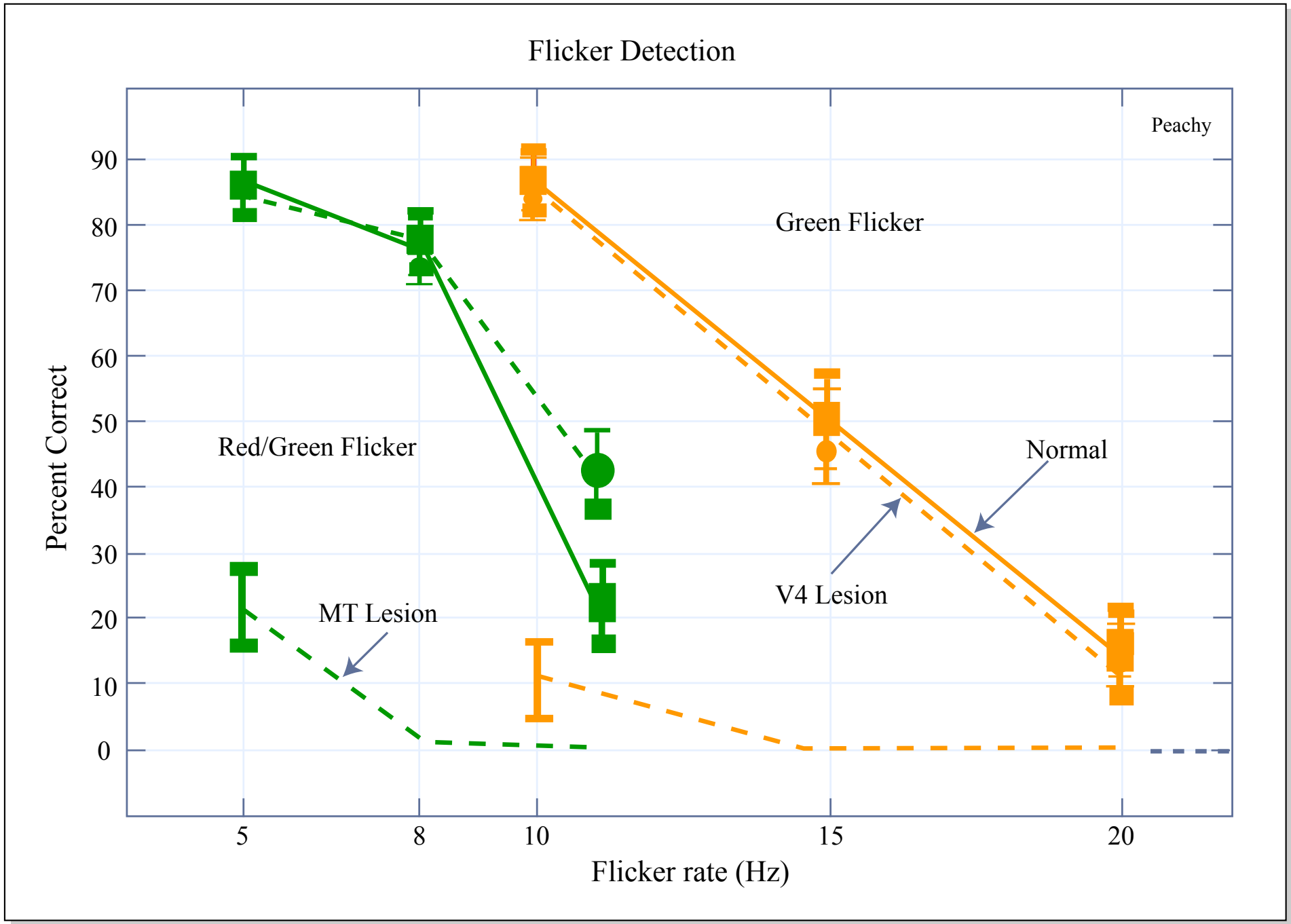


Image by MIT OpenCourseWare.

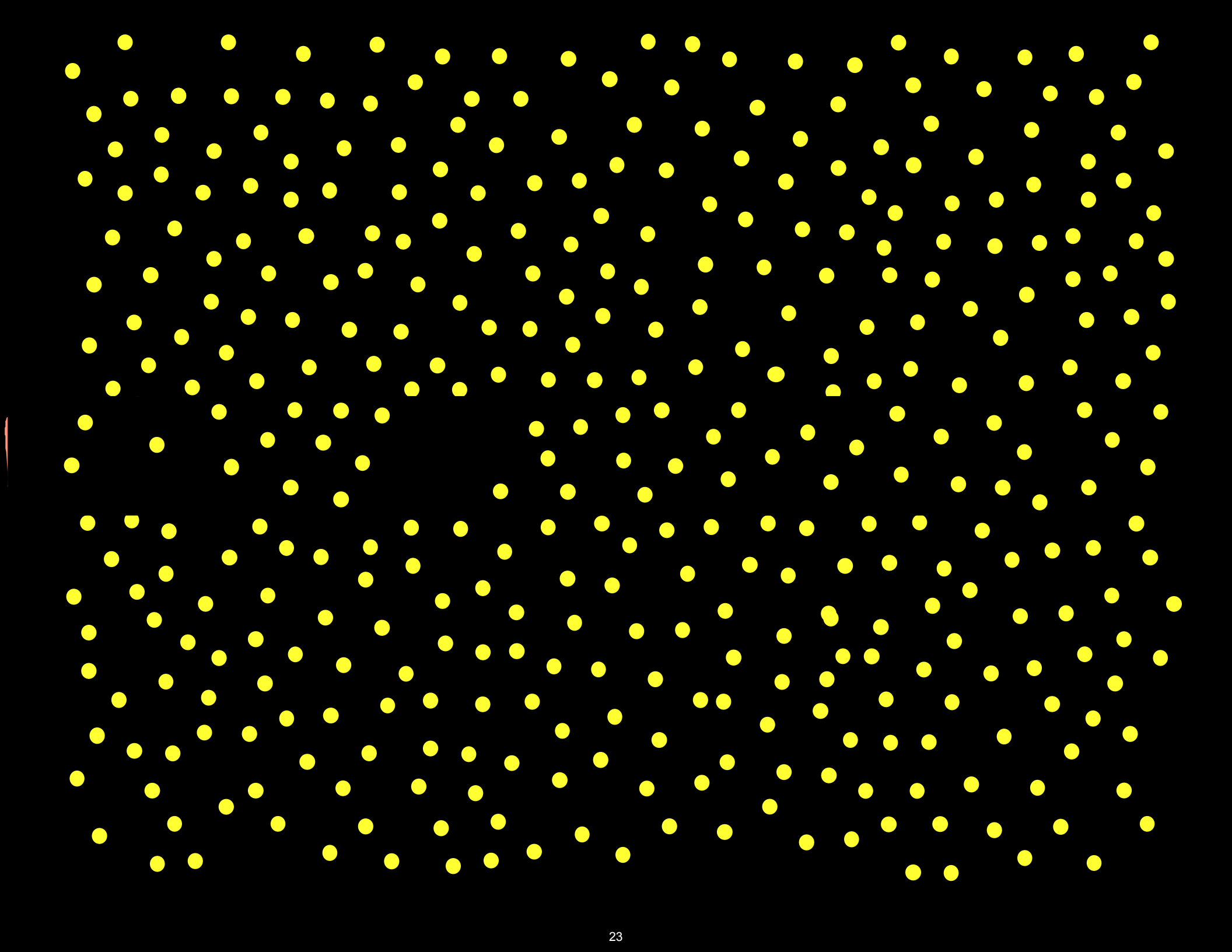


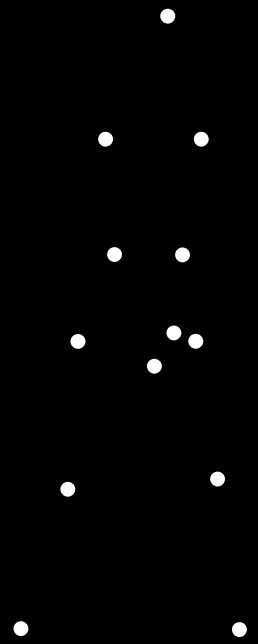


Flicker detection in in intact, V4 and MT blocked regions



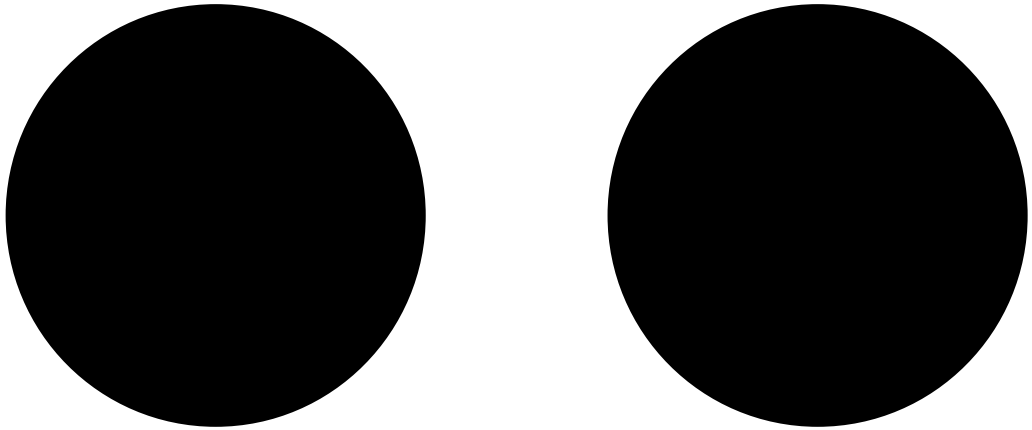
Structure from motion

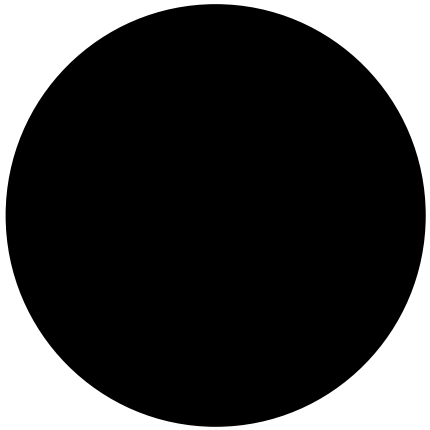




Apparent motion

The jumping disk

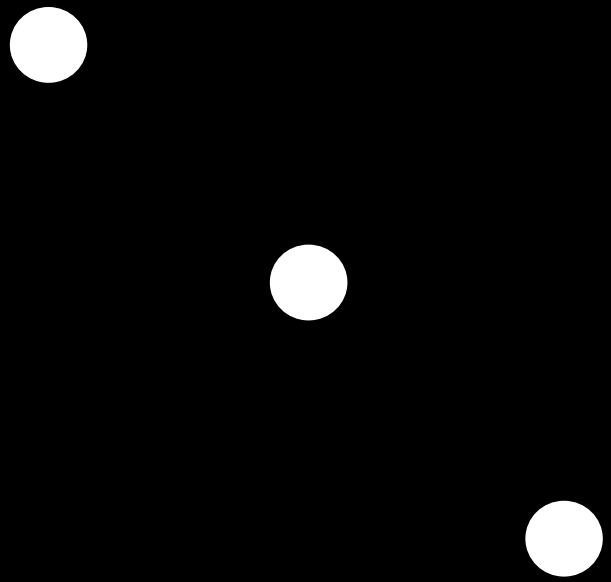




THE BASIC BISTABLE QUARTETS DEMO

Figure removed due to copyright restrictions.

Please see lecture video or Display 1a from Schiller, Peter H., and Christina E. Carvey. "Demonstrations of Spatiotemporal Integration and What they Tell us About the Visual System." *Perception* 35, no. 11 (2006): 1521.



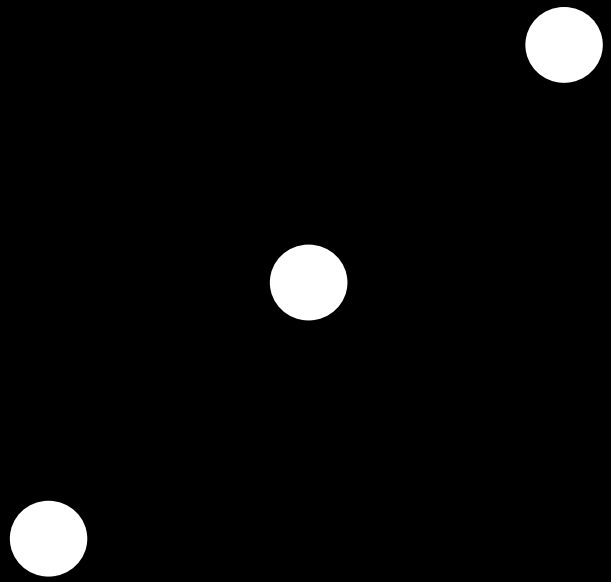


Figure removed due to copyright restrictions.

Please see lecture video or Display 1b from Schiller, Peter H., and Christina E. Carvey. "Demonstrations of Spatiotemporal Integration and What they Tell us About the Visual System." *Perception* 35, no. 11 (2006): 1521.

THE INFLUENCE OF GEOMETRY AND SIZE ON THE PERCEIVED DIRECTION OF APPARENT MOTION

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Please see lecture video or Display 2 from Schiller, Peter H., and Christina E. Carvey. "Demonstrations of Spatiotemporal Integration and What they Tell us About the Visual System." *Perception* 35, no. 11 (2006): 1521.

THE INFLUENCE OF RED/GREEN COLOR ON THE PERCEIVED DIRECTION OF APPARENT MOTION

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Please see lecture video or Display 3a from Schiller, Peter H., and Christina E. Carvey. "Demonstrations of Spatiotemporal Integration and What they Tell us About the Visual System." *Perception* 35, no. 11 (2006): 1521.

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Please see lecture video or Display 3b from Schiller, Peter H., and Christina E. Carvey. "Demonstrations of Spatiotemporal Integration and What they Tell us About the Visual System." *Perception* 35, no. 11 (2006): 1521.

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Please see lecture video or Display 7 from Schiller, Peter H., and Christina E. Carvey. "Demonstrations of Spatiotemporal Integration and What they Tell us About the Visual System." *Perception* 35, no. 11 (2006): 1521.

THE INFLUENCE OF SIZE ON THE PERCEIVED DIRECTION OF APPARENT MOTION

2 to 1 diameter ratio

A.

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Please see lecture video or Display 8a from Schiller, Peter H., and Christina E. Carvey. "Demonstrations of Spatiotemporal Integration and What they Tell us About the Visual System." *Perception* 35, no. 11 (2006): 1521.

THE INFLUENCE OF SIZE ON THE
PERCEIVED DIRECTION OF APPARENT MOTION

3.5 to 1 diameter ratio

B.

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Please see lecture video or Display 8b from Schiller, Peter H., and Christina E. Carvey. "Demonstrations of Spatiotemporal Integration and What they Tell us About the Visual System." *Perception* 35, no. 11 (2006): 1521.

THE INFLUENCE OF COLOR, BRIGHTNESS, SHAPE AND SIZE ON THE PERCEIVED DIRECTION OF APPARENT MOTION

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Please see lecture video or Display 9 from Schiller, Peter H., and Christina E. Carvey. "Demonstrations of Spatiotemporal Integration and What they Tell us About the Visual System." *Perception* 35, no. 11 (2006): 1521.

THE INFLUENCE OF PROXIMITY

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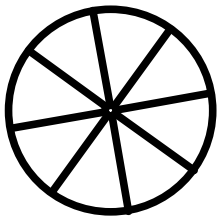
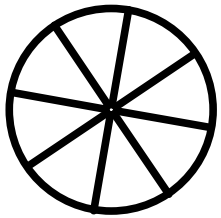
Please see lecture video or Display 12b from Schiller, Peter H., and Christina E. Carvey. "Demonstrations of Spatiotemporal Integration and What they Tell us About the Visual System." *Perception* 35, no. 11 (2006): 1521.

Why we see wheels rotate backwards in the movies

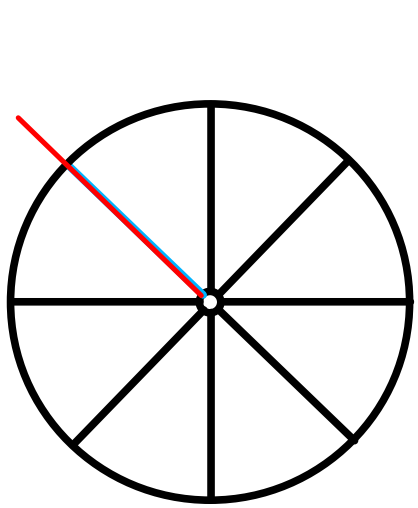
A wheel rotating slowly



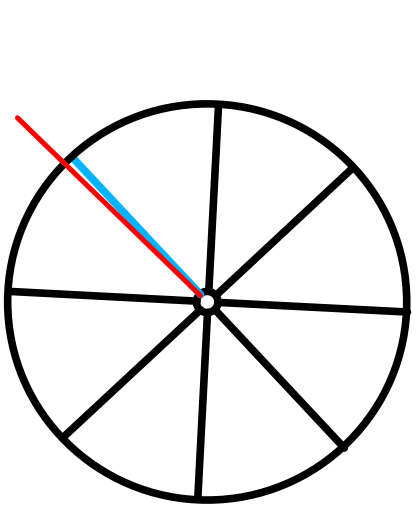
A wheel rotating rapidly



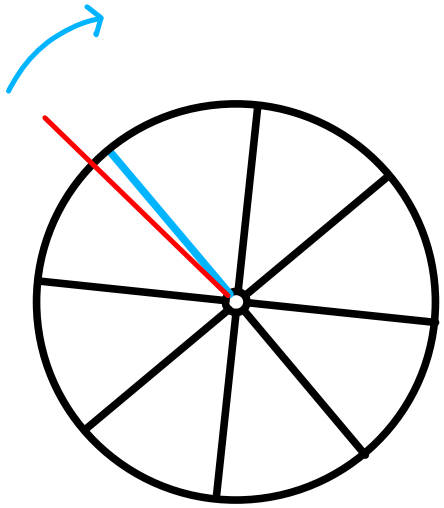
Slow rotation



Frame 1

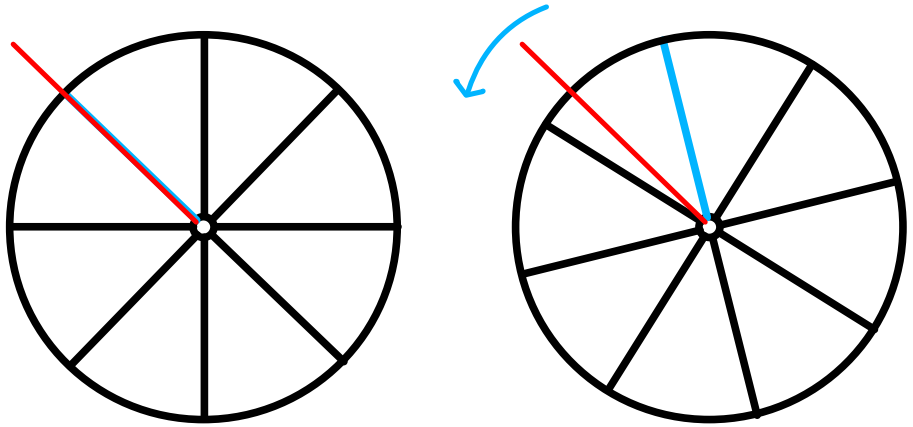


Frame 2



Frame 3

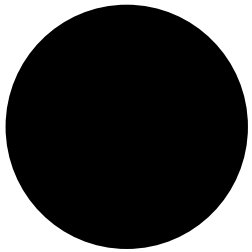
Rapid rotation

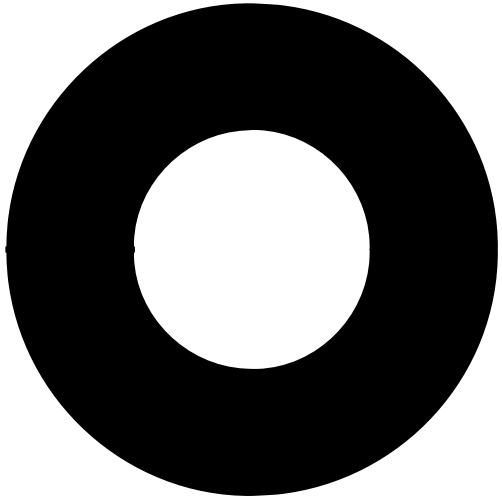


Frame 1 Frame 2

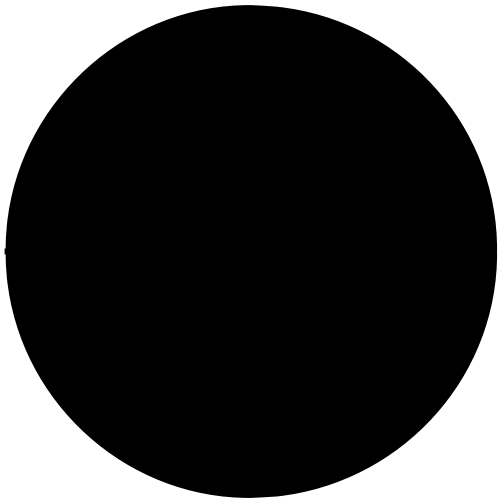
Metacontrast

Disk-ring sequence

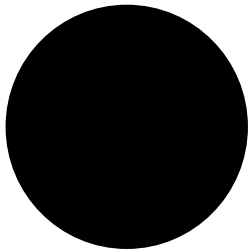


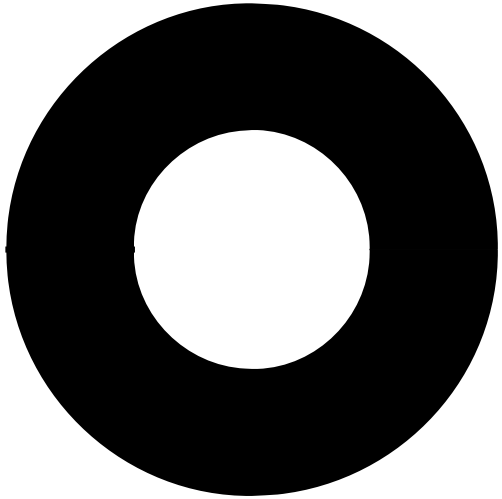


Simultaneous presentation



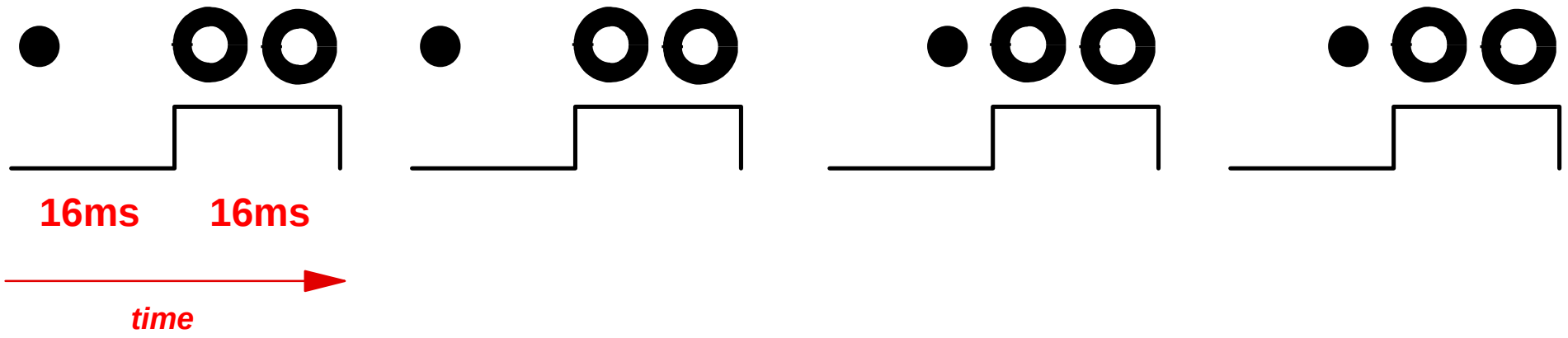
Sequential presentation





Disk and ring and disk alone side

by side shown four times

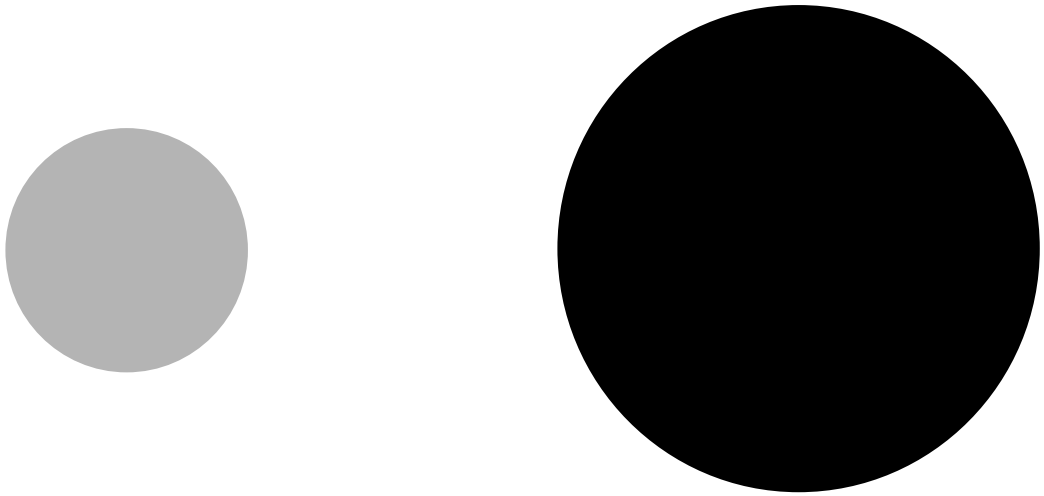


cycling disk and ring with

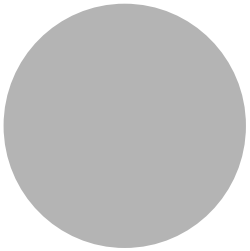
equal cycle times

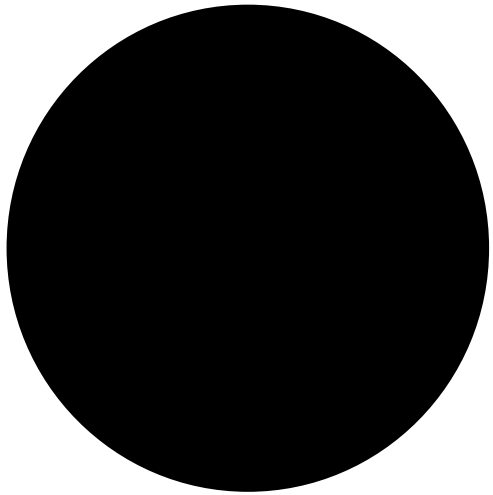
Brightness masking

Brightness masking



1 2

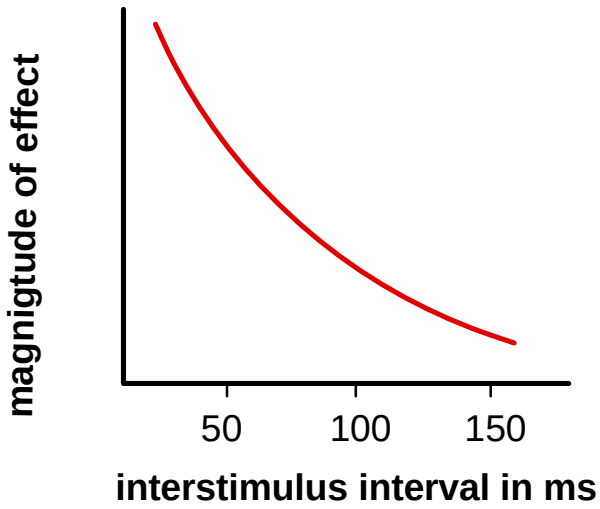




Brightness masking and metacontrast

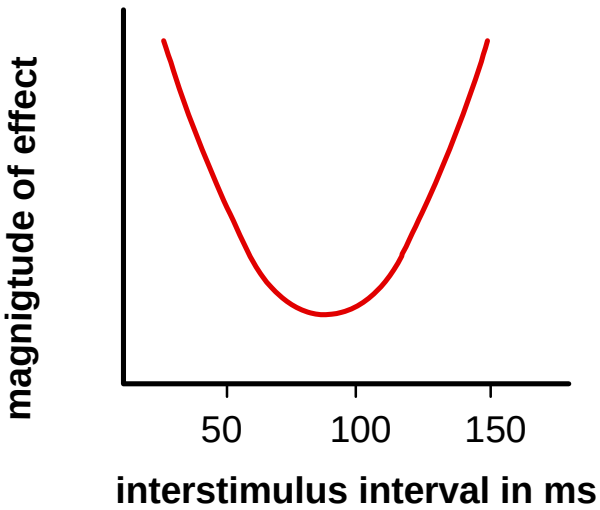
Brightness masking

1. Effect declines with increasing interstimulus interval
2. Does not occur interocularly
3. Mostly due to differential conduction velocity in retina

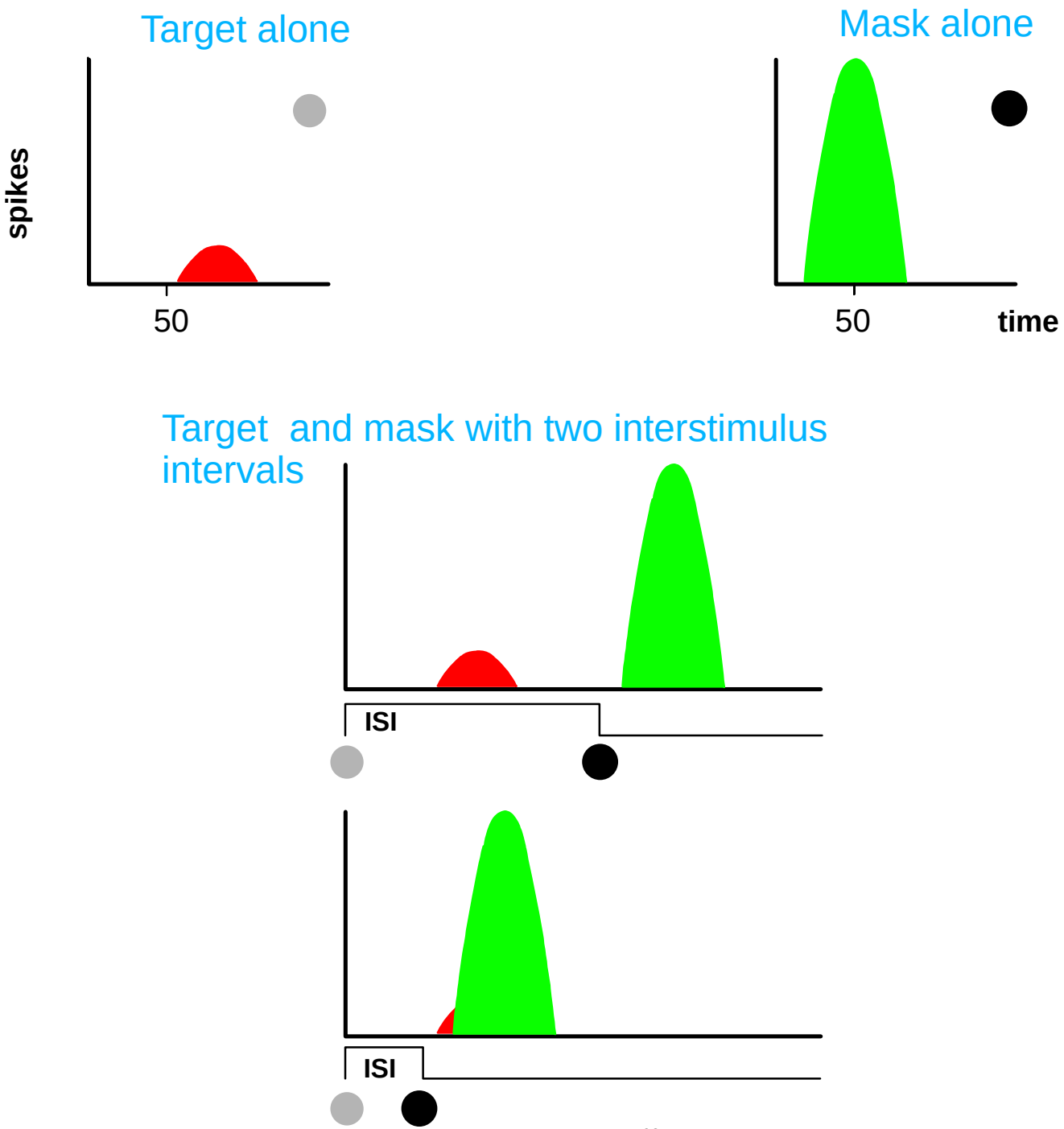


Metacontrast

1. U shaped function
2. Continues to occur interocularly
3. Physiology unclear but linked to motion perception

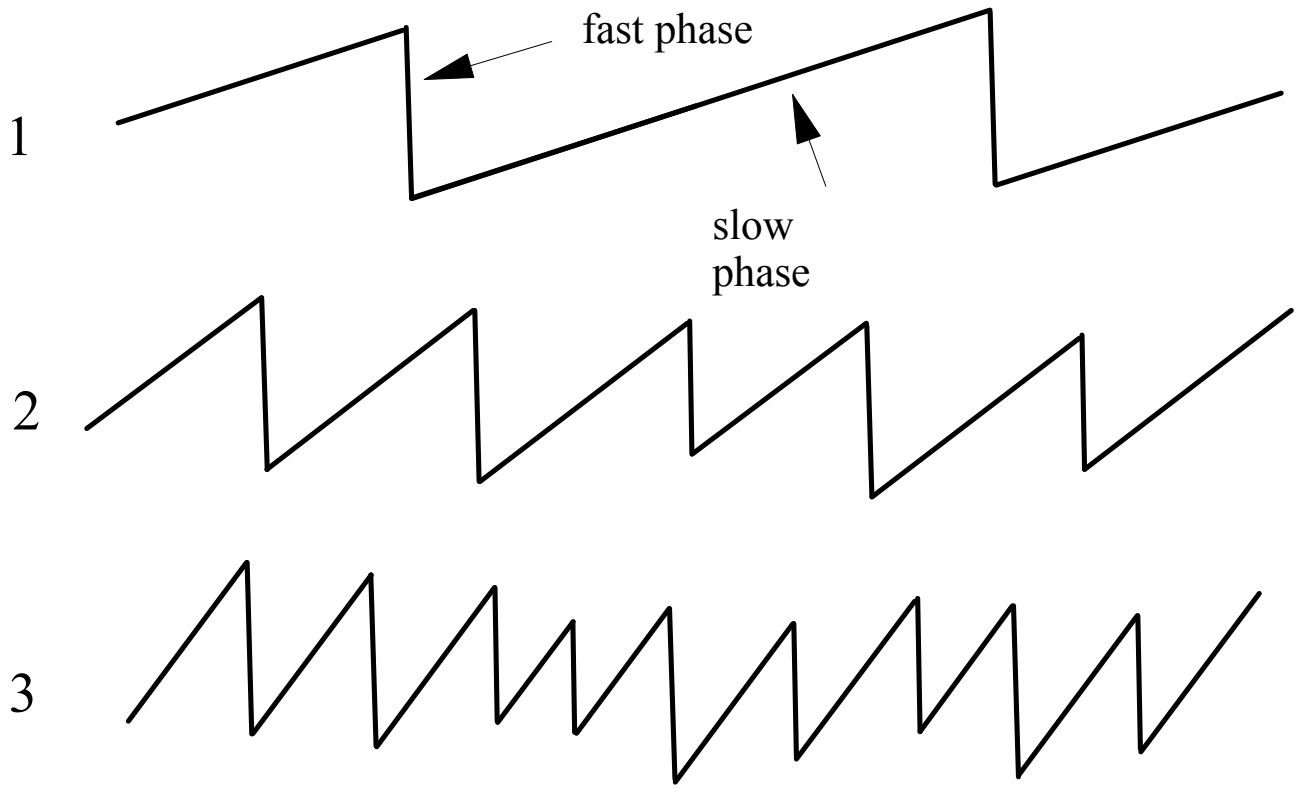


Schematized RGC cell response to brightness masking



Optokinetic nystagmus

Optokinetic nystagmus



Optokinetic nysgtagmus induced in the left and right eyes of a rabbit

Figure removed due to copyright restrictions.

Please refer to lecture video or Knapp, A. G., M. Ariel, et al. "Analysis of Vertebrate Eye Movements following Intravitreal Drug Injections. I. Blockade of Retinal ON-cells by 2-amino-4-phosphonobutyrate Eliminates Optokinetic Nystagmus." *Journal of neurophysiology* 60, no. 3 (1988): 1010-21.

Optokinetic nysgtagmus after APB injected into the right eye

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Please refer to lecture video or Knapp, A. G., M. Ariel, et al. "Analysis of Vertebrate Eye Movements following Intravitreal Drug Injections. I. Blockade of Retinal ON-cells by 2-amino-4-phosphonobutyrate Eliminates Optokinetic Nystagmus." *Journal of neurophysiology* 60, no. 3 (1988): 1010-21.

The effect of APB on optikinetic nyustagmus in monkey

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Please refer to lecture video or Knapp, A. G., M. Ariel, et al. "Analysis of Vertebrate Eye Movements following Intravitreal Drug Injections. I. Blockade of Retinal ON-cells by 2-amino-4-phosphonobutyrate Eliminates Optokinetic Nystagmus." *Journal of neurophysiology* 60, no. 3 (1988): 1010-21.

Optokinetic response in normal and immobilized eye

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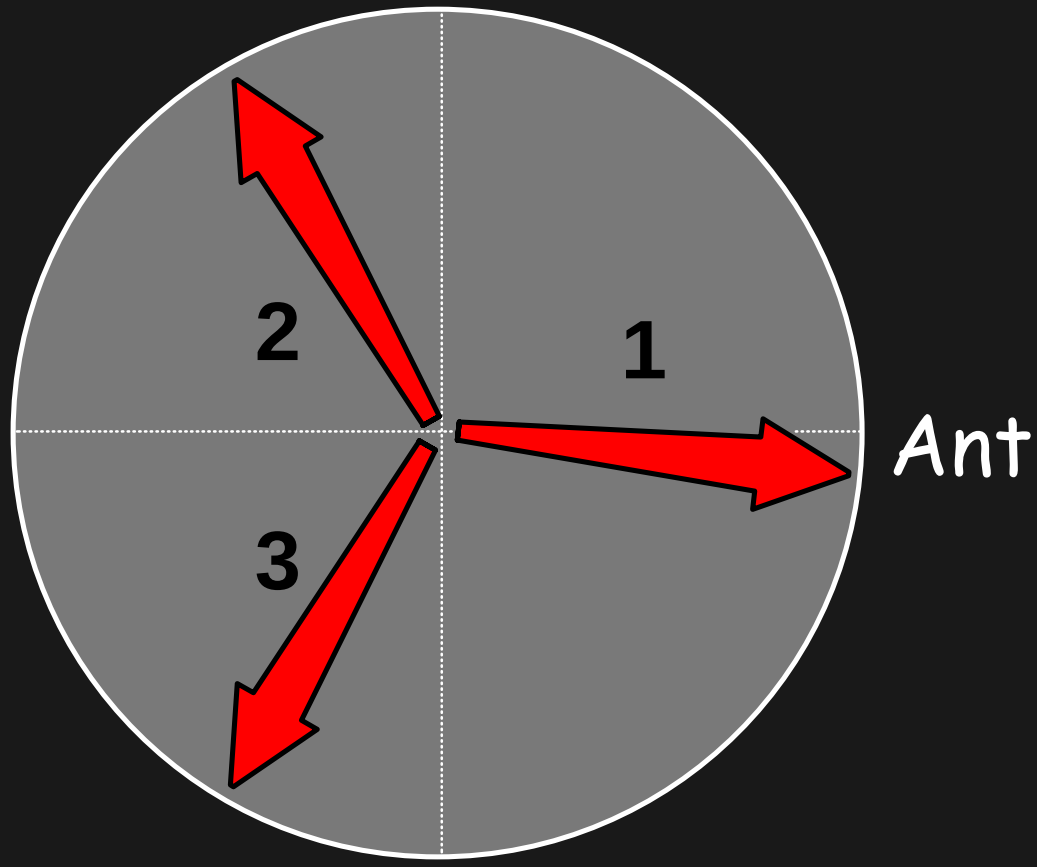
Please refer to lecture video or Knapp, A. G., M. Ariel, et al. "Analysis of Vertebrate Eye Movements following Intravitreal Drug Injections. I. Blockade of Retinal ON-cells by 2-amino-4-phosphonobutyrate Eliminates Optokinetic Nystagmus." *Journal of neurophysiology* 60, no. 3 (1988): 1010-21.

Motion analysis in the accessory optic system

Prime axes of the retinal ganglion cells of Dogiel that feed into the accessory optic system

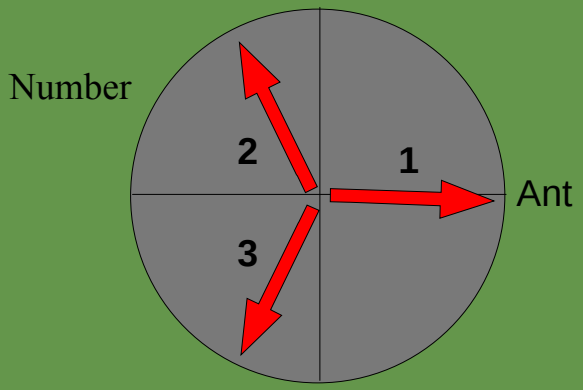


The axons of the cells of Dogiel project to the terminal nuclei

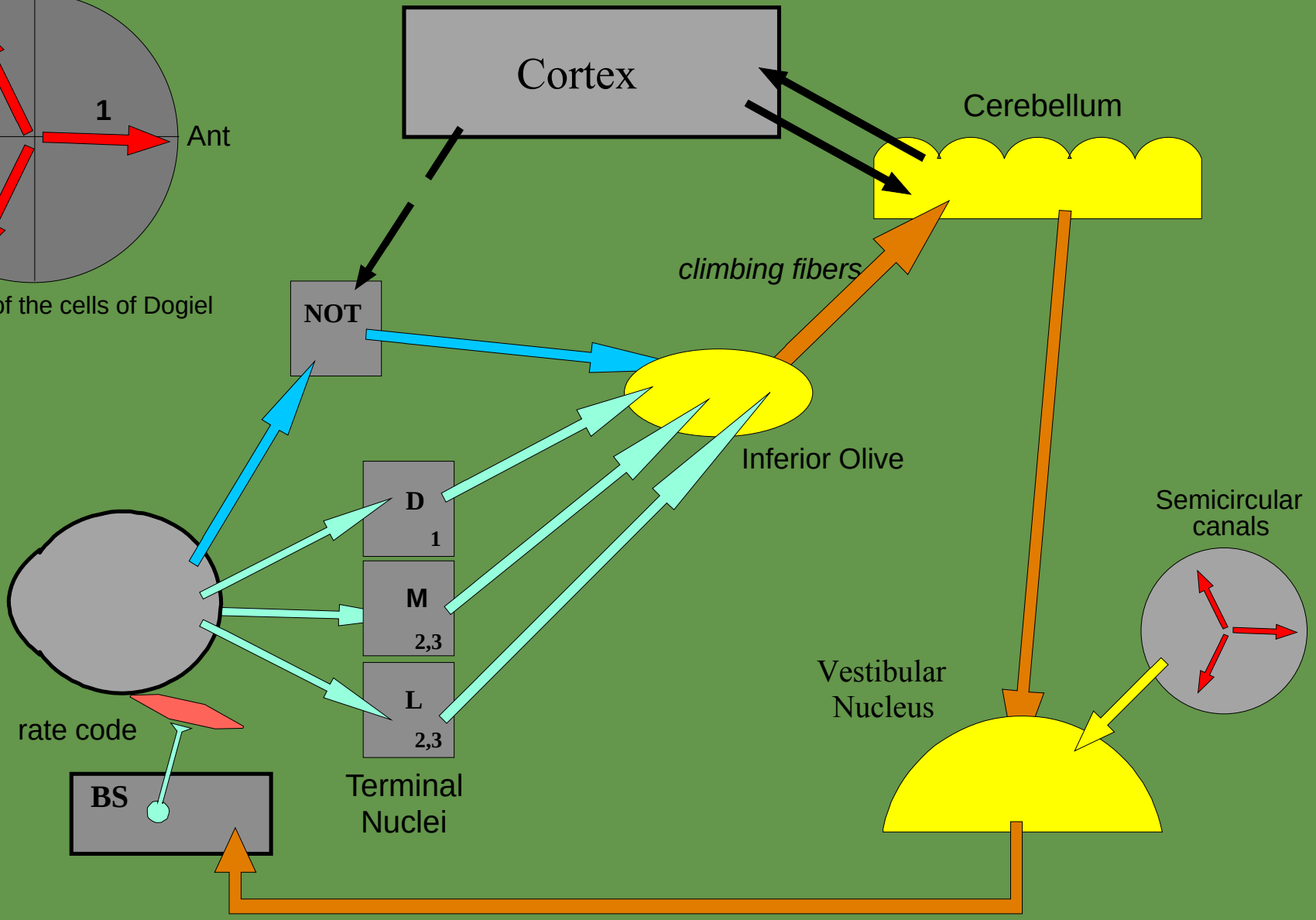
Major Pathways of the Accessory Optic System (AOS)

Velocity response of AOS neurons = 0.1-1.0 deg/sec

of AOS RGCs in rabbit = 7K out of 350K



Prime axes of the cells of Dogiel



9.04 Sensory Systems

Fall 2013