

Depth perception

Cues used for coding depth in the brain

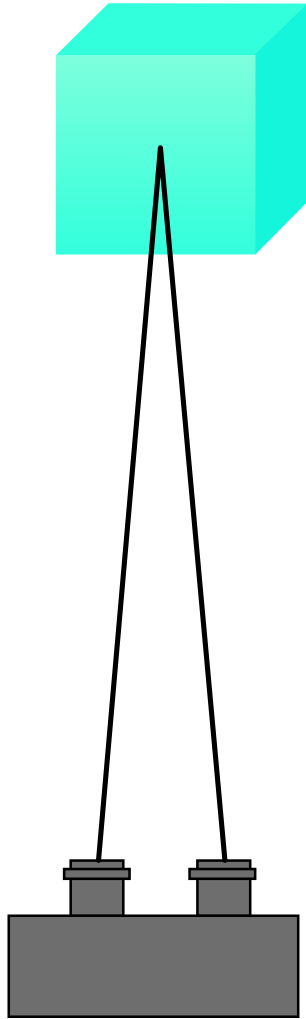
Oculomotor cues

Visual cues

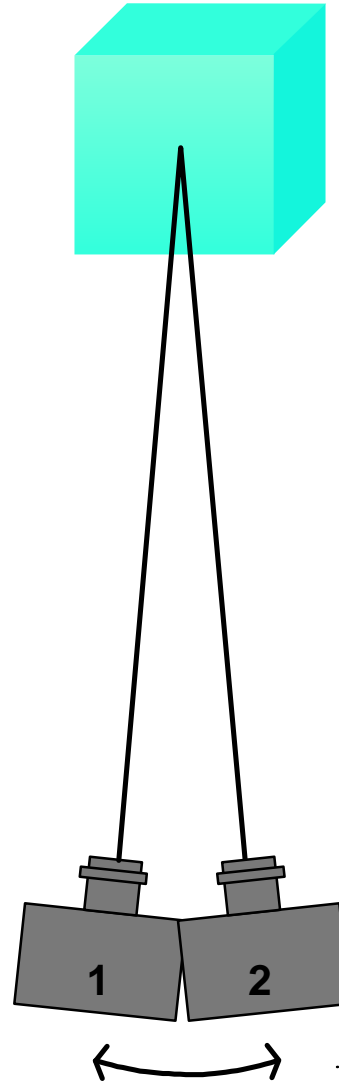
accommodation vergence	<i>Binocular</i> stereopsis
	<i>Monocular</i> motion parallax shading interposition size perspective

Stereopsis, basic facts

Two simple methods for creating stereo images



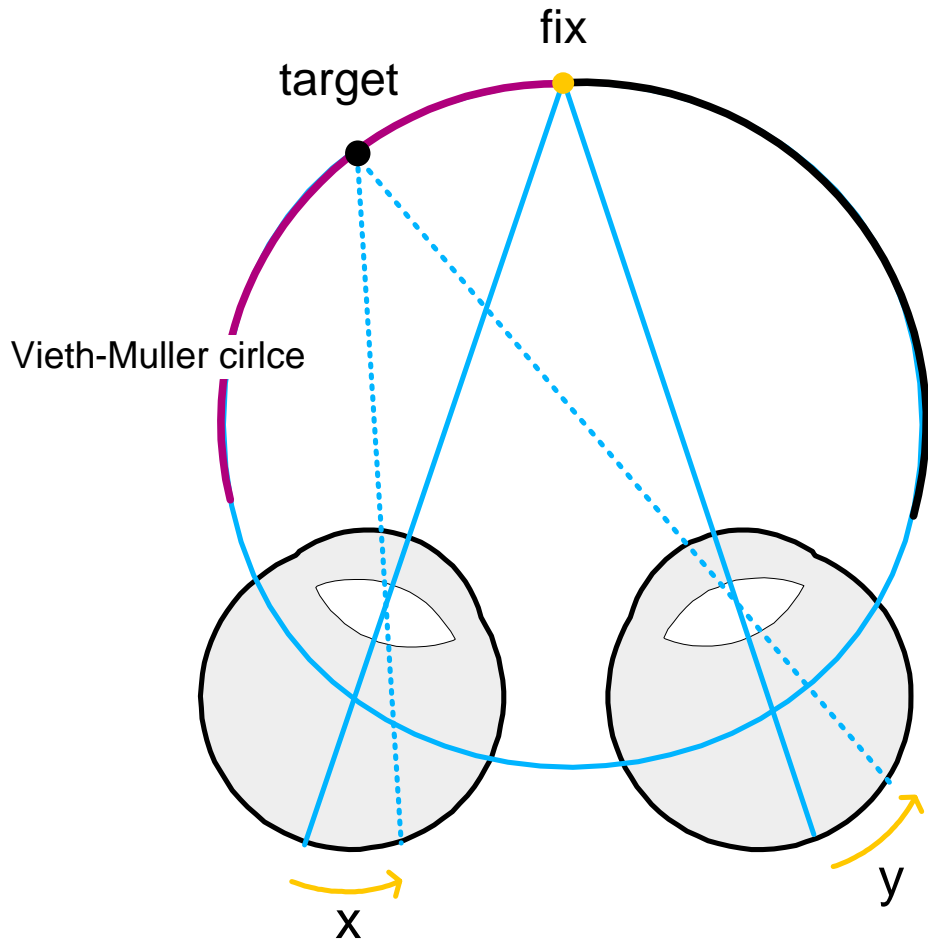
stereo camera



swiveled regular camera

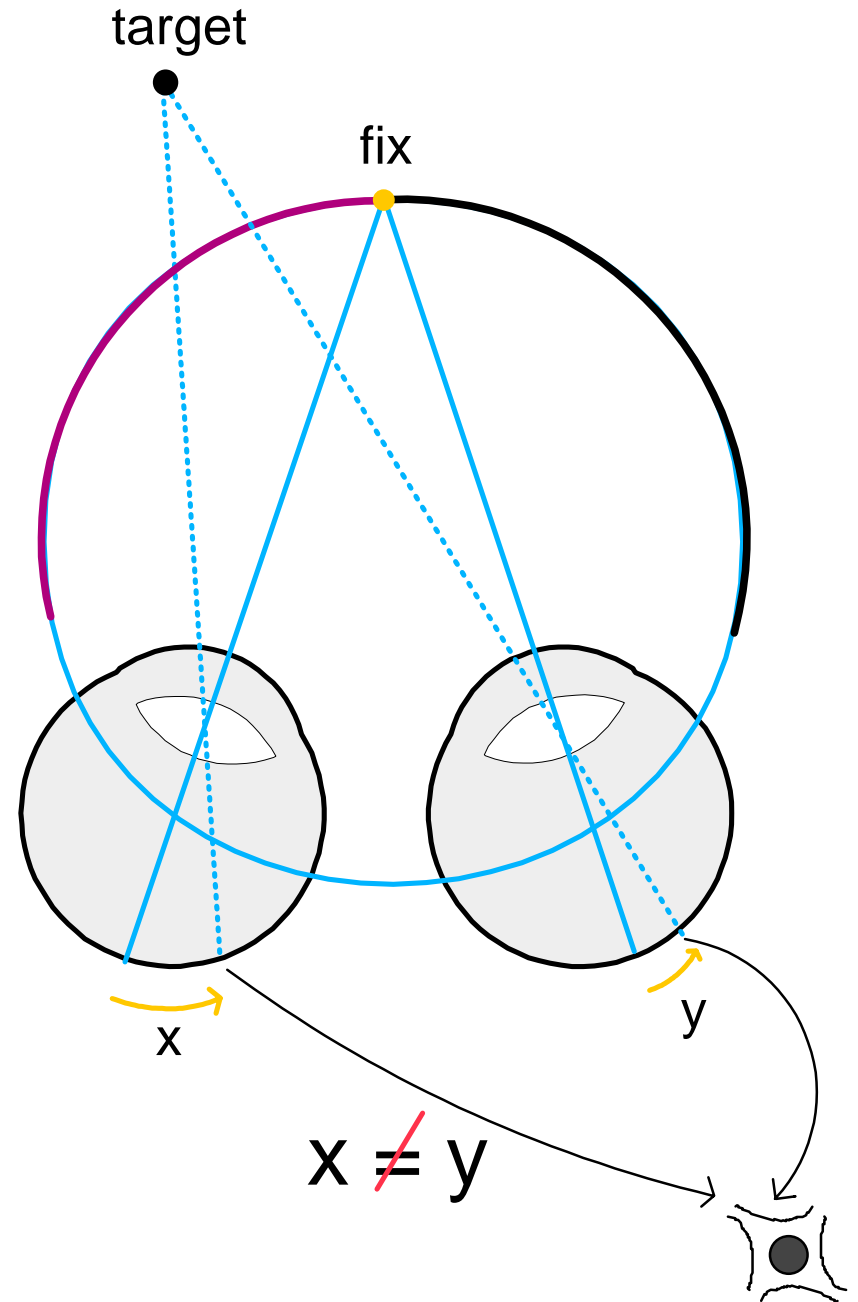
Retinal disparity utilized for stereopsis

Target hits corresponding retinal points



$$x = y$$

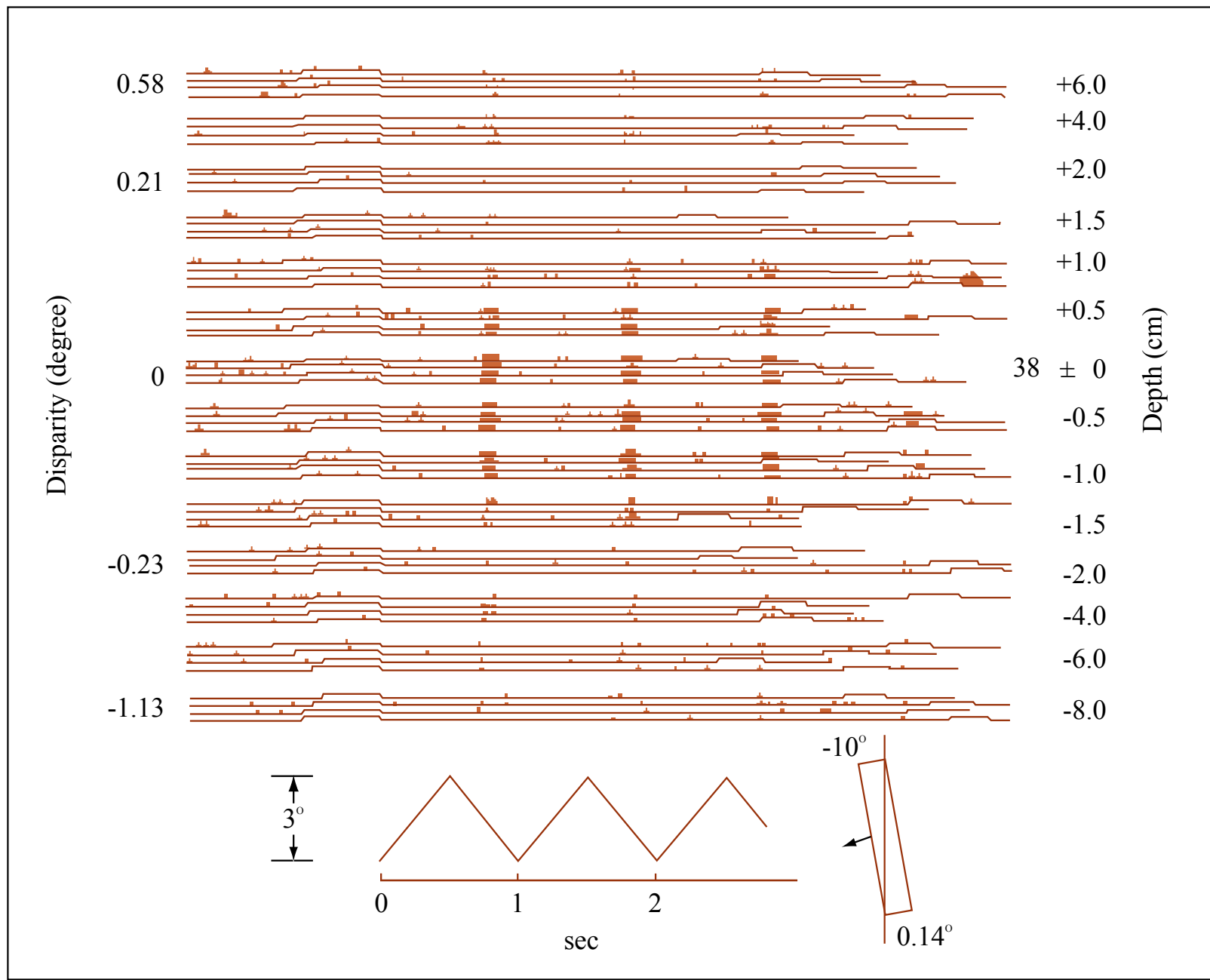
Target hits non-corresponding retinal points



$$x \neq y$$

Stereopsis, neuronal responses

V1 cell response to drifting bars at varied stereo depths



V1 cell response to drifting bars at varied stereo depths

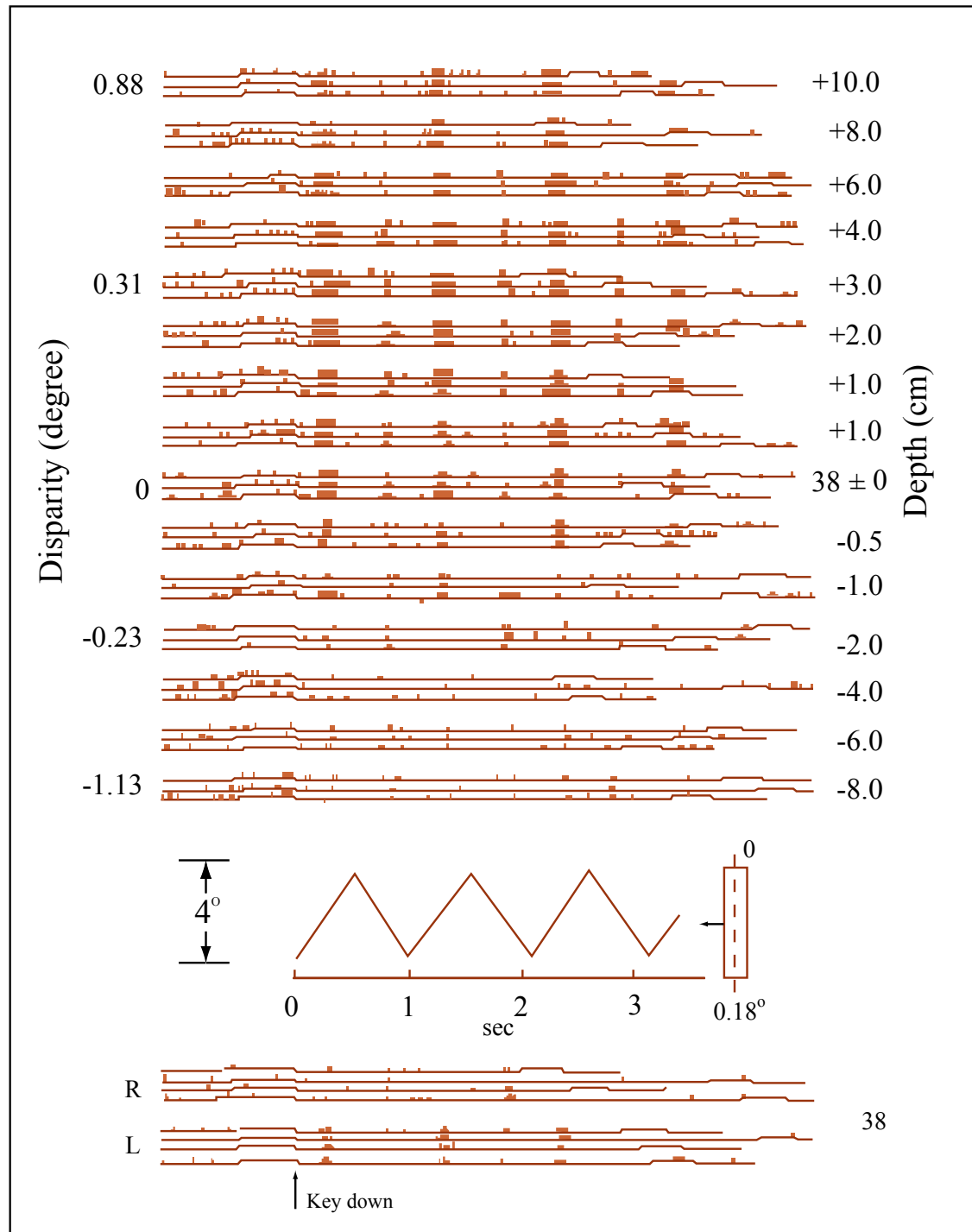


Figure by MIT OCW.

Basic cell types for stereo

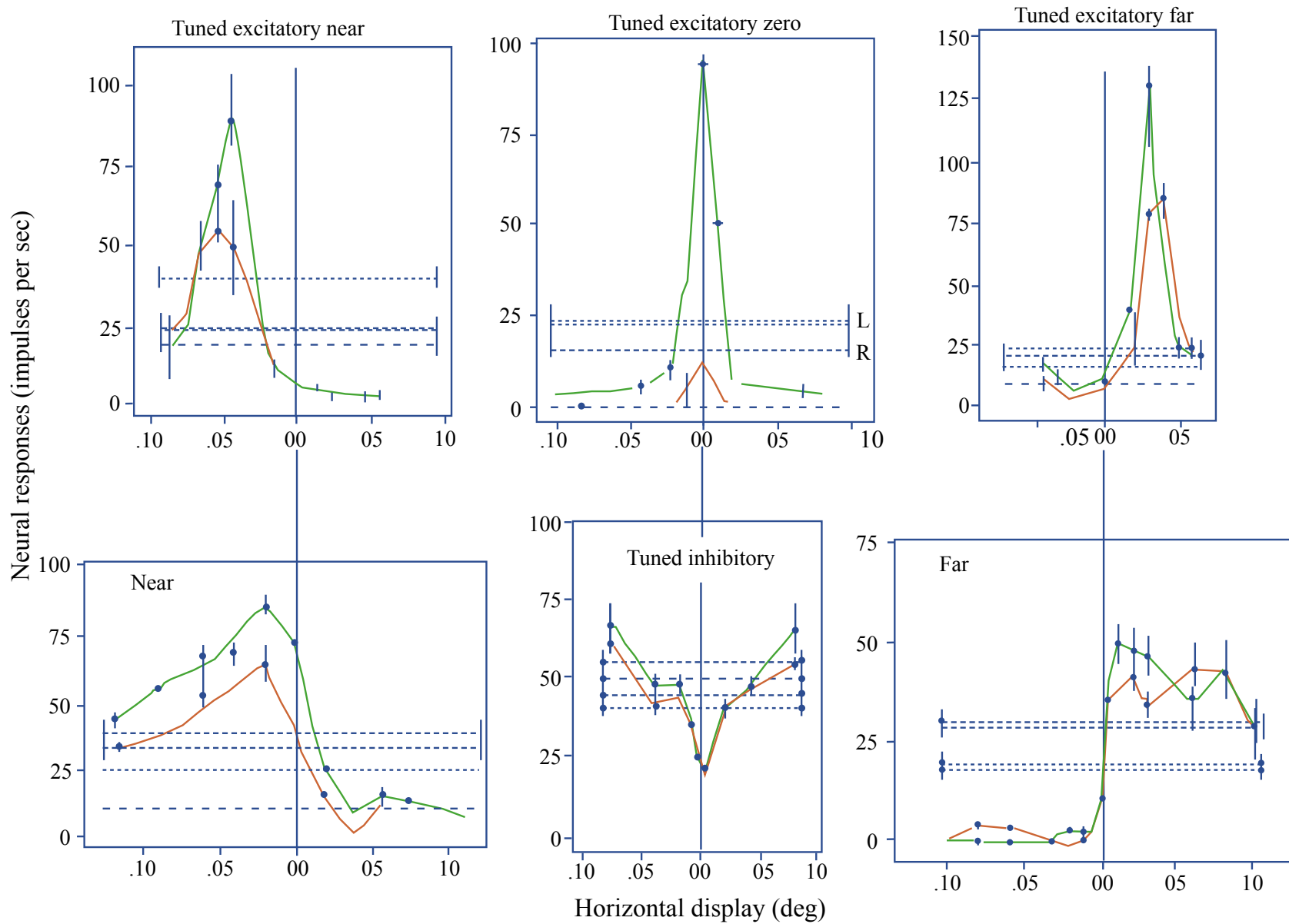
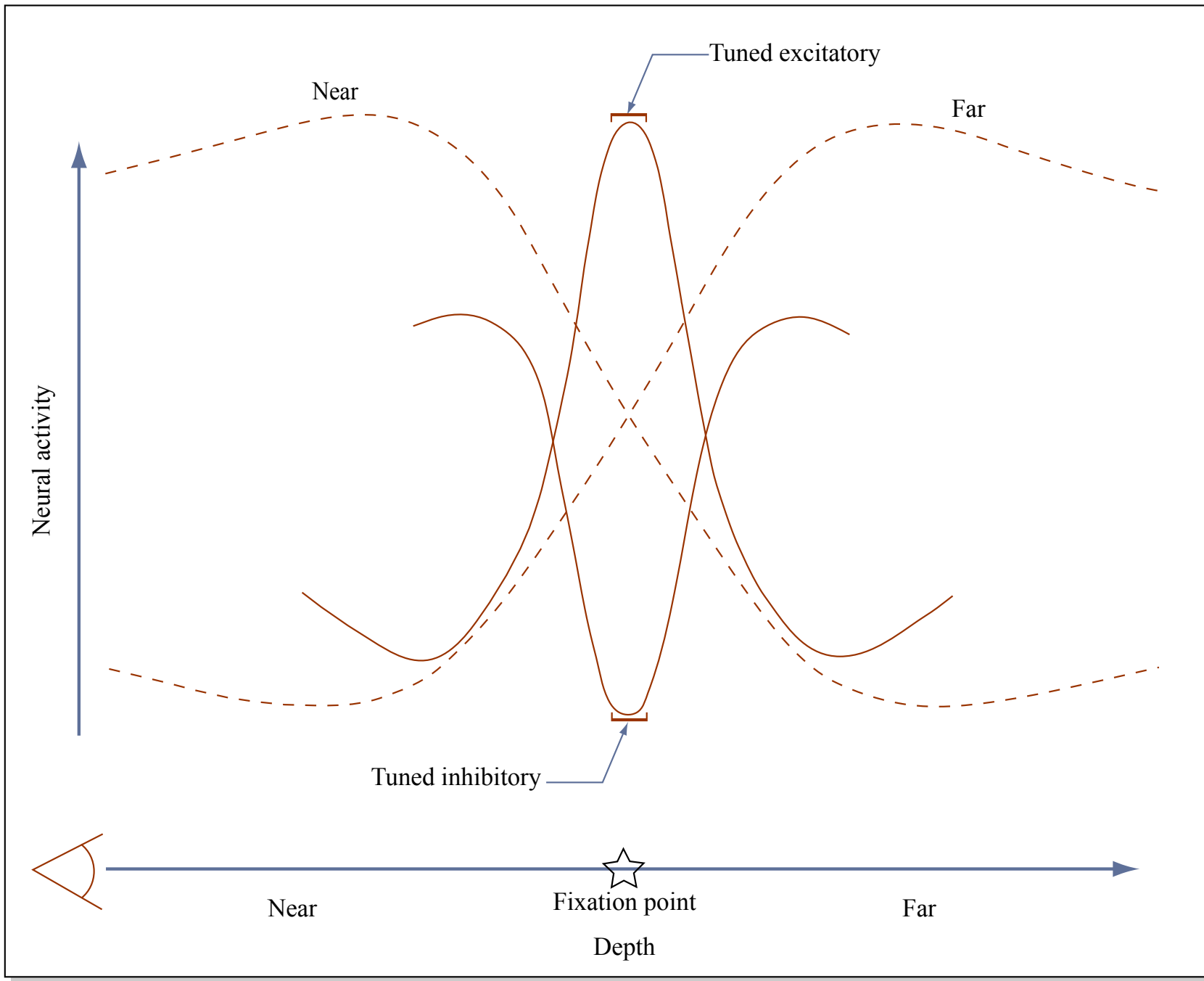


Figure by MIT OCW.

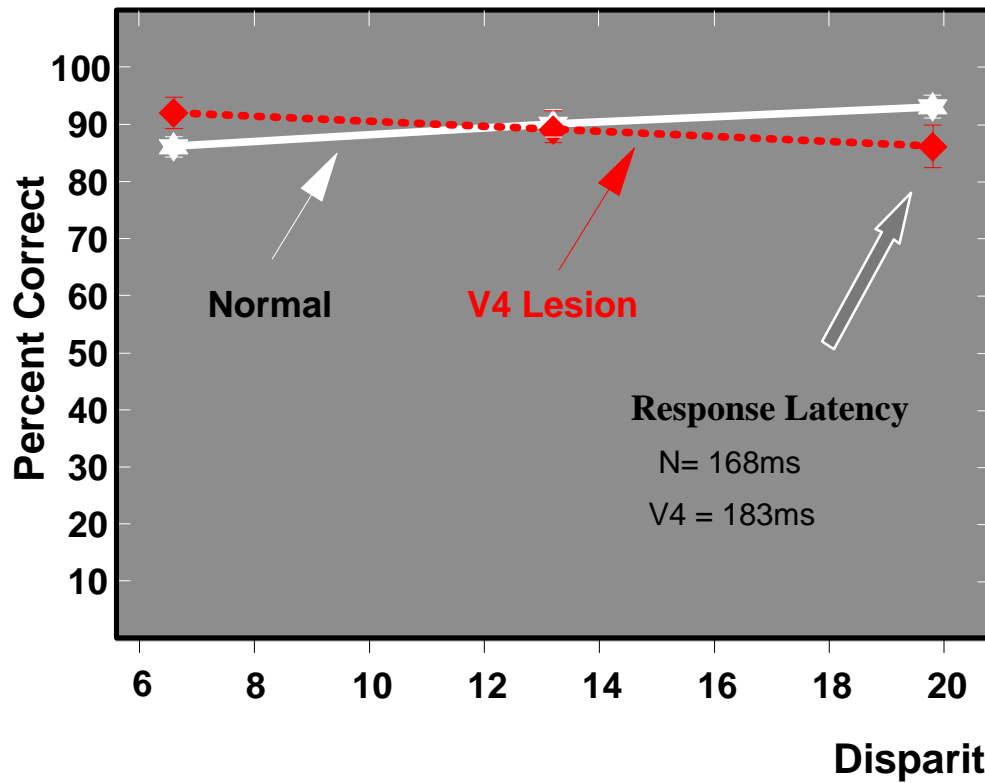
Basic cell types for stereo



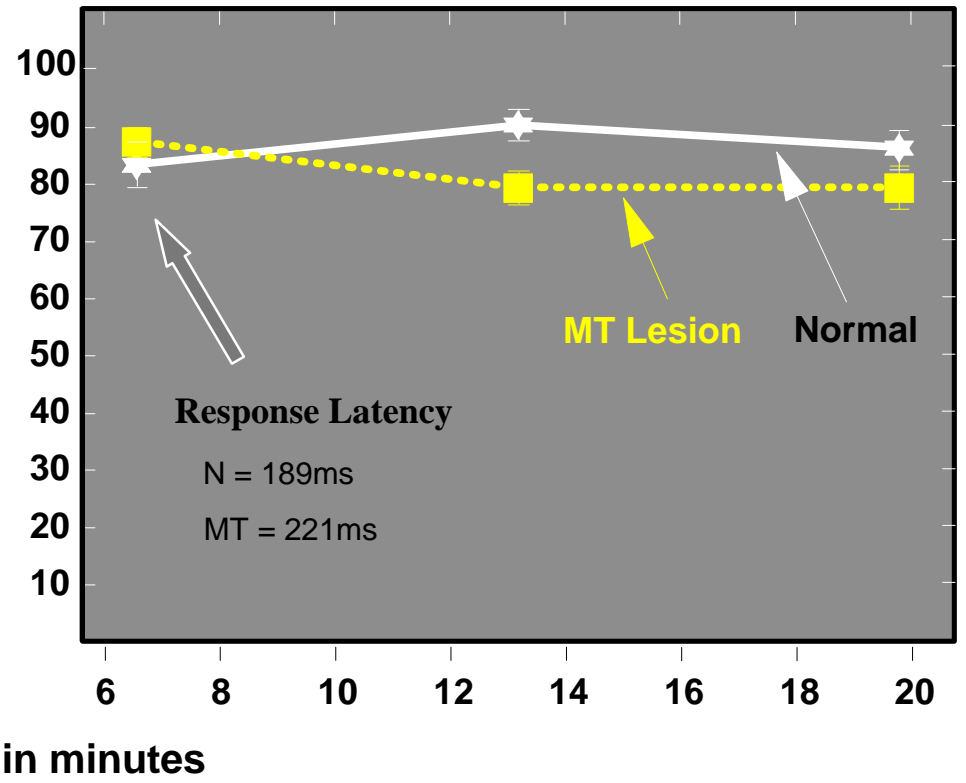
The effects of V4 and MT lesions on stereoscopic depth perception

Stereopsis

V4 lesion

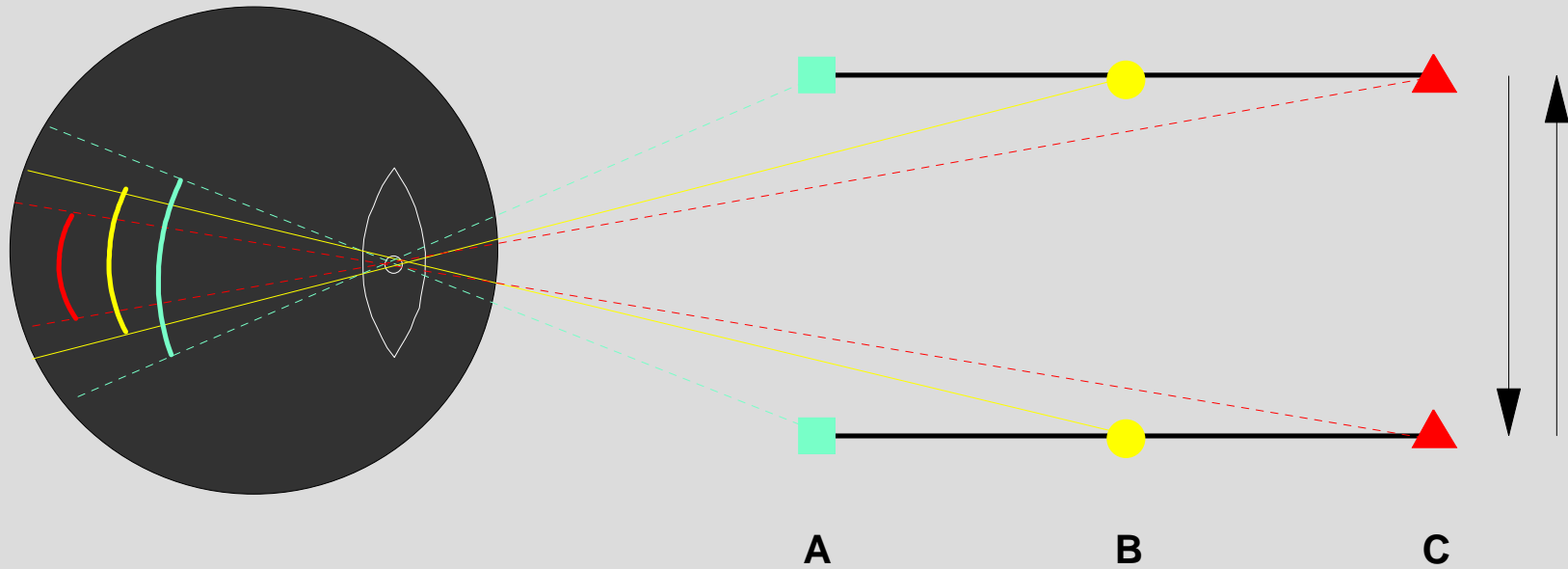


MT lesion



Motion parallax

MOTION PARALLAX, the eye is stationary

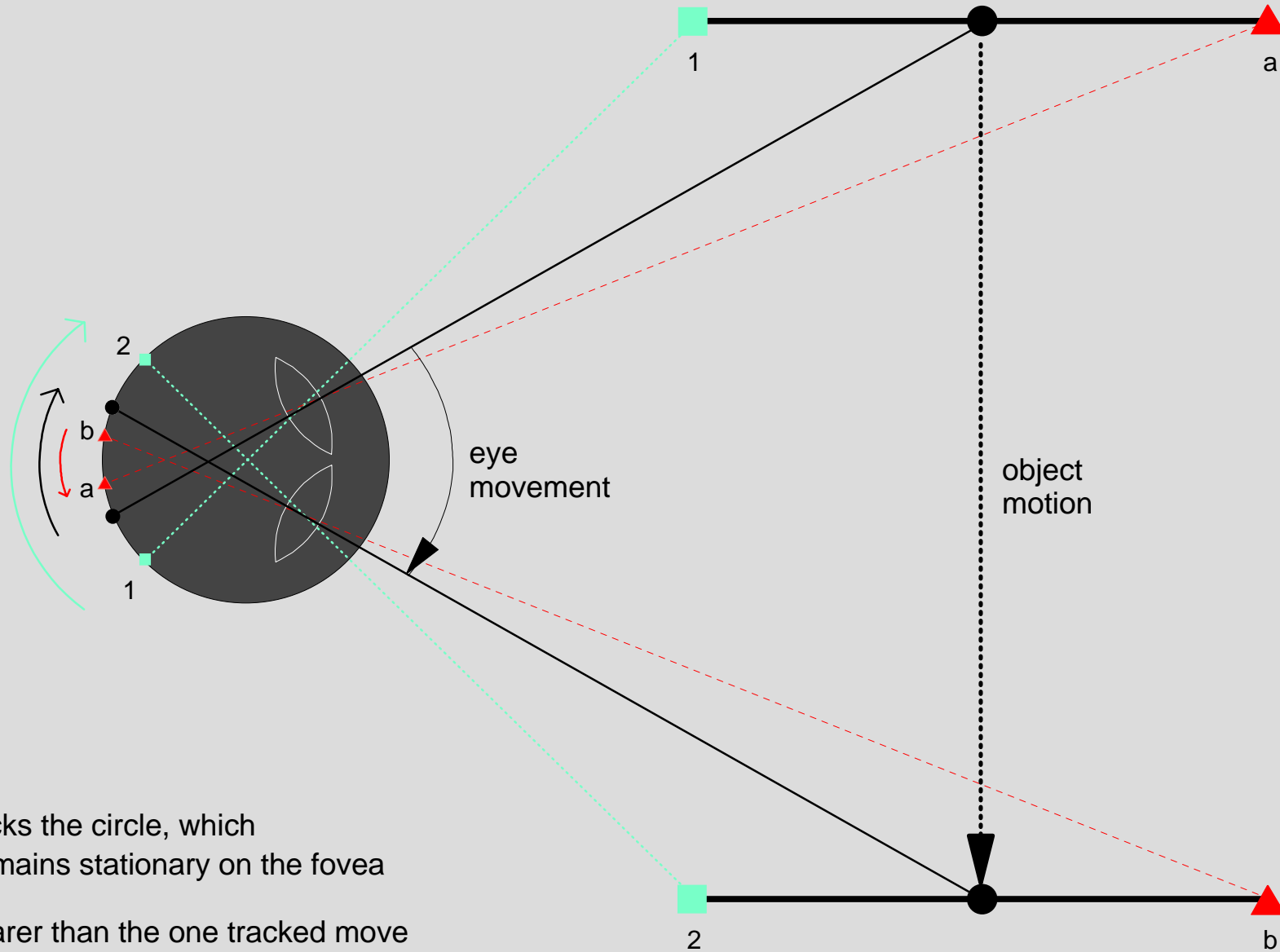


Velocity of motion:

A fastest, C slowest, creating velocity gradient

With rigidity constraint highest relative velocity is judged to be closest

MOTION PARALLAX, the eye tracks



The eye tracks the circle, which therefore remains stationary on the fovea

Objects nearer than the one tracked move at greater velocities on the retinal surface than objects further; the further objects actually move in the opposite direction on the retina.

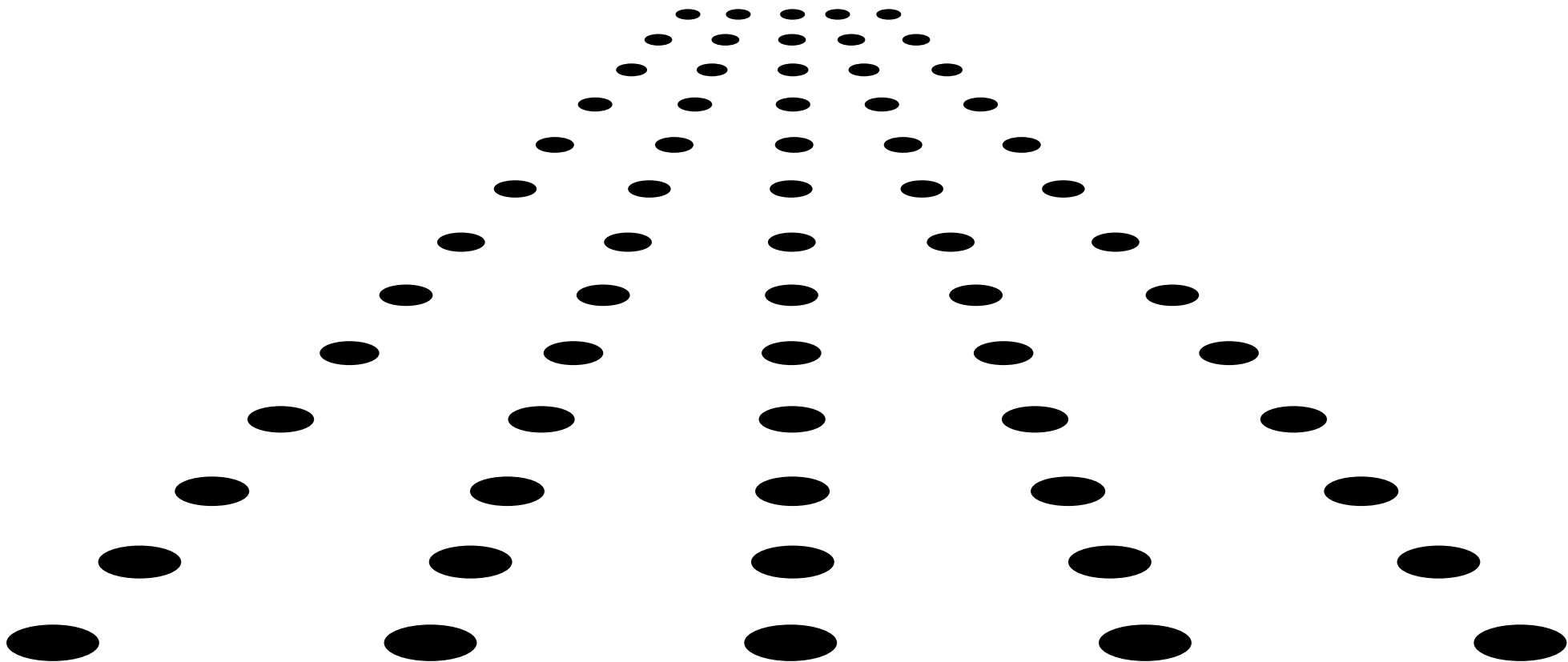
Motion parallax

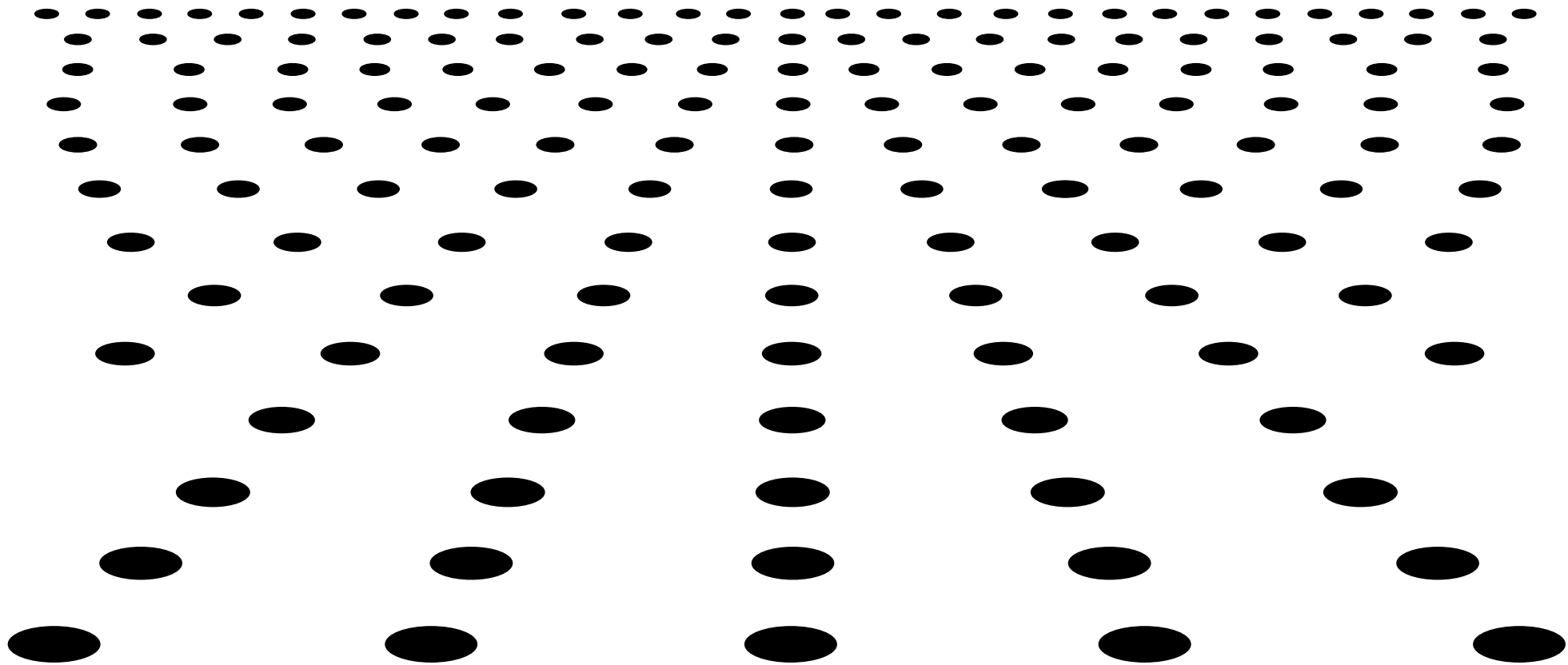
To derive depth information from motion parallax neurons are needed that provide information about velocity and direction of motion and perhaps also about **differential** motion.

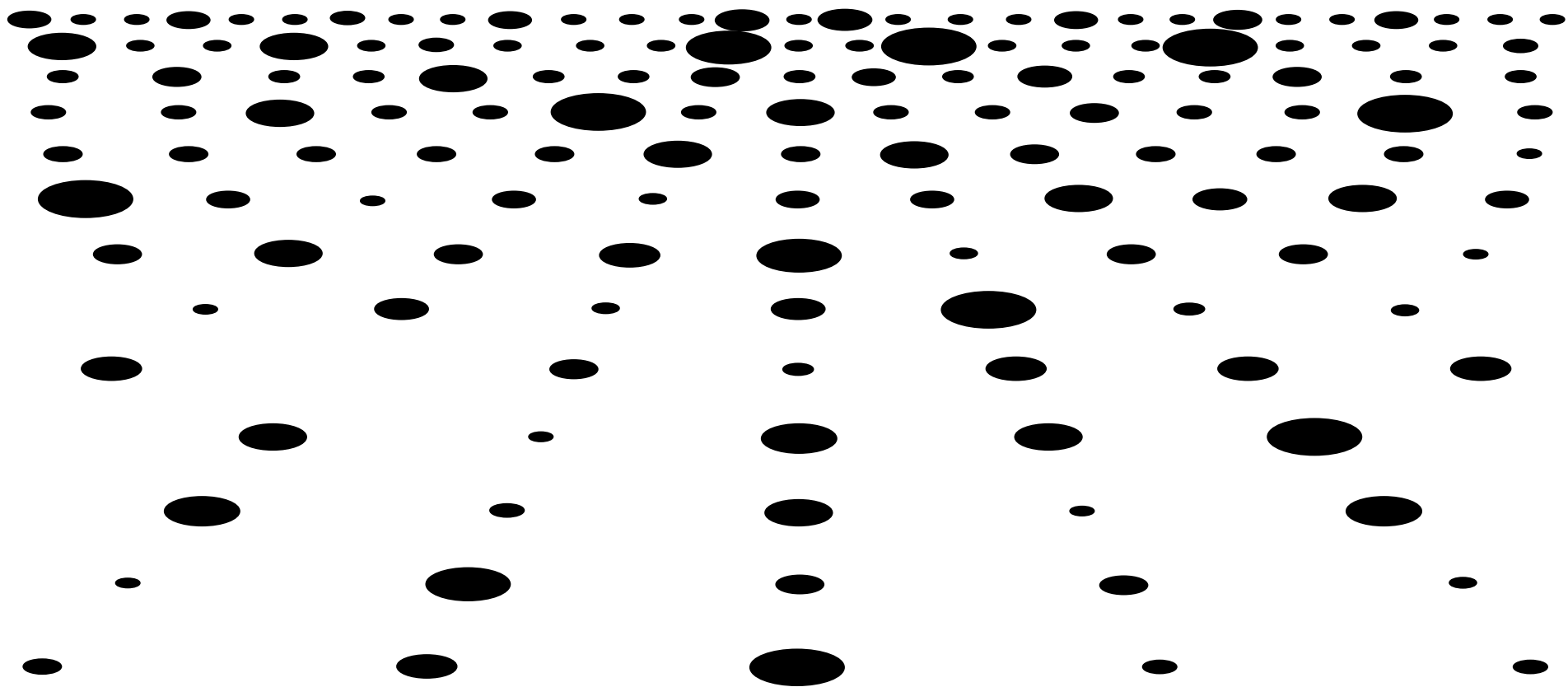
The majority of cells in V1 are direction and velocity selective. Some appear also to be selective for differential motion.

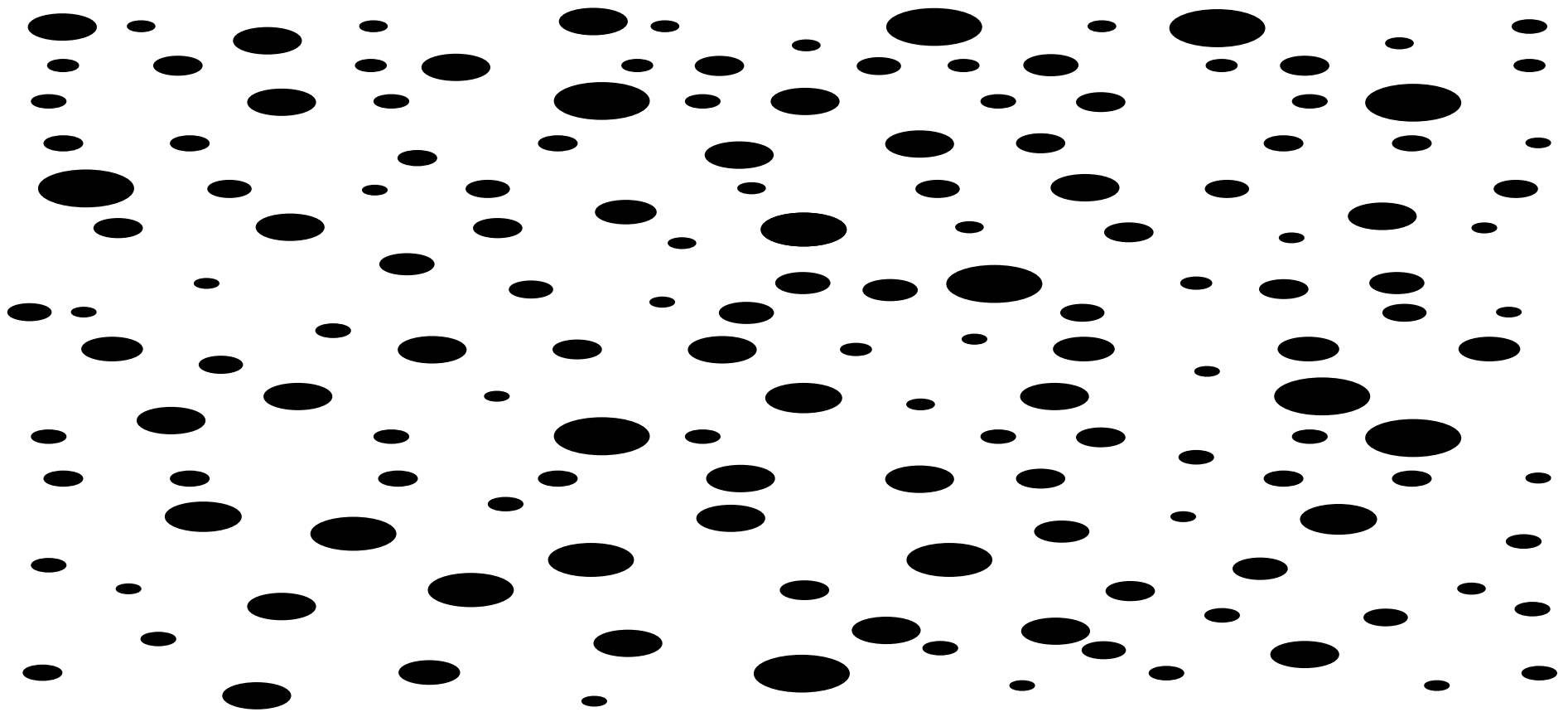
Cells that process motion parallax have also been found in MT.

Perspective

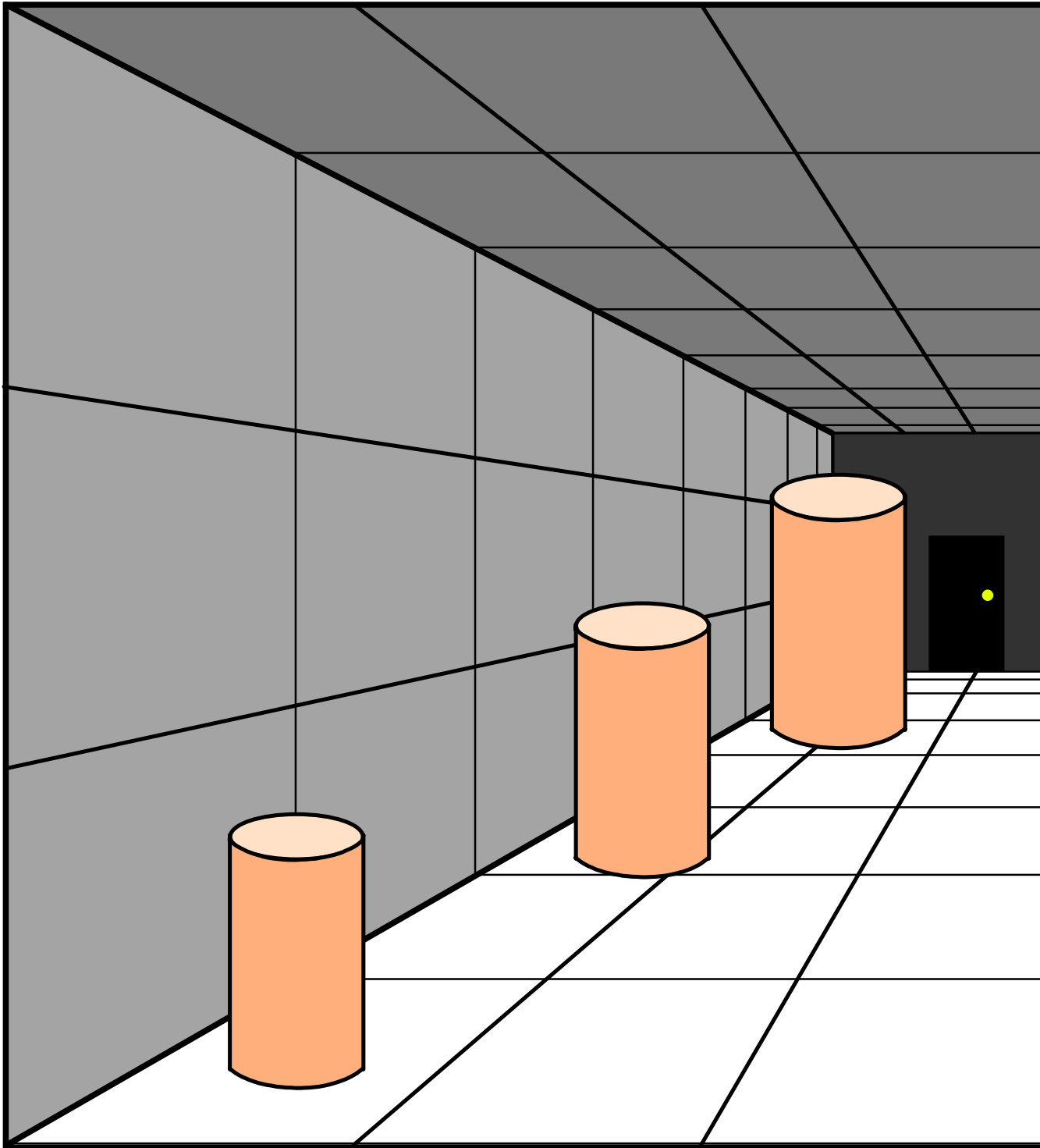


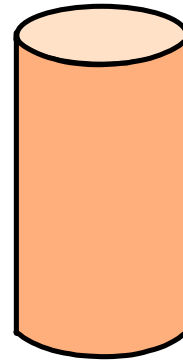
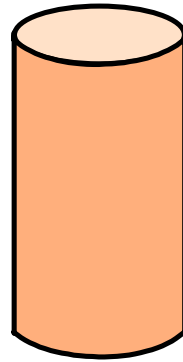
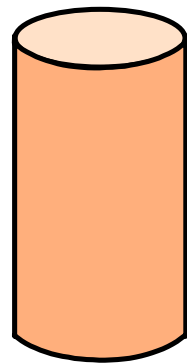






Perspective illusion





Summary, depth:

1. Numerous mechanisms for analyzing depth have been identified that include vergence and accommodation, stereopsis, parallax, shading, and perspective.
2. Several cortical structures process stereopsis utilizing disparity information; the number of disparities represented is limited as in the case of color coding.
3. Utilizing motion parallax for depth processing necessitates neurons specific for direction, velocity and differential velocity; several areas, including V1 and MT process motion parallax.
4. Area MT contributes to the analysis of motion, motion parallax, depth, and flicker; however, these analyses are also carried out by several other structures.
5. Little is known at present about the manner in which information about shading and perspective is analyzed by the brain.