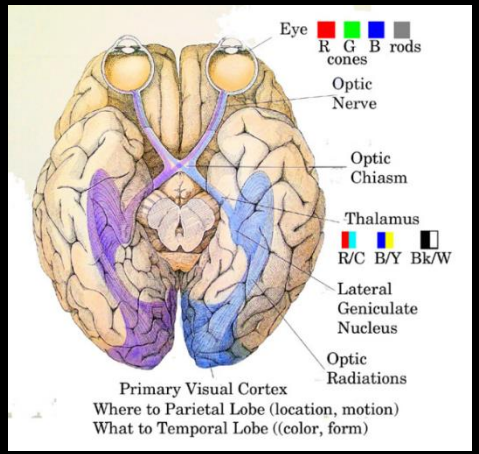
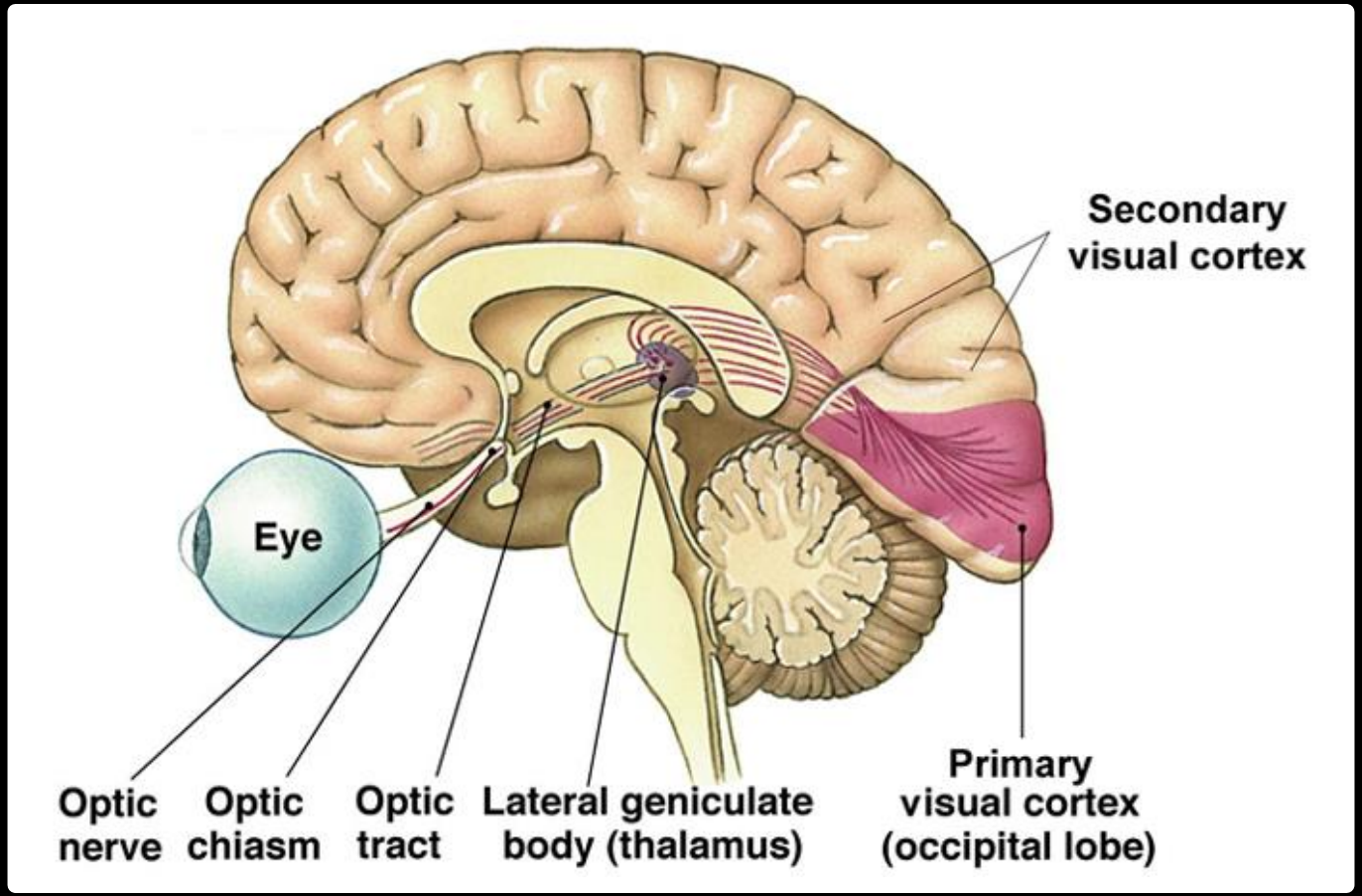
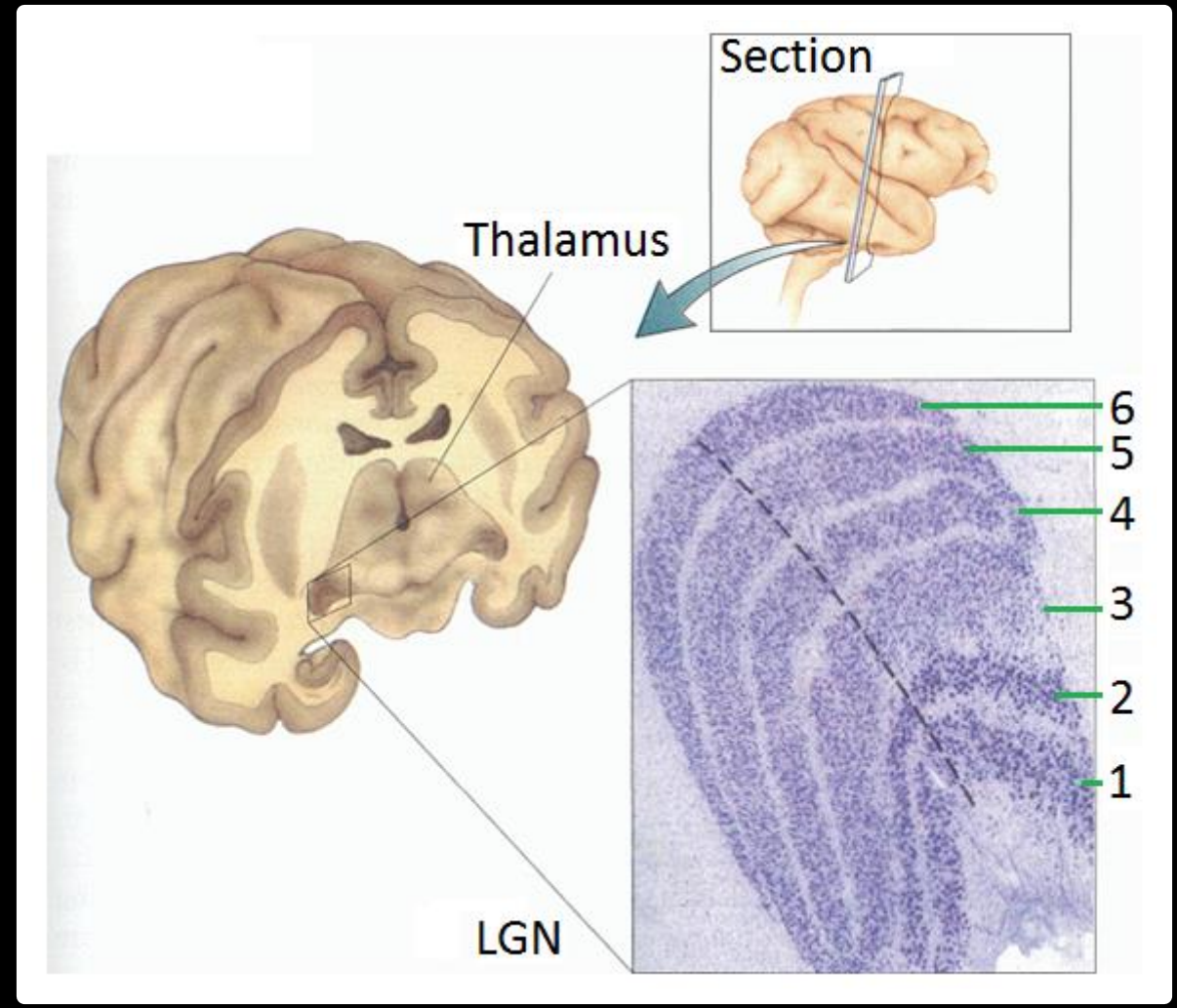
CS4495/6495
Introduction to Computer Vision

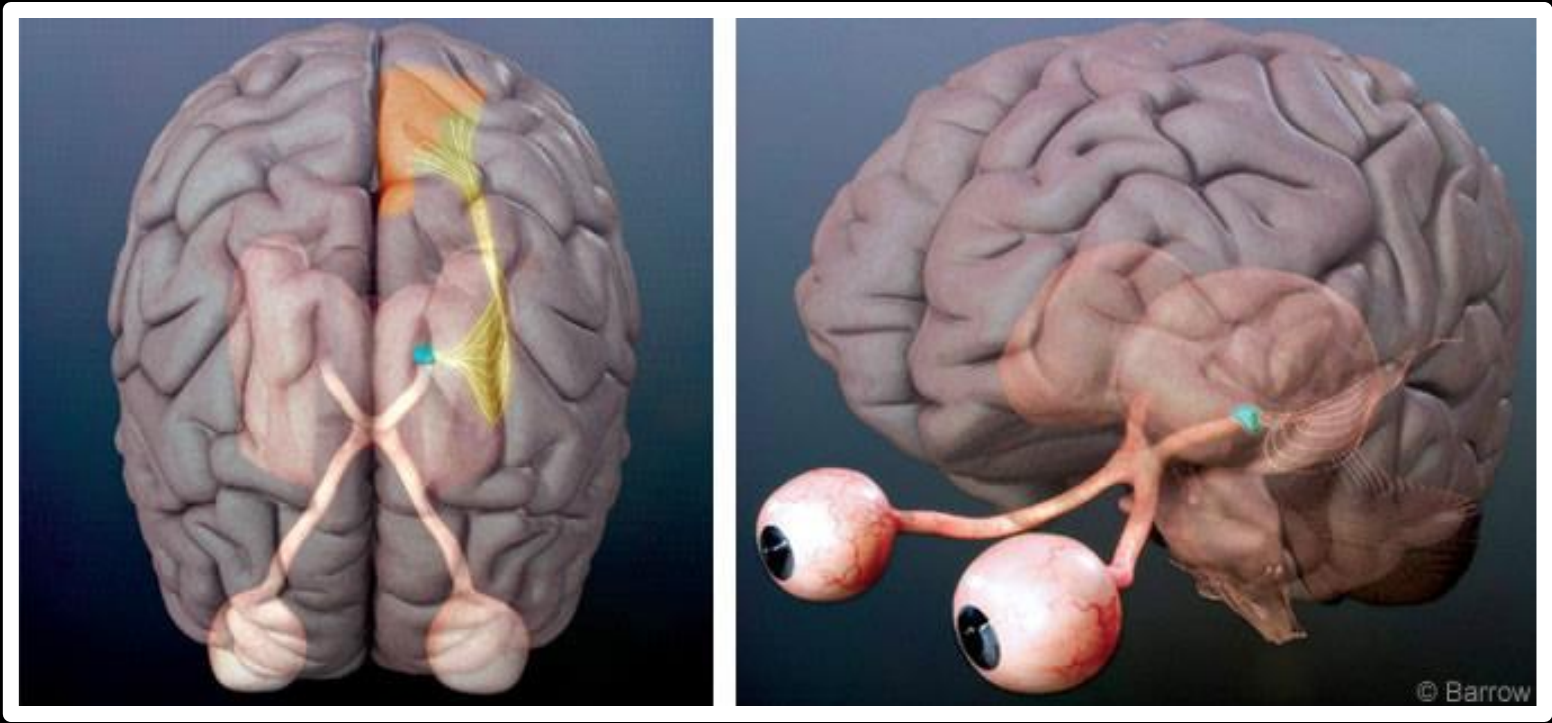
10B-L1 *Vision in the brain*



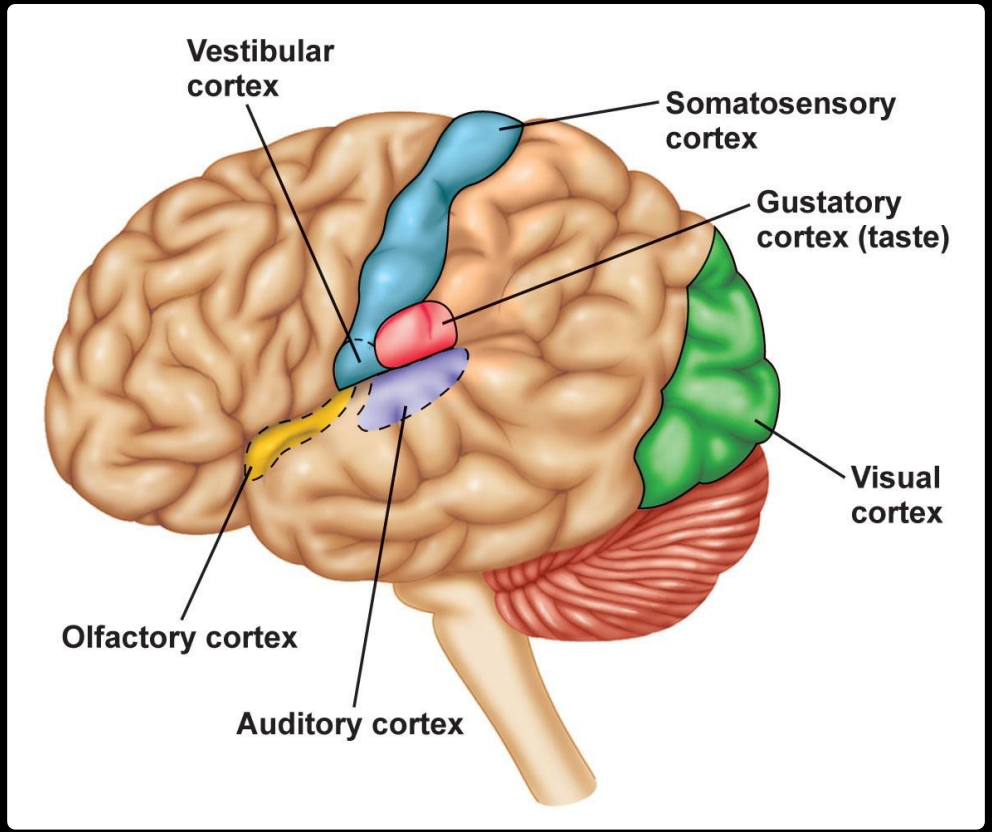

Secondary visual cortex
Eye
Optic nerve
Optic chiasm
Optic tract
Lateral geniculate body (thalamus)
Primary visual cortex (occipital lobe)


Section
Thalamus
6
5
4
3
2
1
LGN

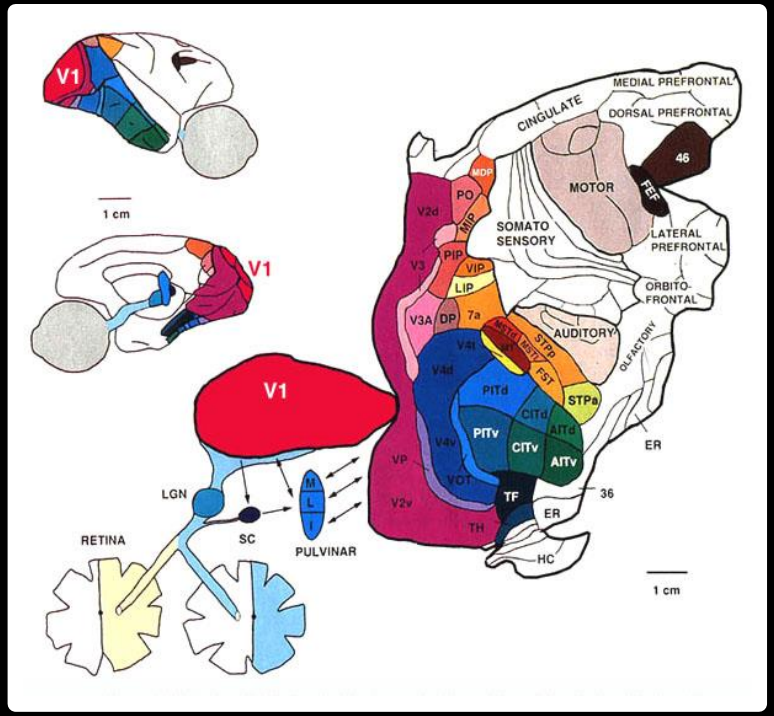
Superior colliculus

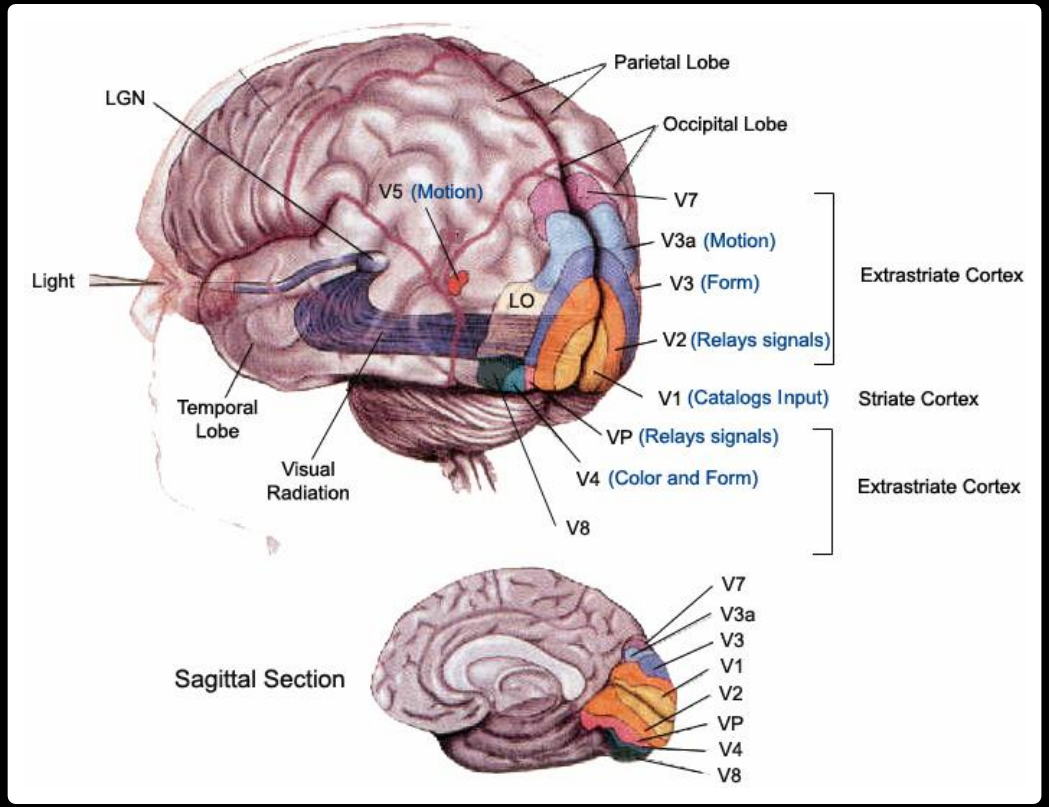


Cerebral cortex: Functional areas

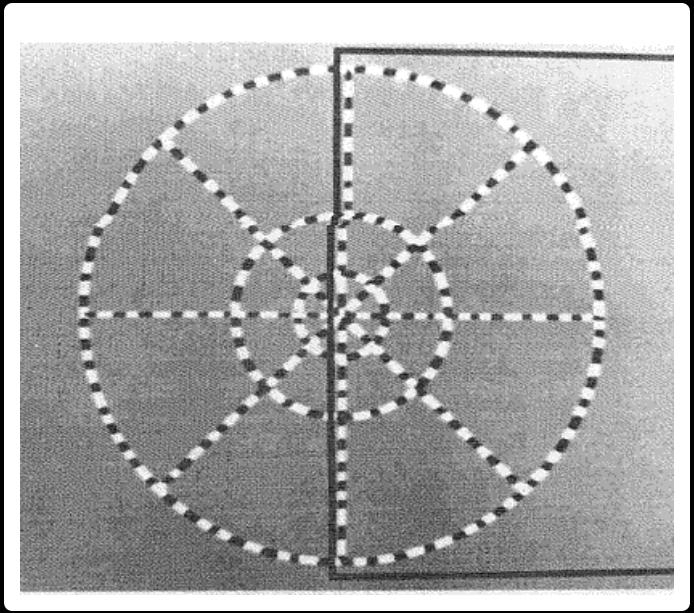


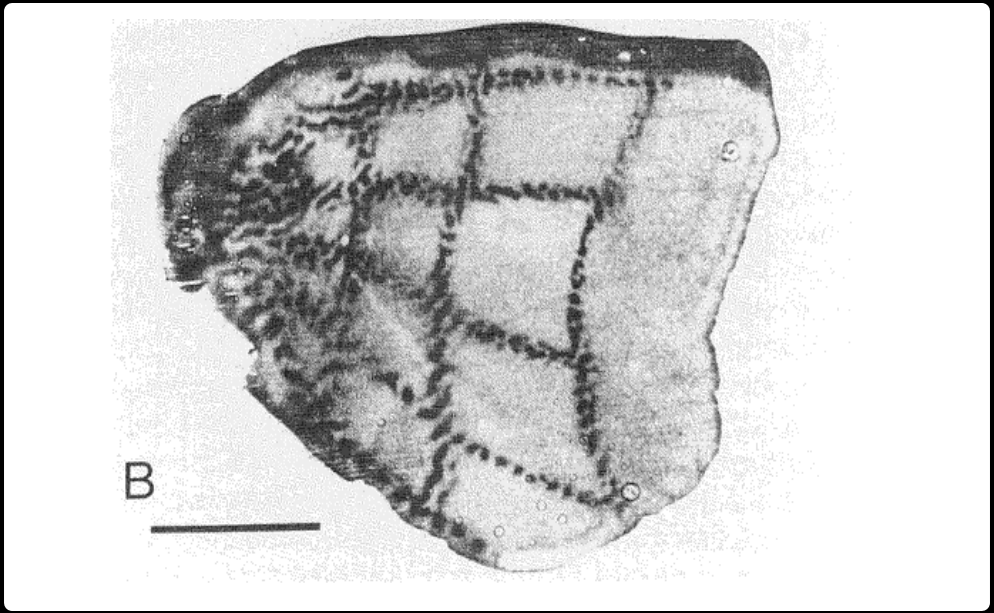
Visual processing areas





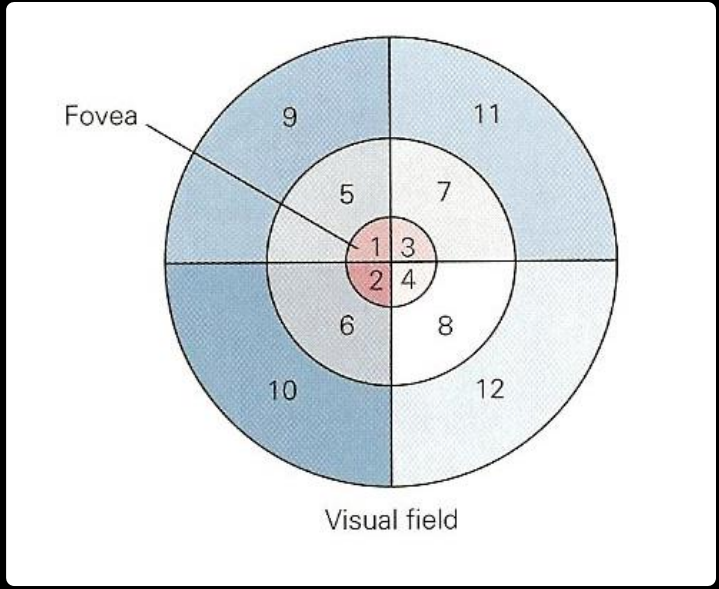
Mapping from Retina to V1

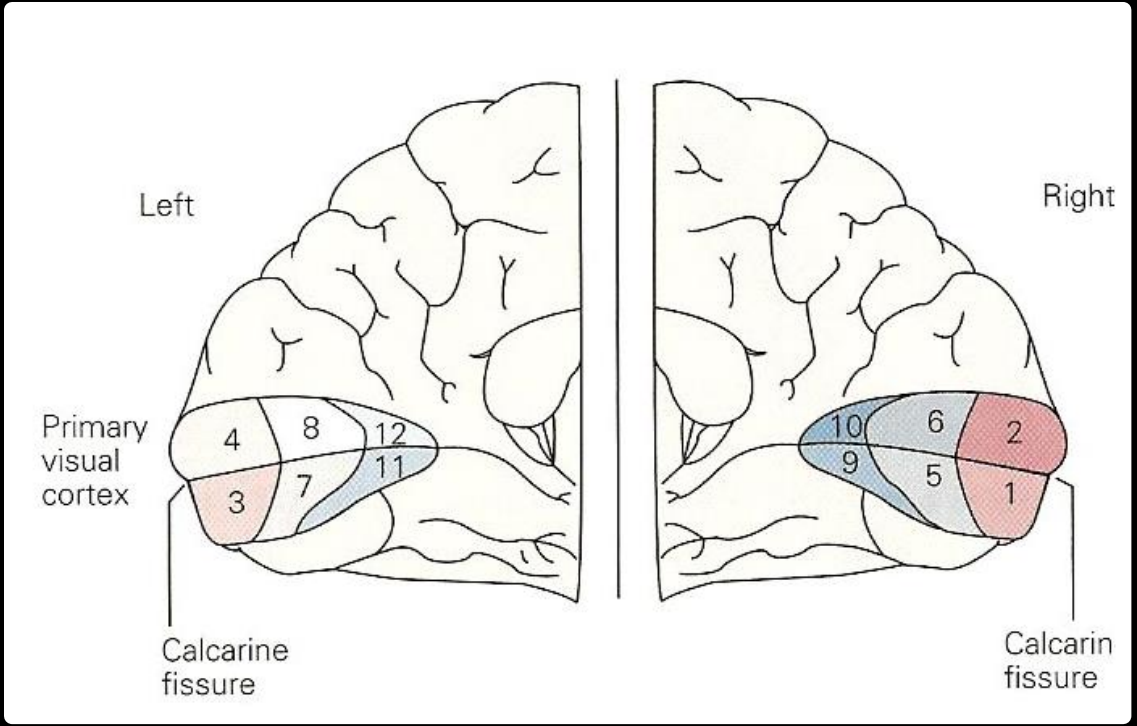




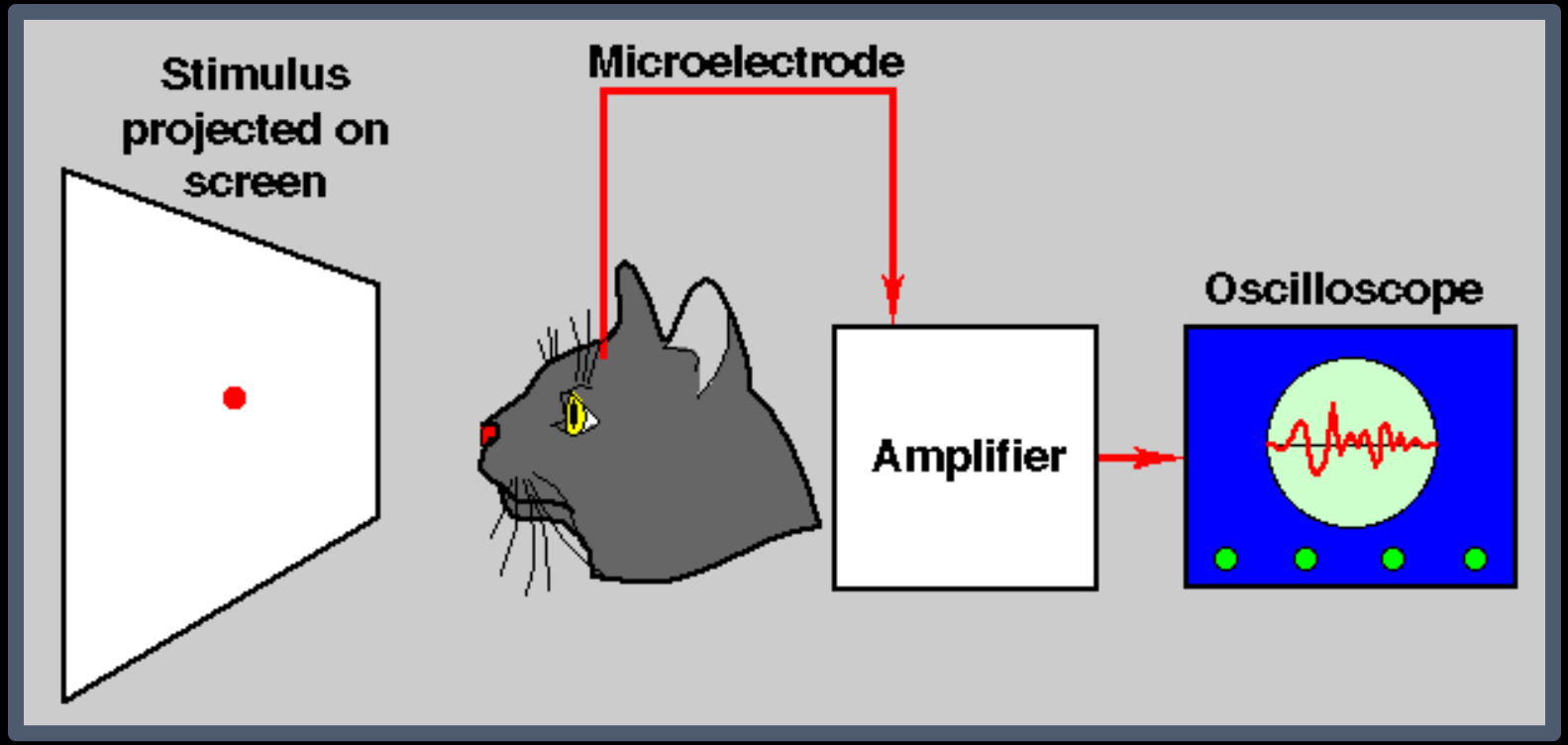
Tootell, Switkes, Silverman, and Hamilton
Functional Anatomy of Macaque Striate Cortex. II: Retinotopic Organization
The Journal of Neuroscience, May 1988

“Log-polar” retinatopic mapping

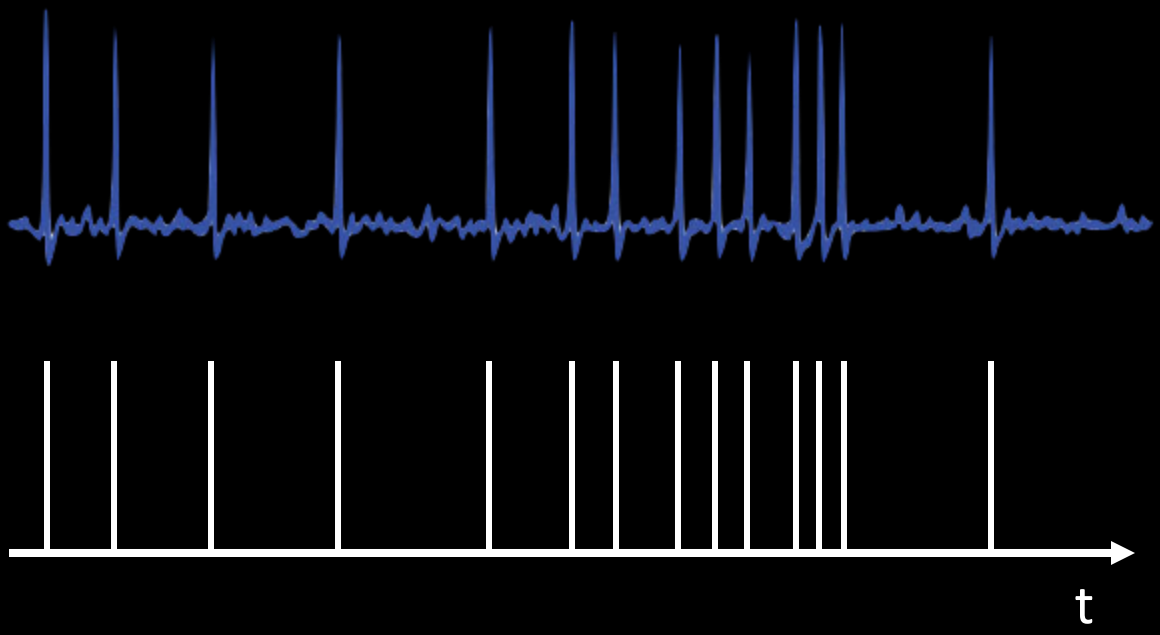




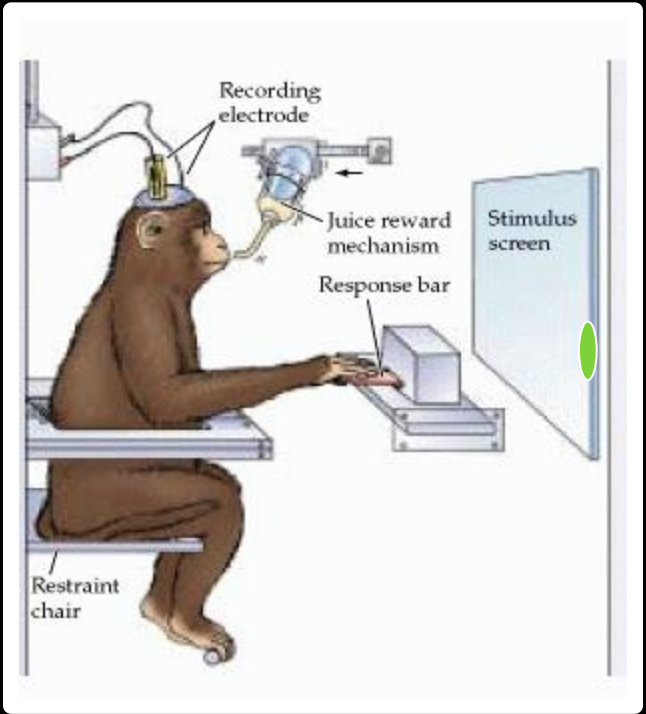
Physiological Recording



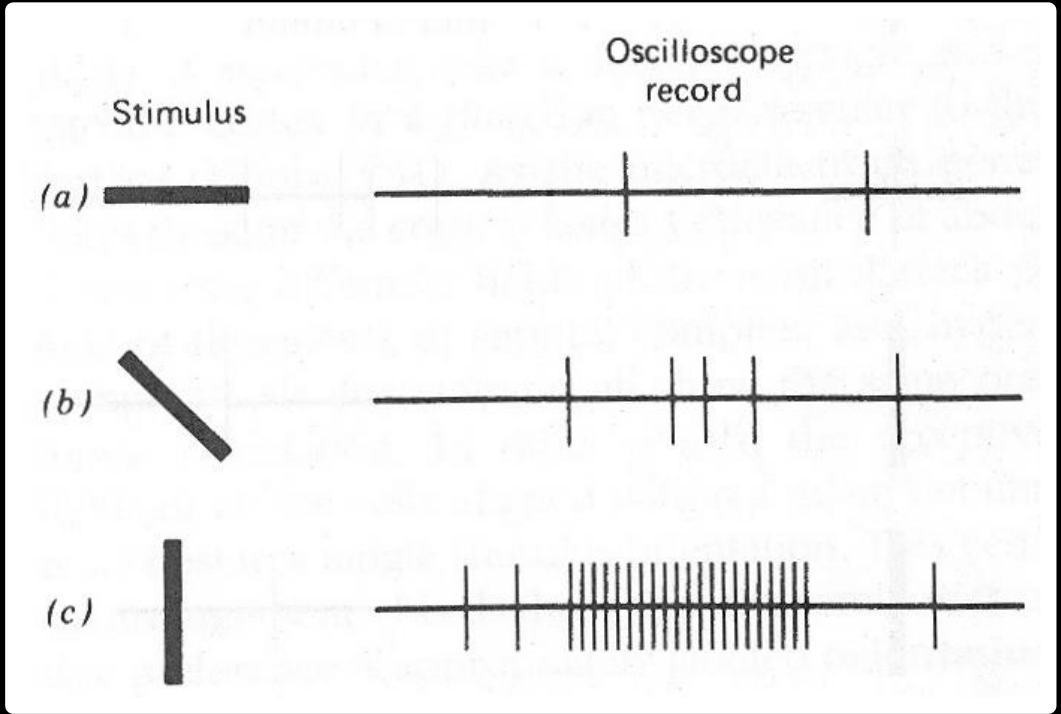
Recording from a Neuron



V1: Orientation Selectivity

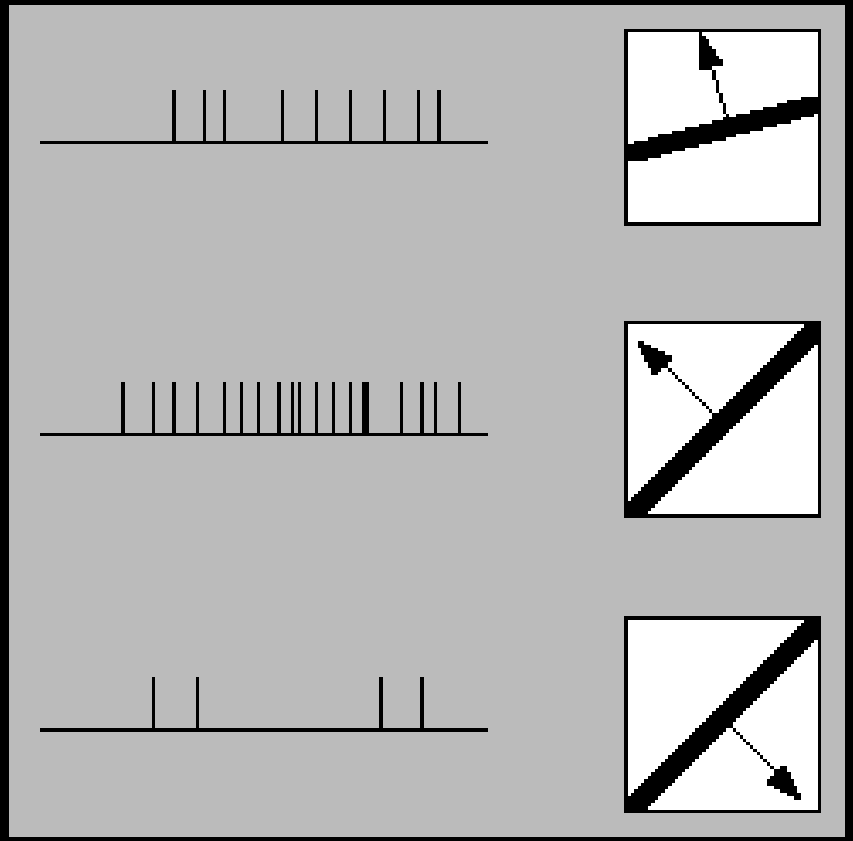


Receptive field

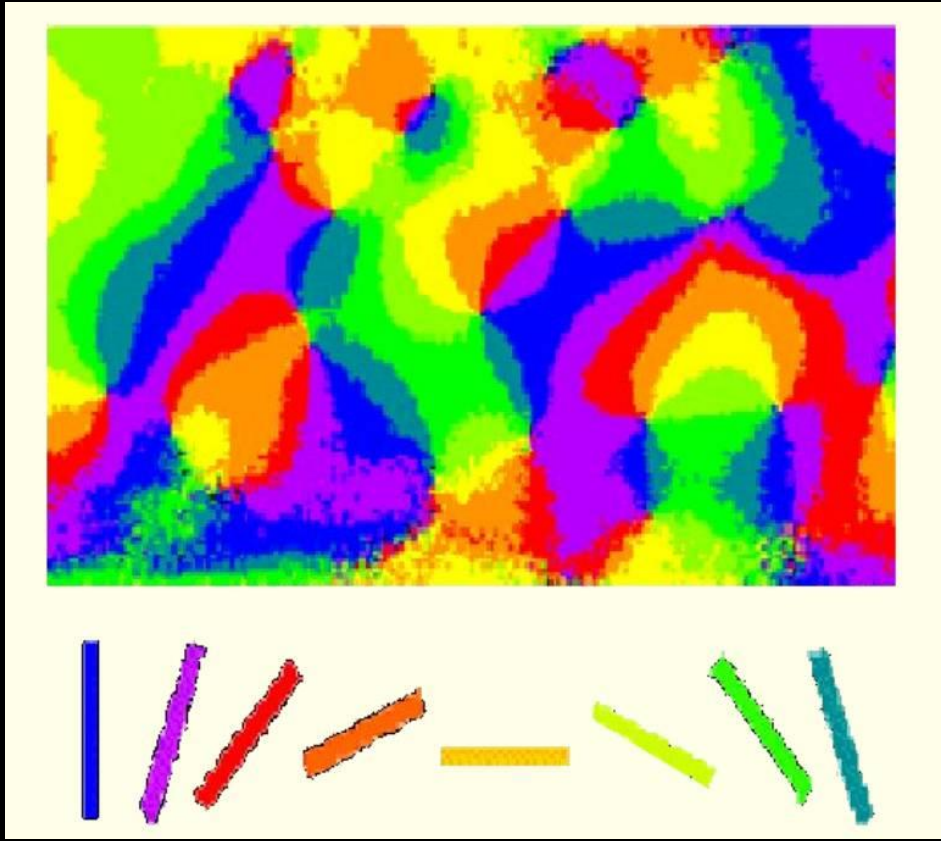


Orientation selectivity

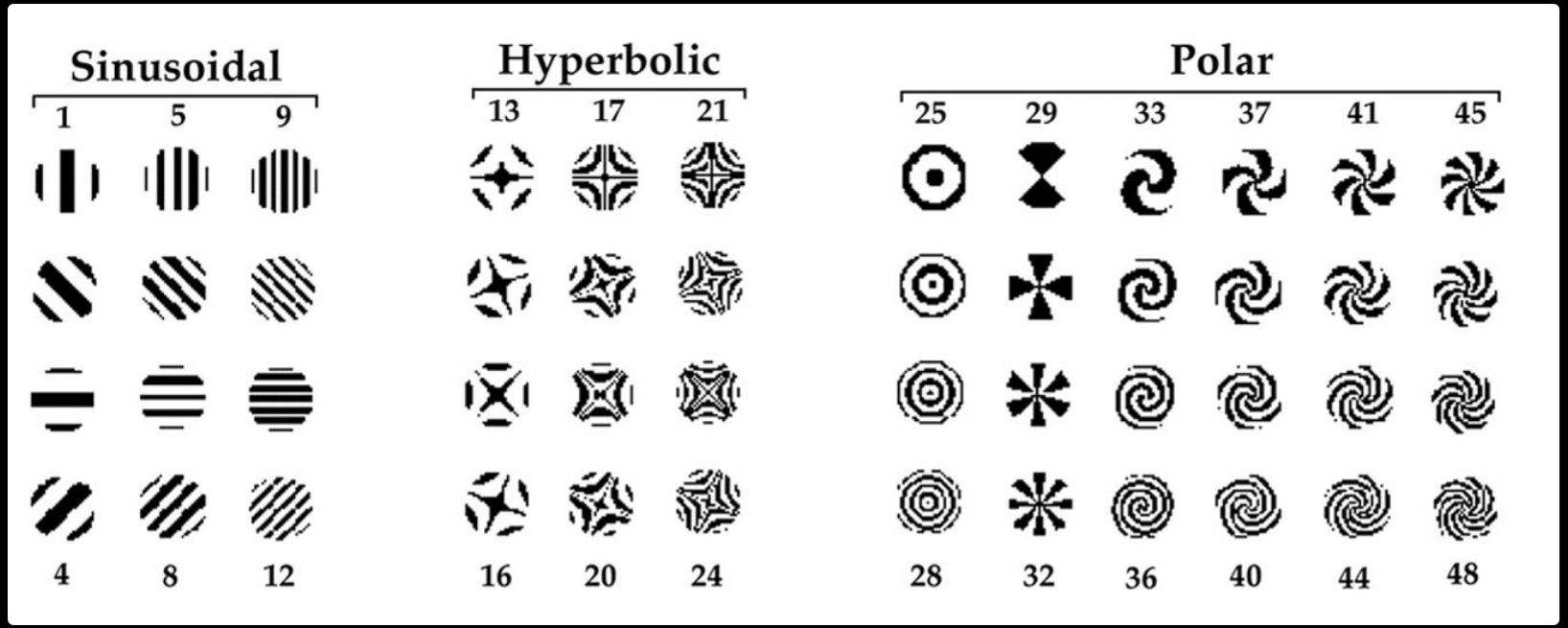
V1: Direction selectivity



Orientation Map, Optical Recording



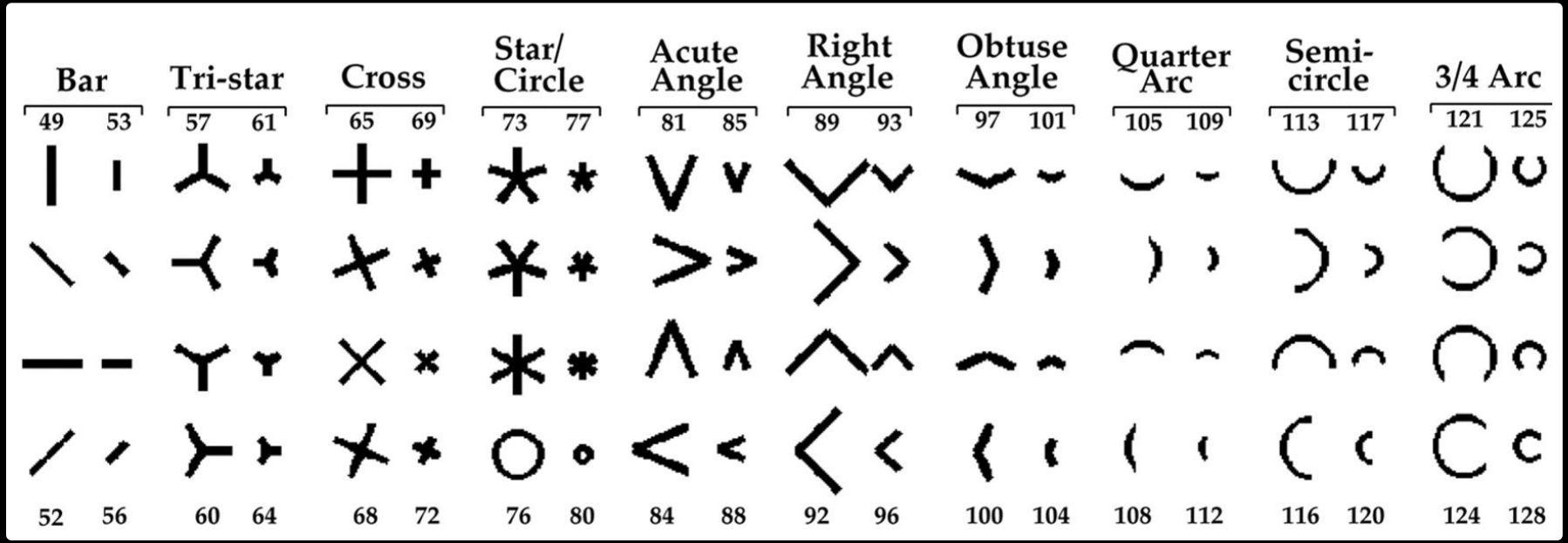
Hunting for features in V2



Temporal Dynamics of Shape Analysis in Macaque Visual Area V2

Hegdé and Van Essen; J Neurophysiology 2004

Hunting for features in V2



Temporal Dynamics of Shape Analysis in Macaque Visual Area V2

Hegdé and Van Essen; J Neurophysiology 2004

Increasing complexity

Inferotemporal cortex
Features

K. Tanaka,
Neuronal Mechanisms of Object Recognition
Science, 1993

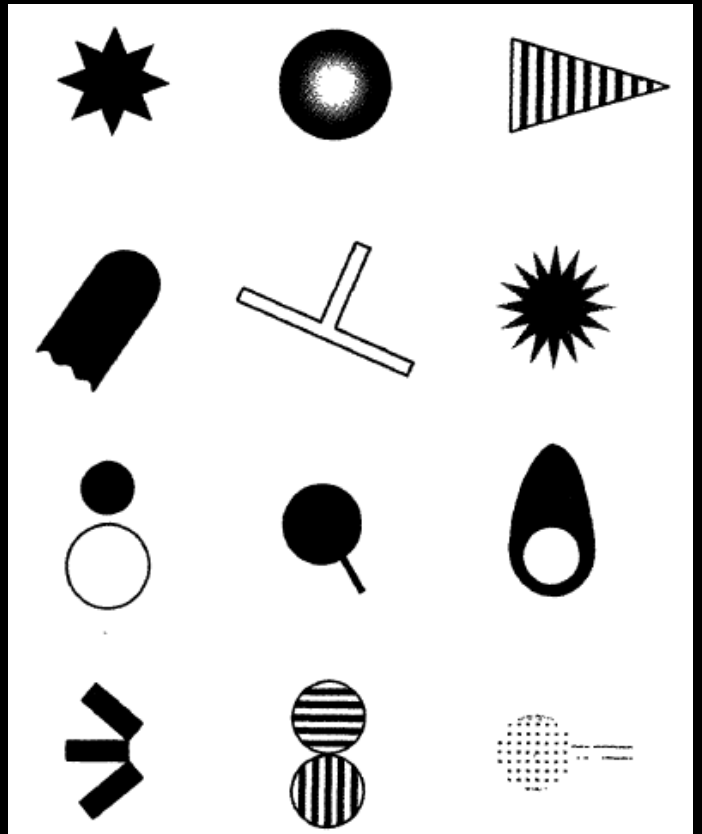
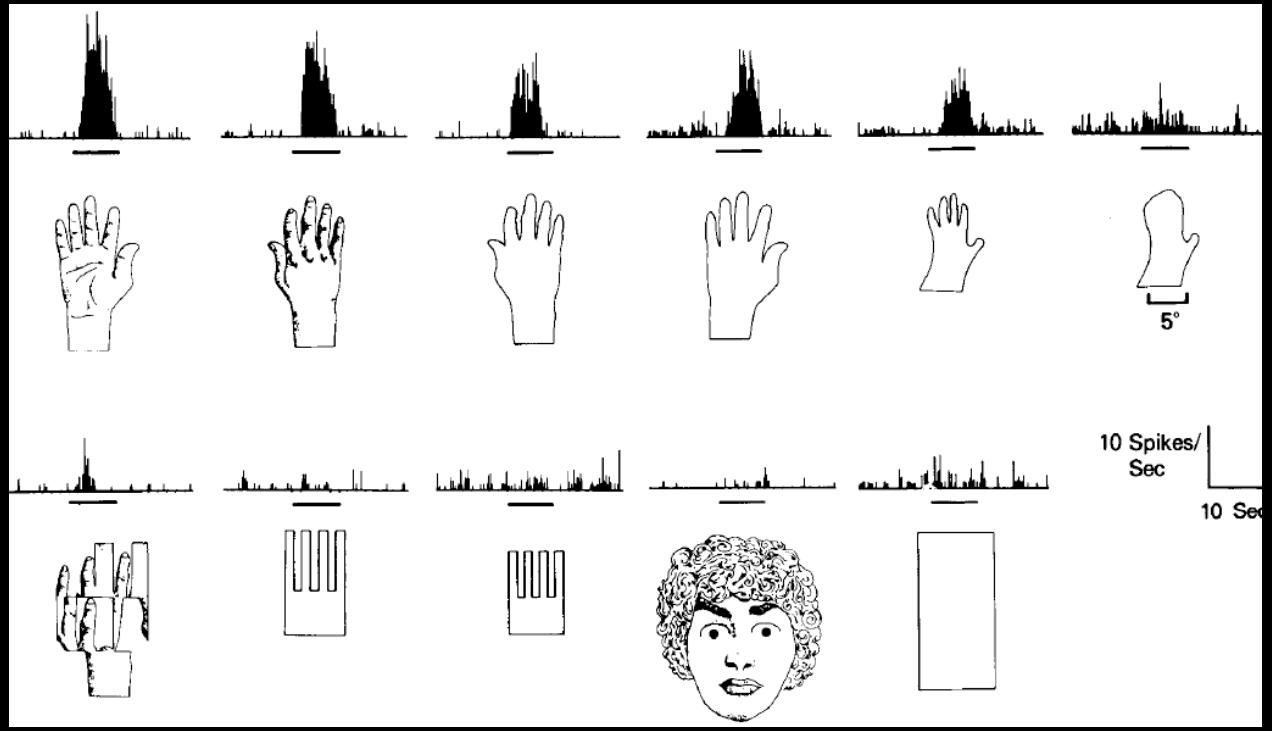


Fig. 2. Twelve examples of the critical features for the activation of single cells in area TE.

SCIENCE • VOL. 262 • 29 OCTOBER 1993

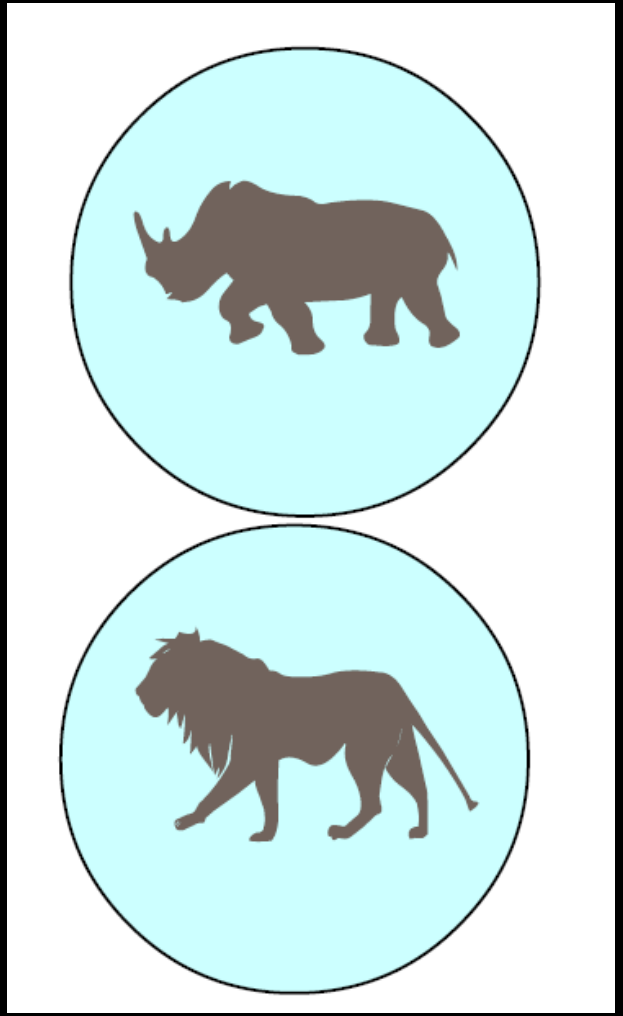
‘Hand neuron’ in area IT

Desimone, Albright, Gross and Bruce *Stimulus-selective properties of inferior temporal neurons in the macaque.* J Neurosci. 1984



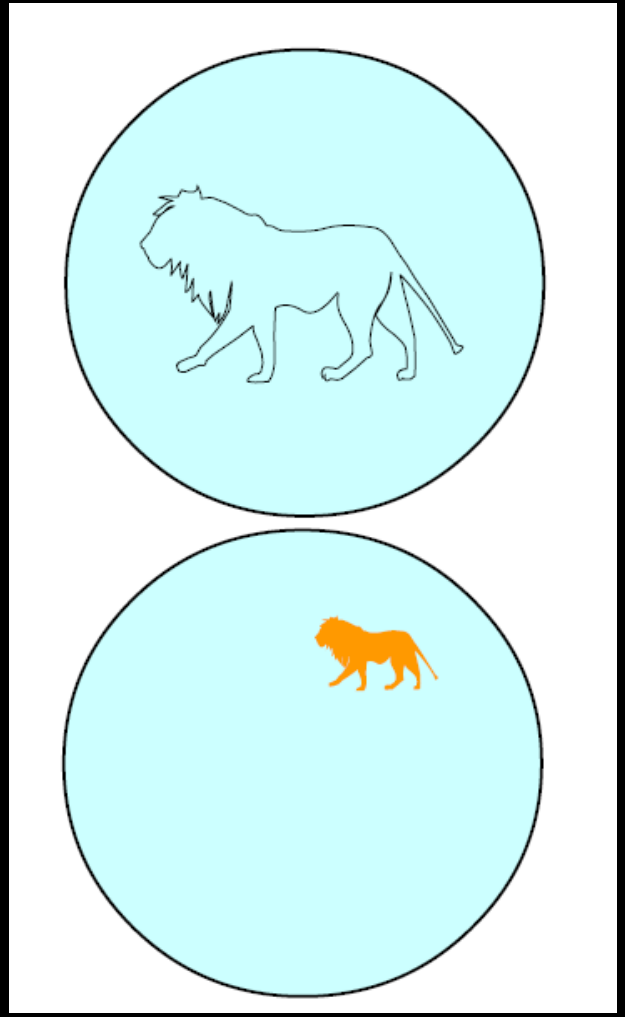
Some images look somewhat similar but represent different things

These fire **similar** cells in **V1** but **different** cells in **IT**.



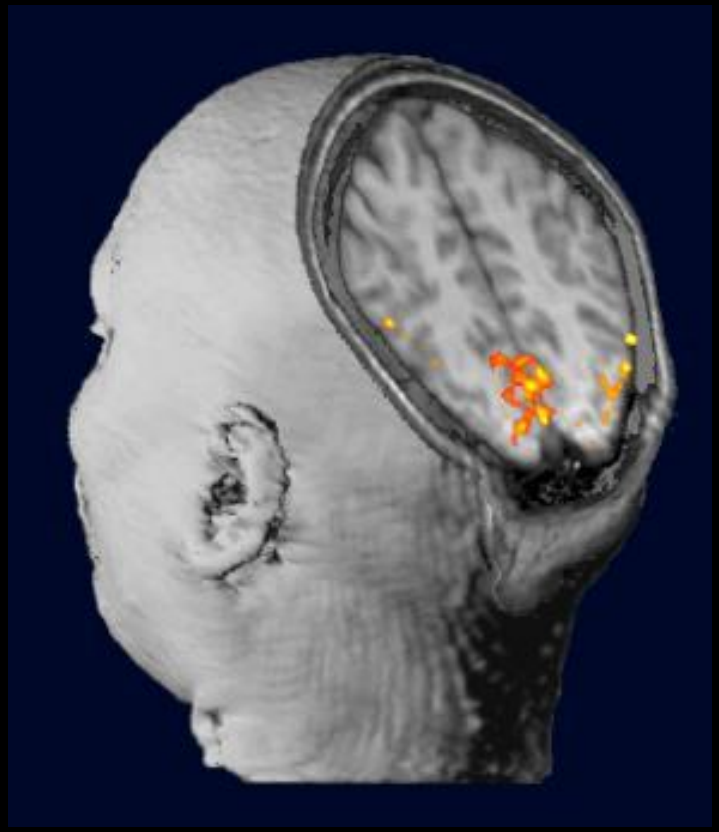
Other images **look very different** but are the **same thing**.

These fire very **different** cells in **V1** but the **same** cells in **inferior temporal** cortex.

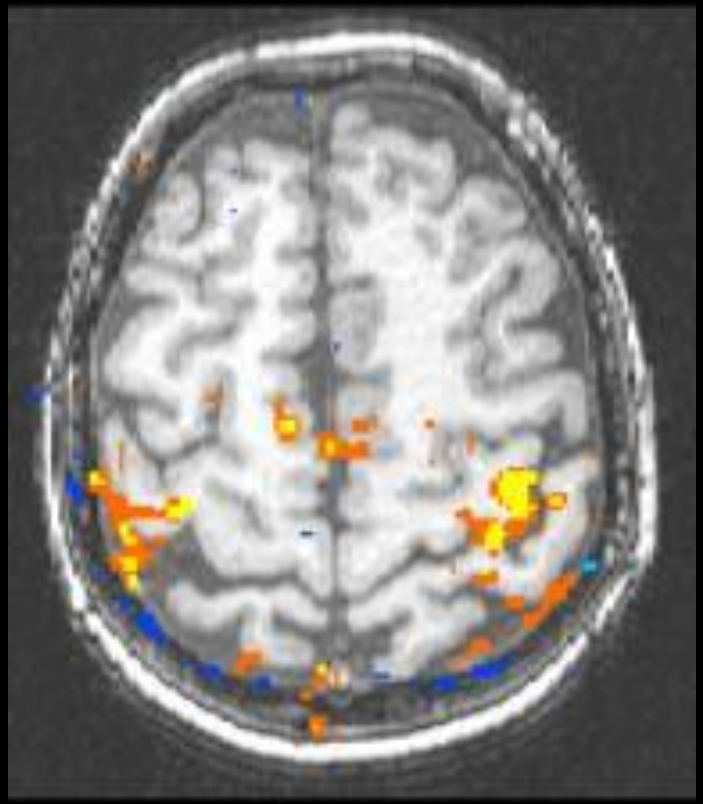


fMRI Magnet

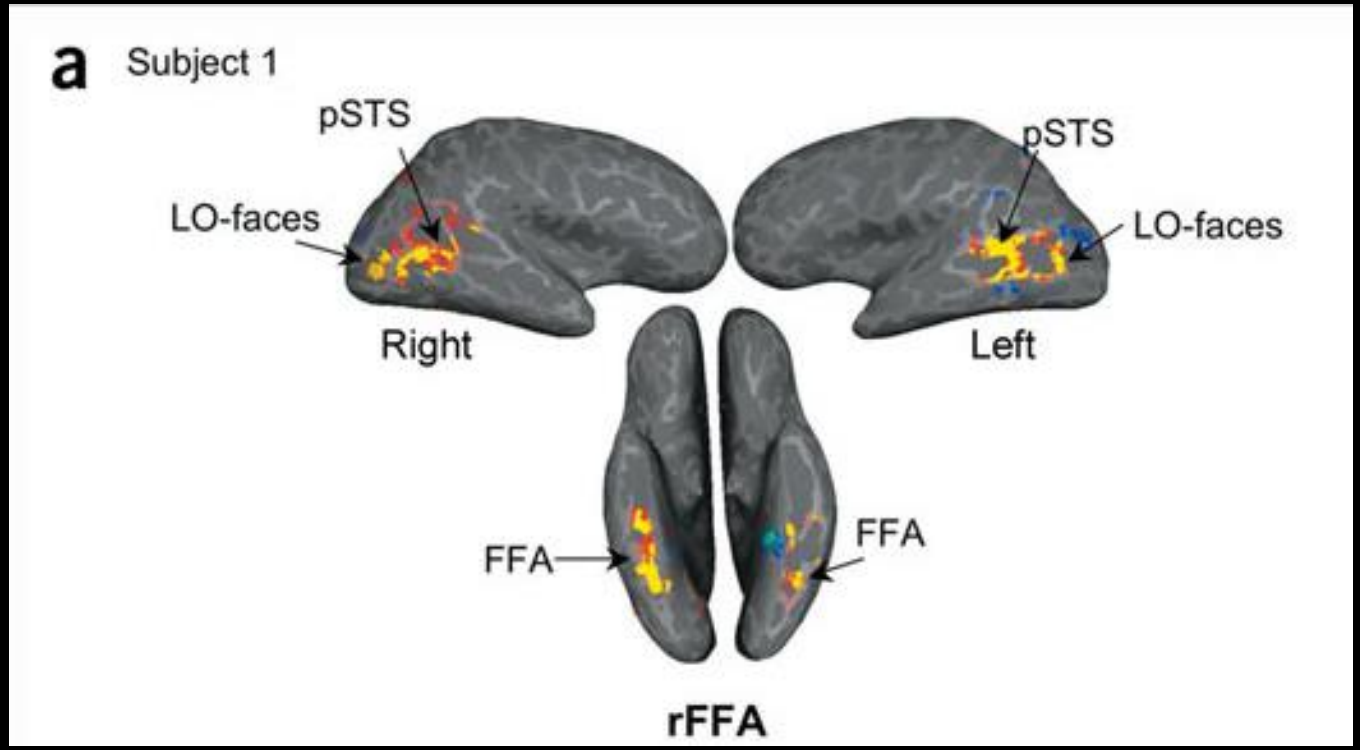
fMRI Activation



fMRI Activation Slice



FFA

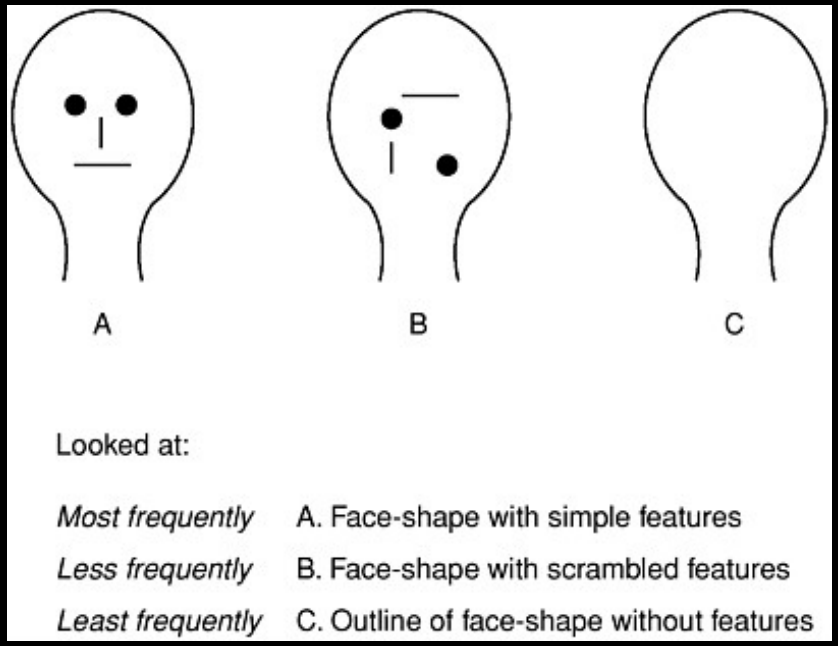


Kalanit Grill-Spector, Nicholas Knouf & Nancy Kanwisher

The fusiform face area subserves face perception, not generic within-category identification

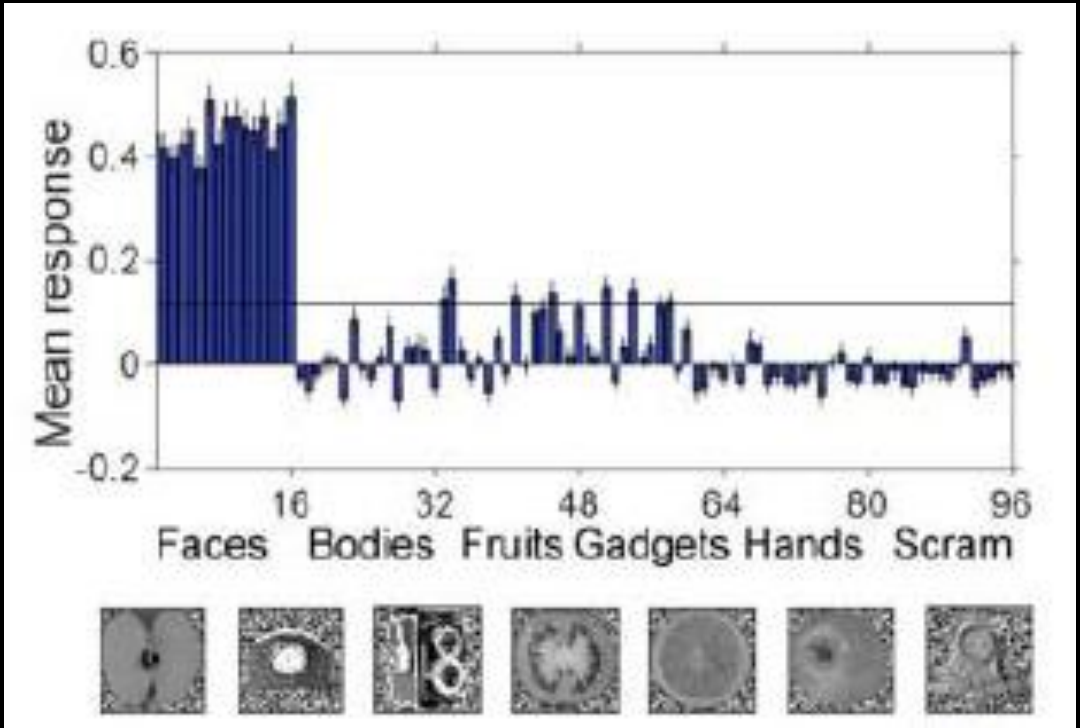
Nature Neuroscience 7, 555 - 562 (2004)

Faces are special: Early preference for faces?



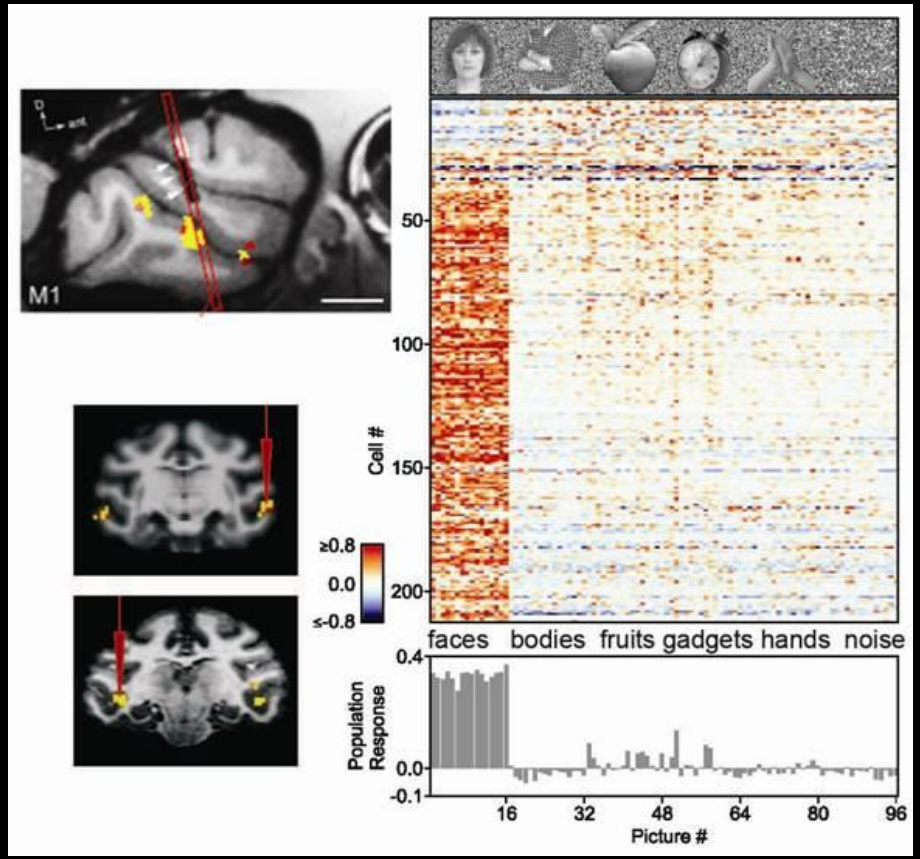
Neonates and infants prefer faces from the first minutes of life

Face-selective Responses

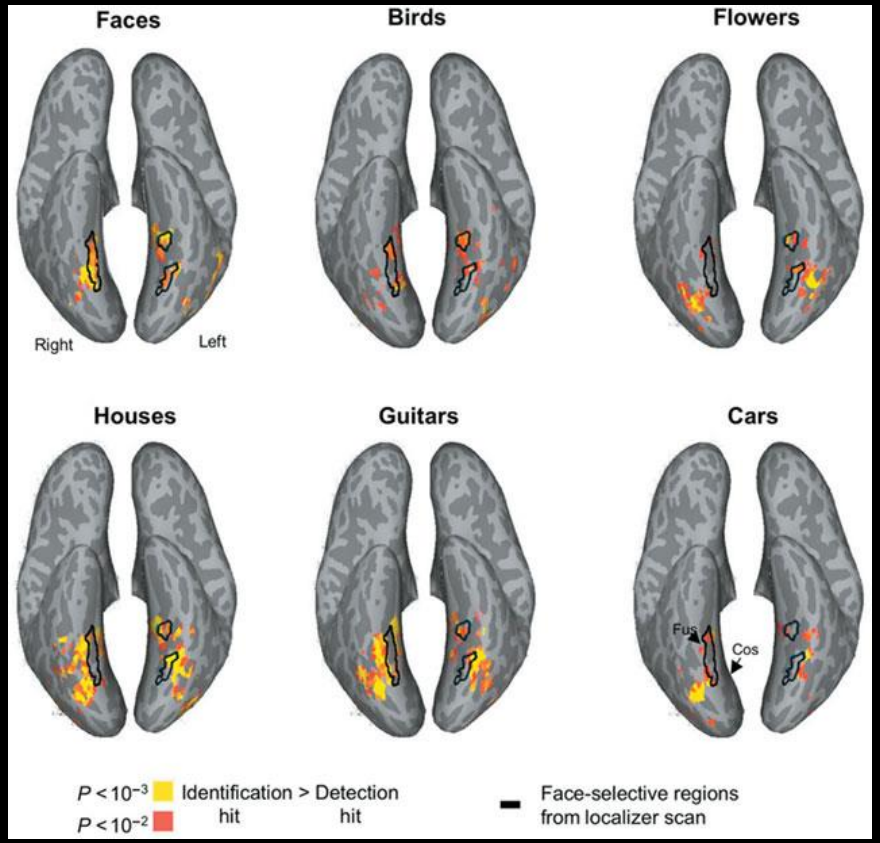


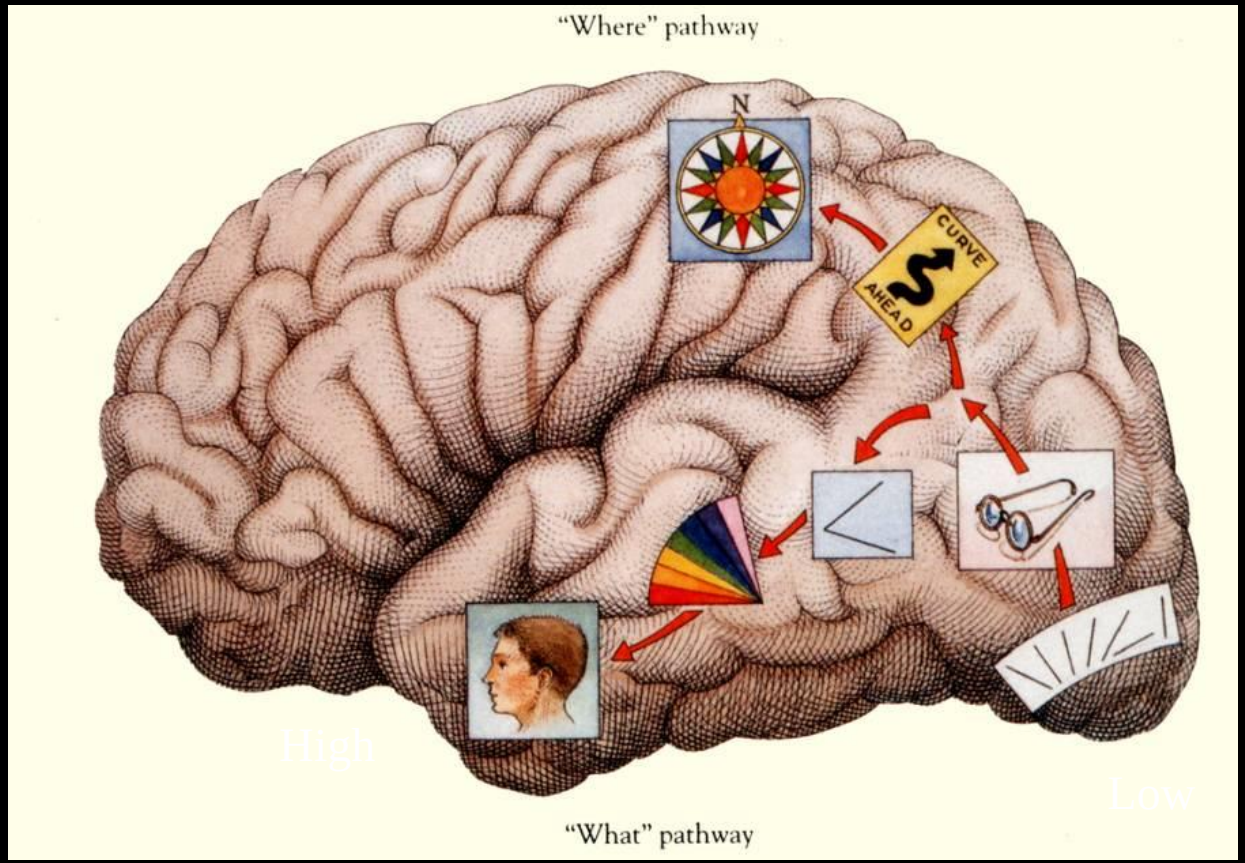
Cell responses to 96 images, 16 of them faces

All cells in this small area respond to faces



And more object specific areas

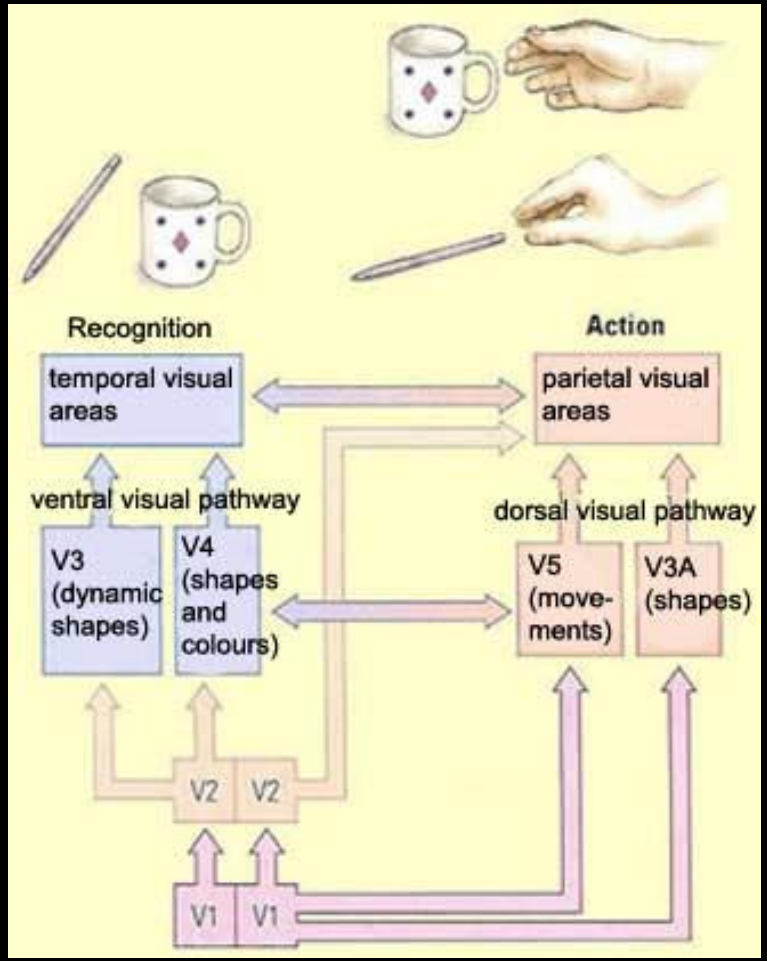




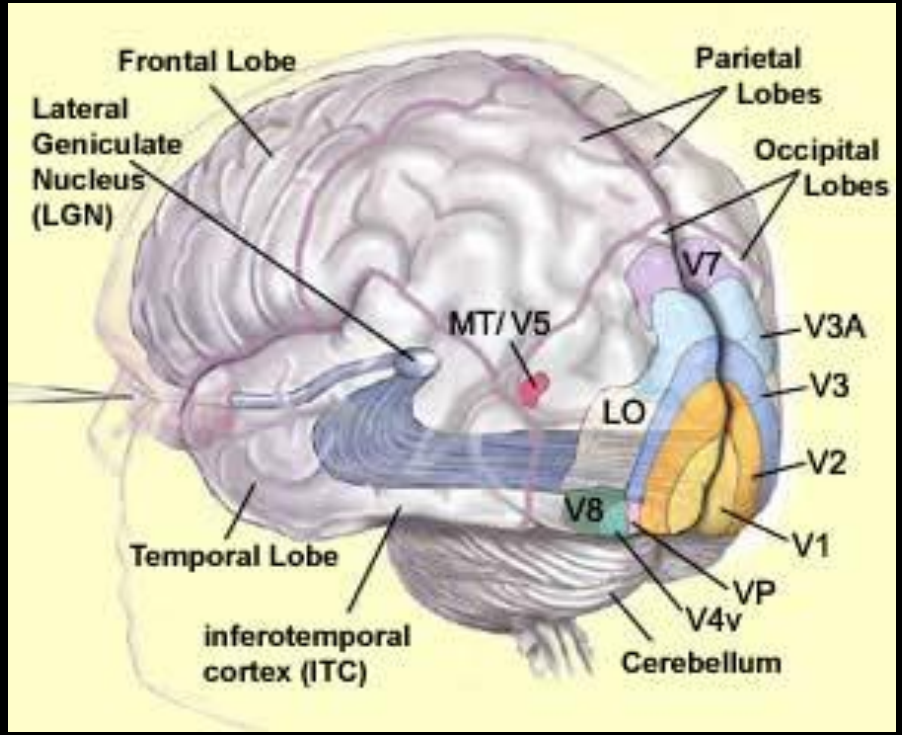
From ‘low’ to ‘high-level’ vision

More pathways

The two visual streams



MT: Motion area

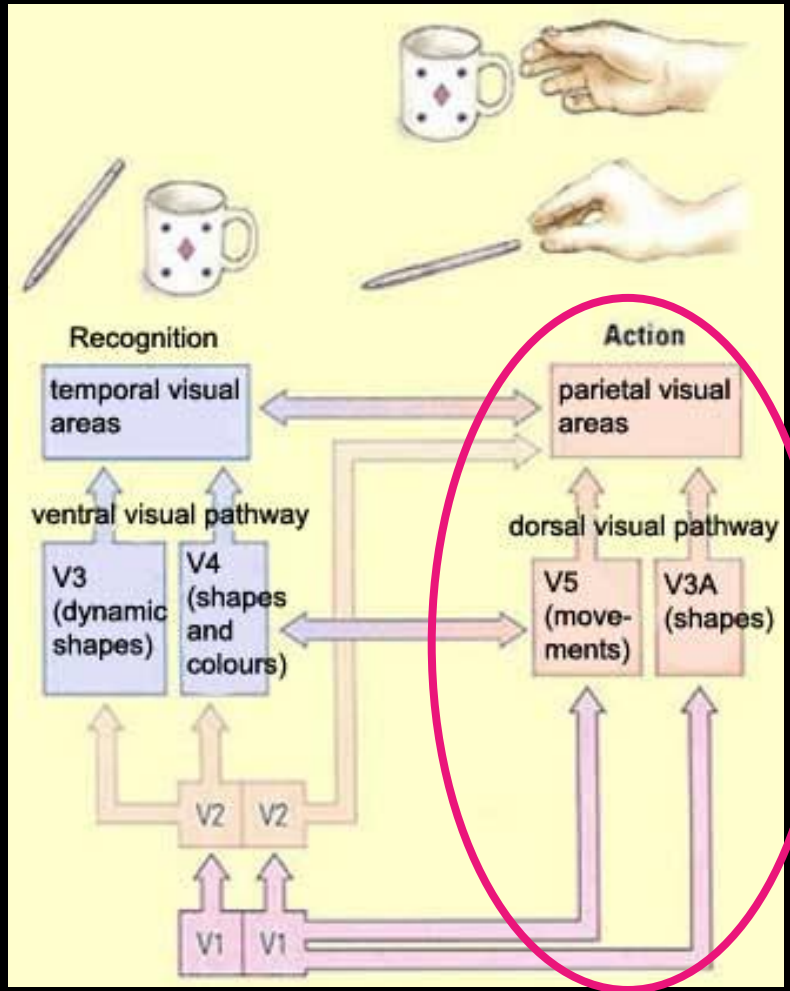


Visual area MT – specializing in visual motion

MT motion blindness

Gisela Leibold -- Unable to see motion, feels anxious as she rides down an escalator in Munich.

She could not cross a street, because the motion of cars was invisible to her: a car was up the street and then upon her, without ever seeming to occupy the intervening space.


Recognition
Action
temporal visual areas
parietal visual areas
ventral visual pathway
dorsal visual pathway
V3 (dynamic shapes)
V4 (shapes and colours)
V5 (move-ments)
V3A (shapes)
V2
V2
V1
V1

Fin