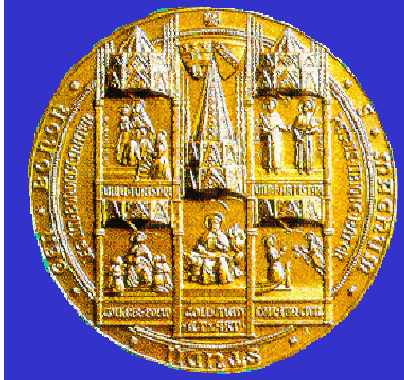


Department of Human and General
Physiology
University of Bologna, Italy

European Union Commission

FP7-ICT- 217077-EYESHOTS

Kick-off meeting

Bologna, 7-8 March 2008

Joint visuo-motor features in the parietal cortex

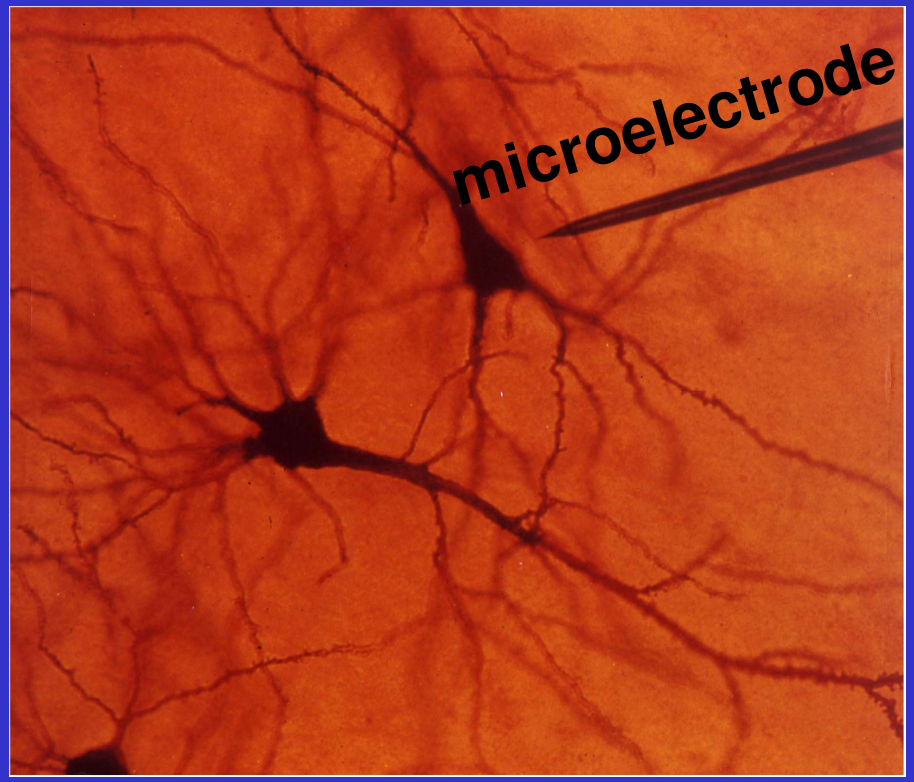
Patrizia Fattori, Michela Gamberini, Rossella Breveglieri,
Nicoletta Marzocchi, Claudio Galletti

UNIBO expertise:
experimental (neurophysiological) approach to the link between perception and action

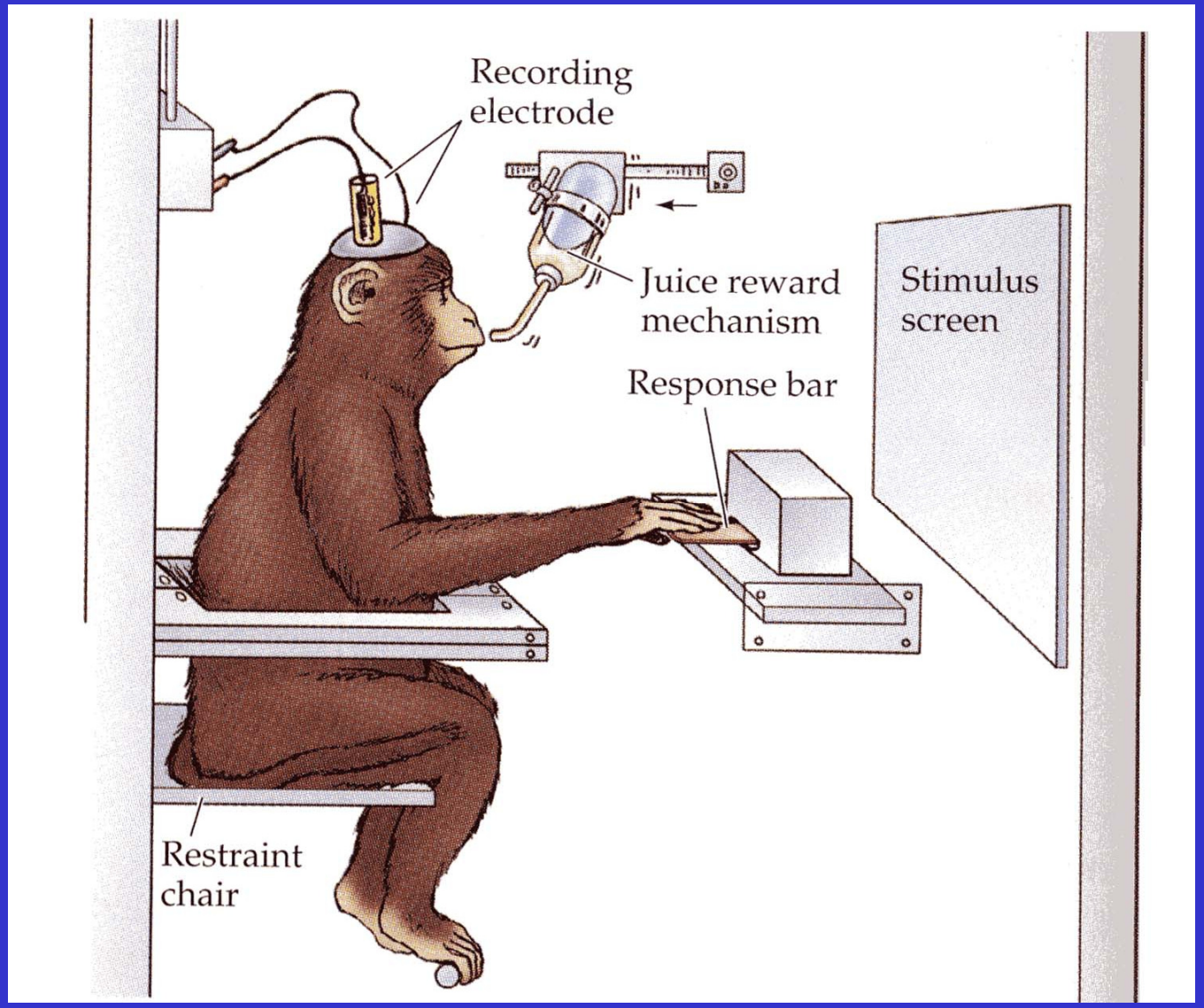
Main goal:
experimental characterization of the neural correlates of multisensory 3D representation, in order to provide architectural guidelines for the production of biologically-inspired artificial intelligence systems able to interact with the 3D world

Single cell recording

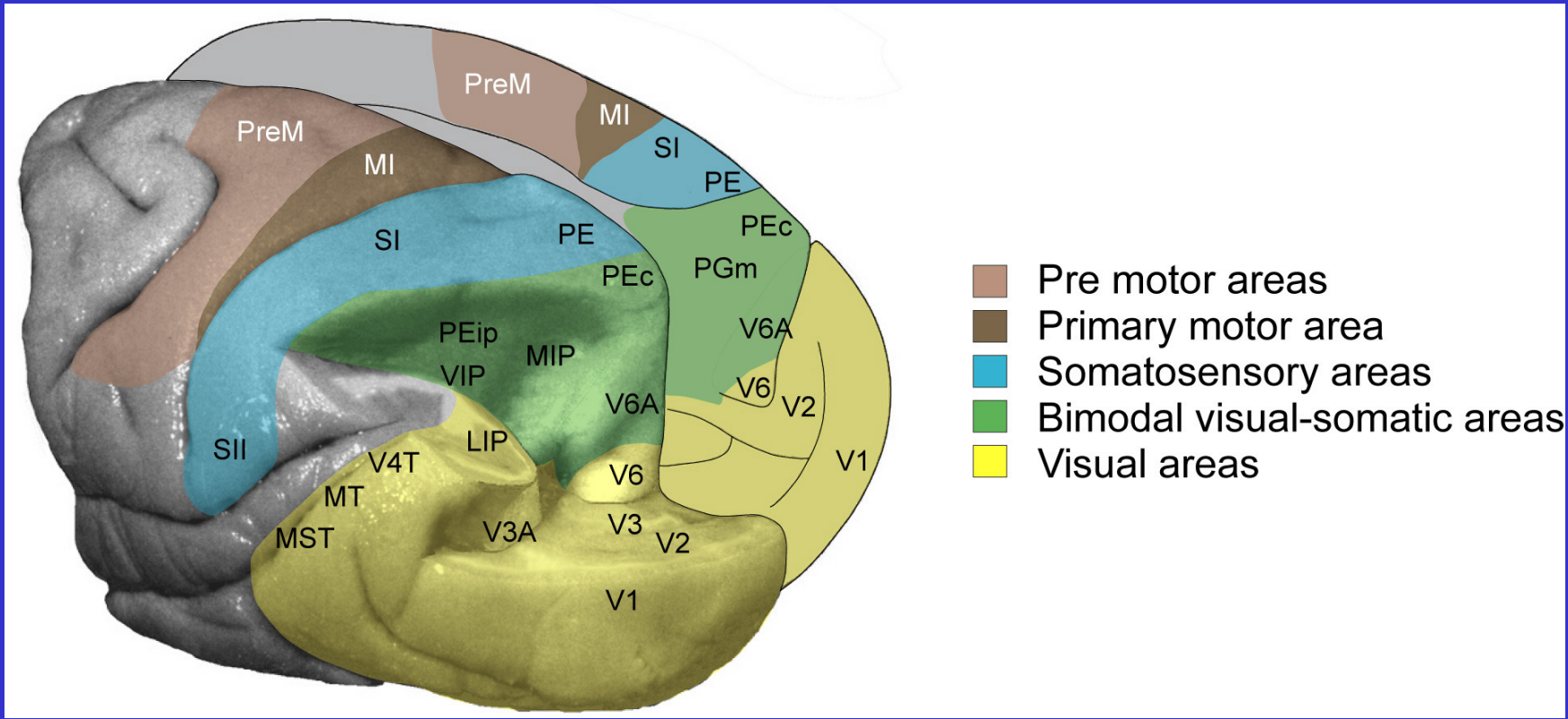
Extracellular recording



Behavioural neurophysiology

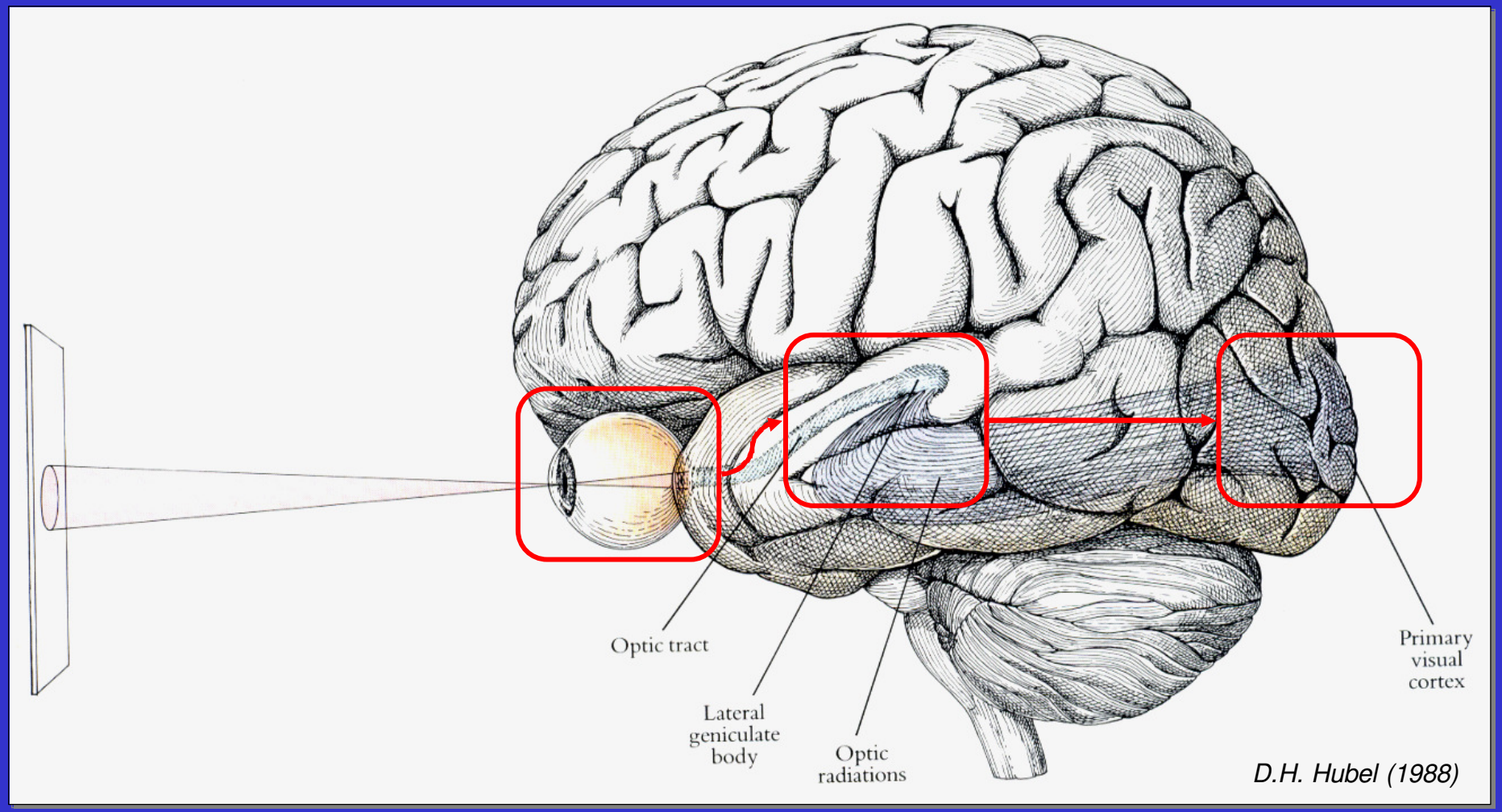


The brain region of our interest: the medial parieto-occipital cortex



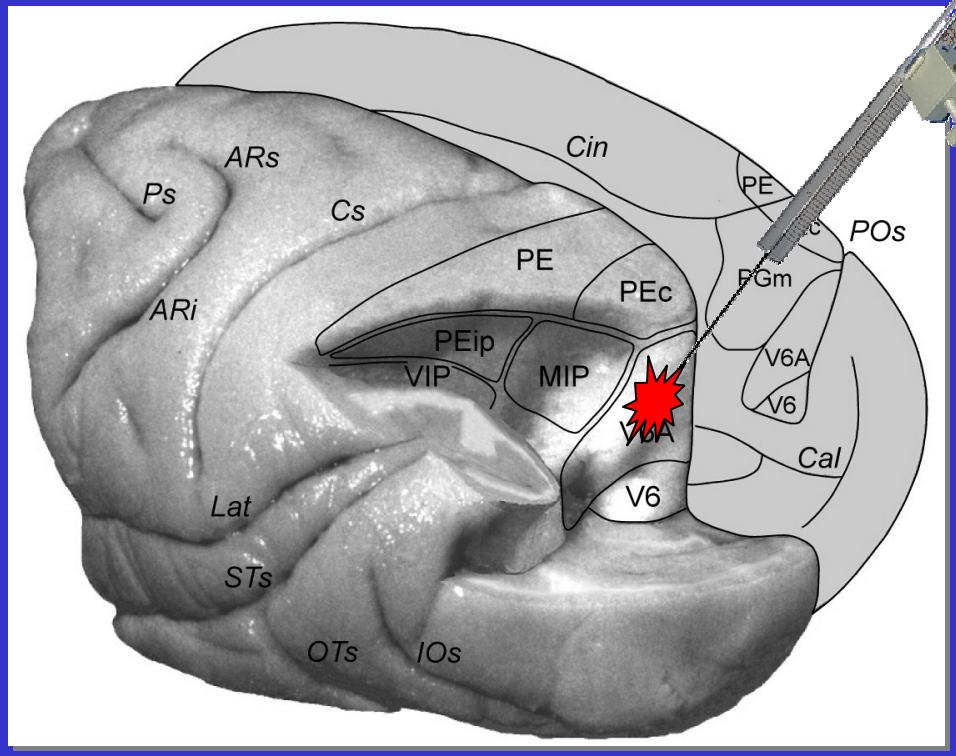
- Study of neuronal circuits involved in the process of visuo-motor integration

- Reconstruction of the region of interest and localization of neurons studied

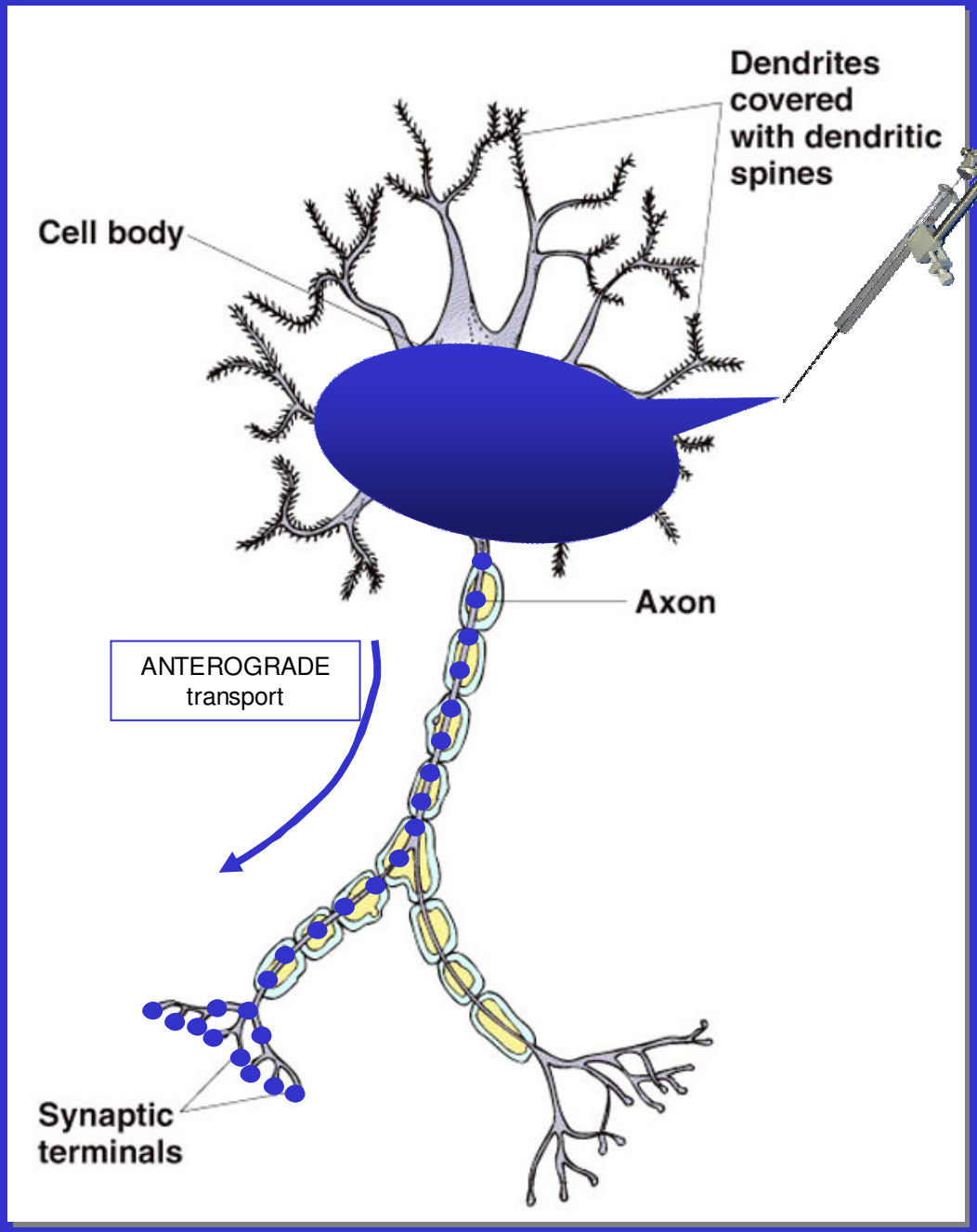


D.H. Hubel (1988)

Neuronal tracer injections

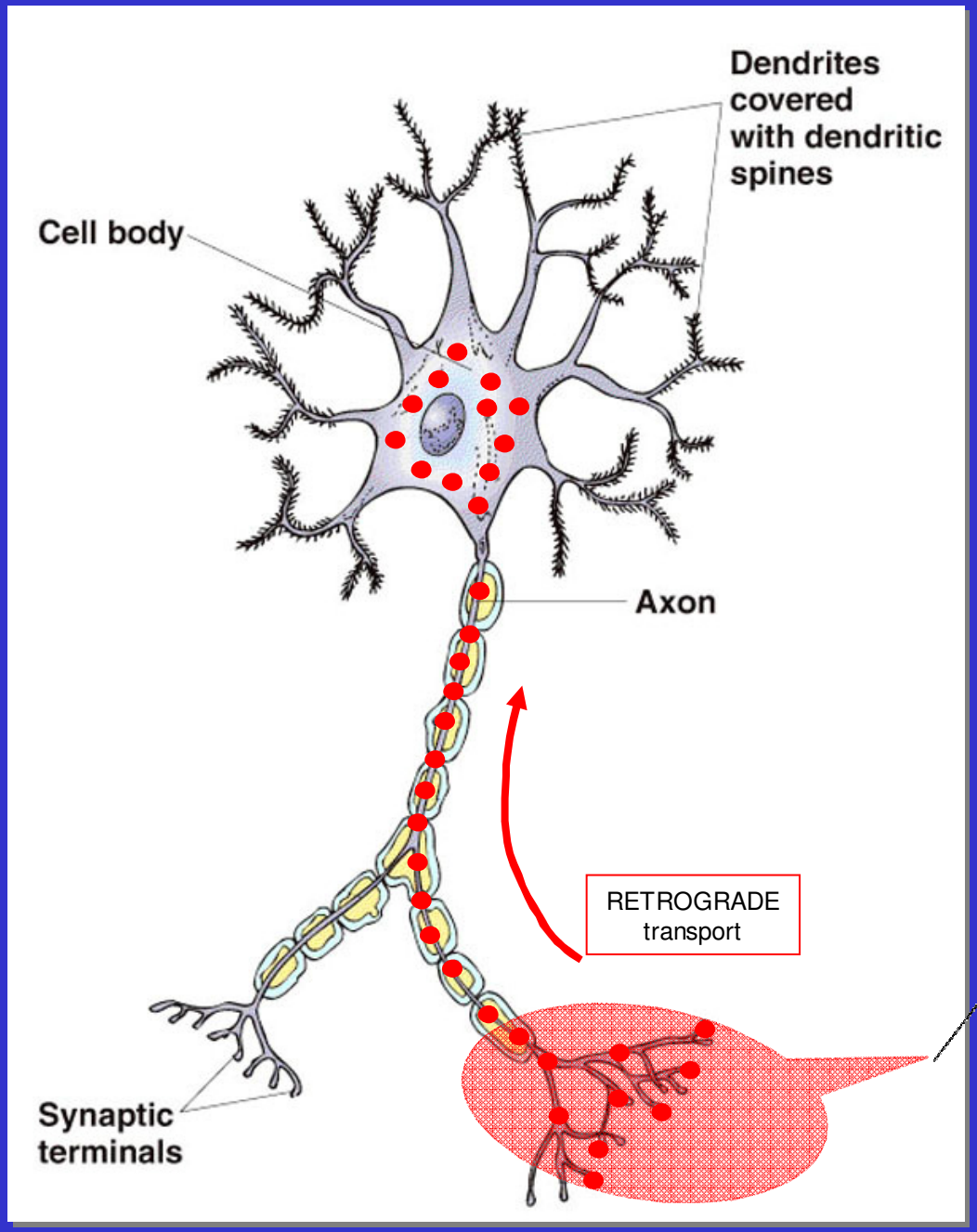


Neuron



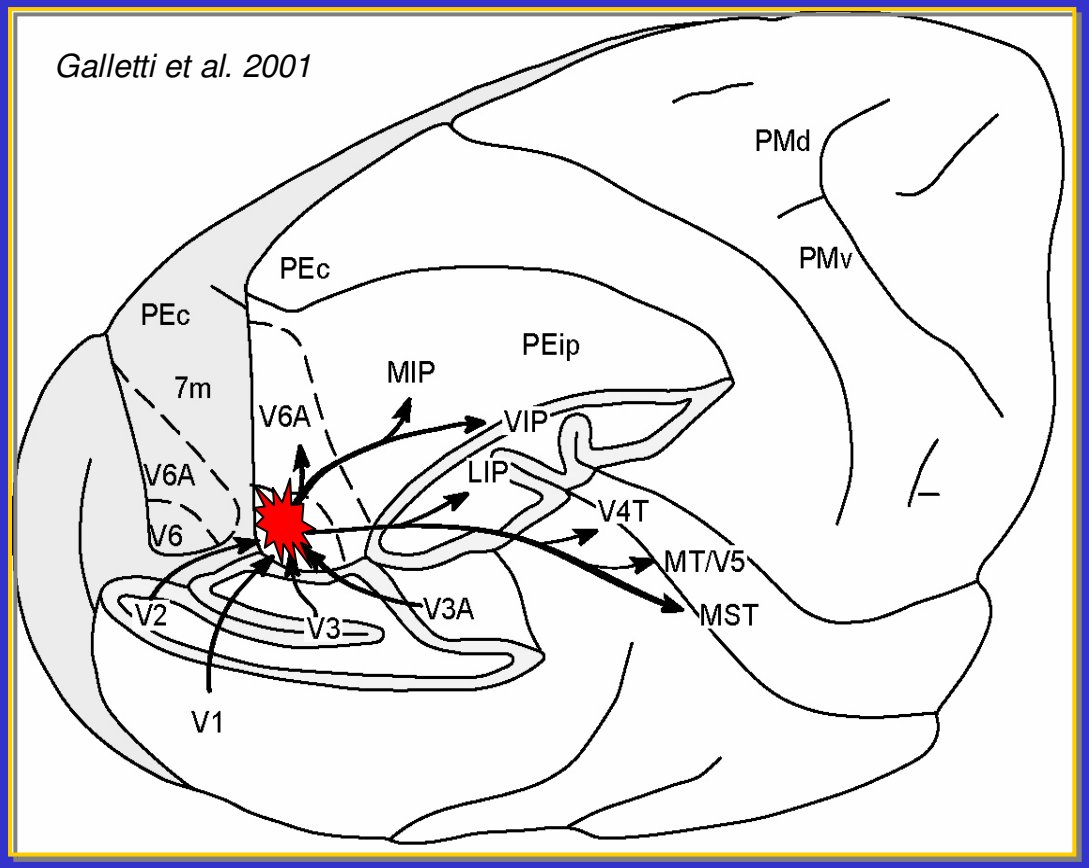
ANTEROGRADE tracer

Neuron

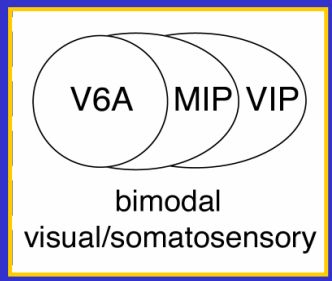


RETROGRADE tracer

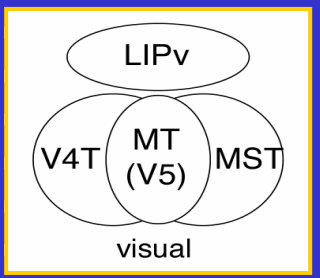
Cortical connection of area V6



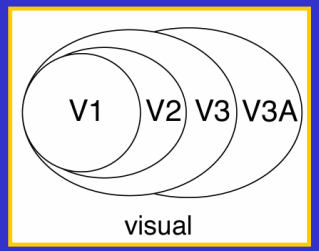
dorso-medial stream (22%)



dorso-lateral stream (30%)

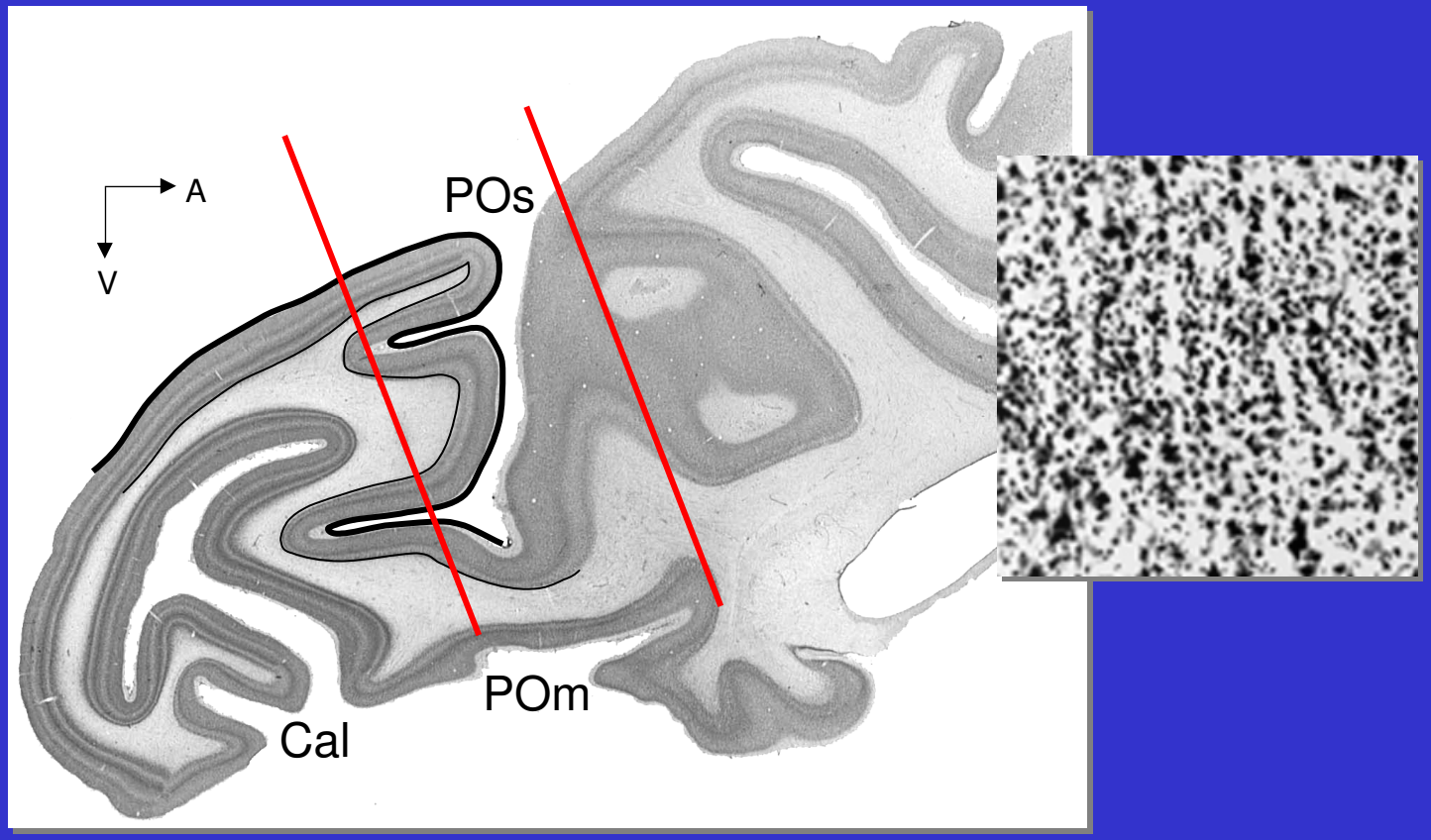


Occipital lobe
(47 %)



V6

Reconstruction of penetration



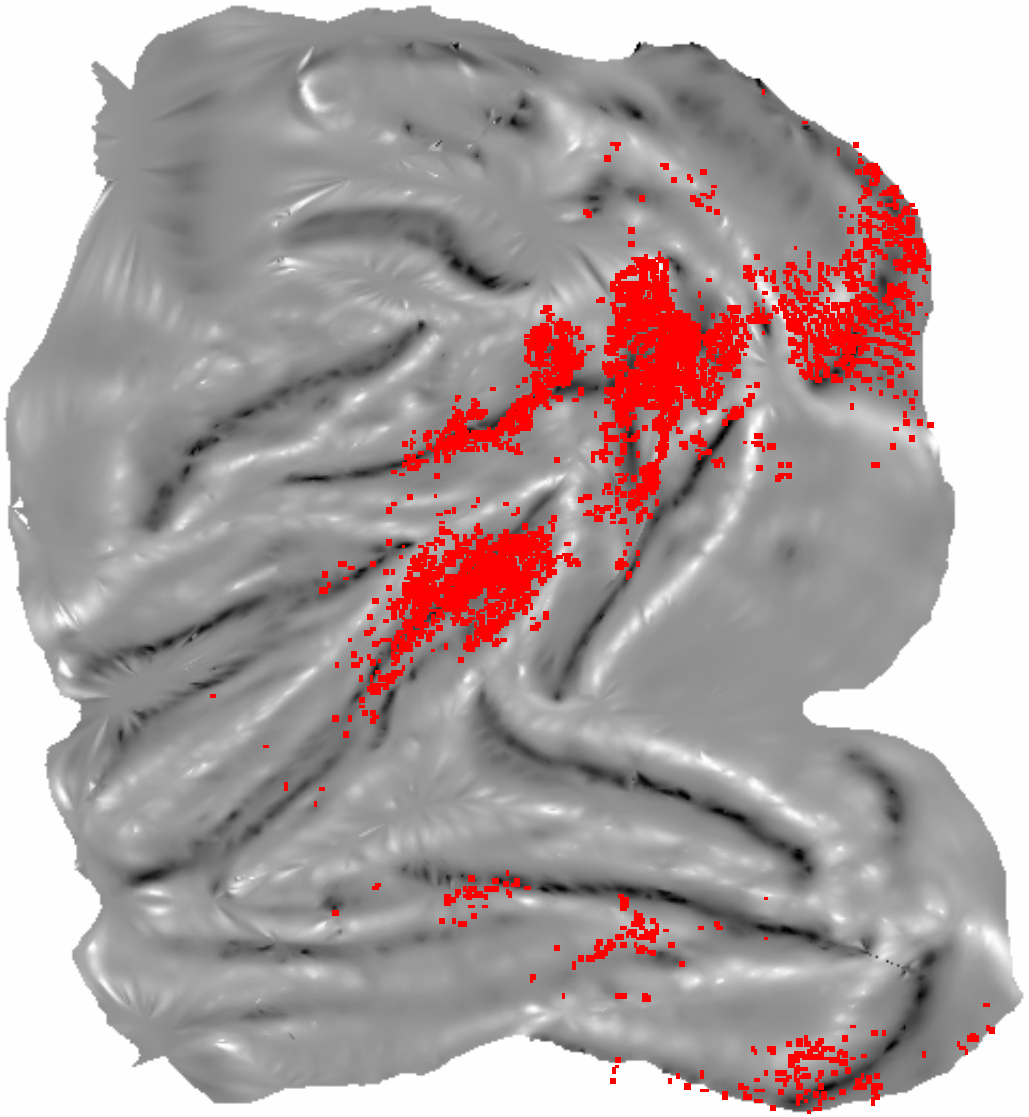
1) Microscopic observation of Nissl stained sections

2) Digitalization of sections

3) Reconstruction of microelectrode tracks

Digital 2D-3D reconstructions

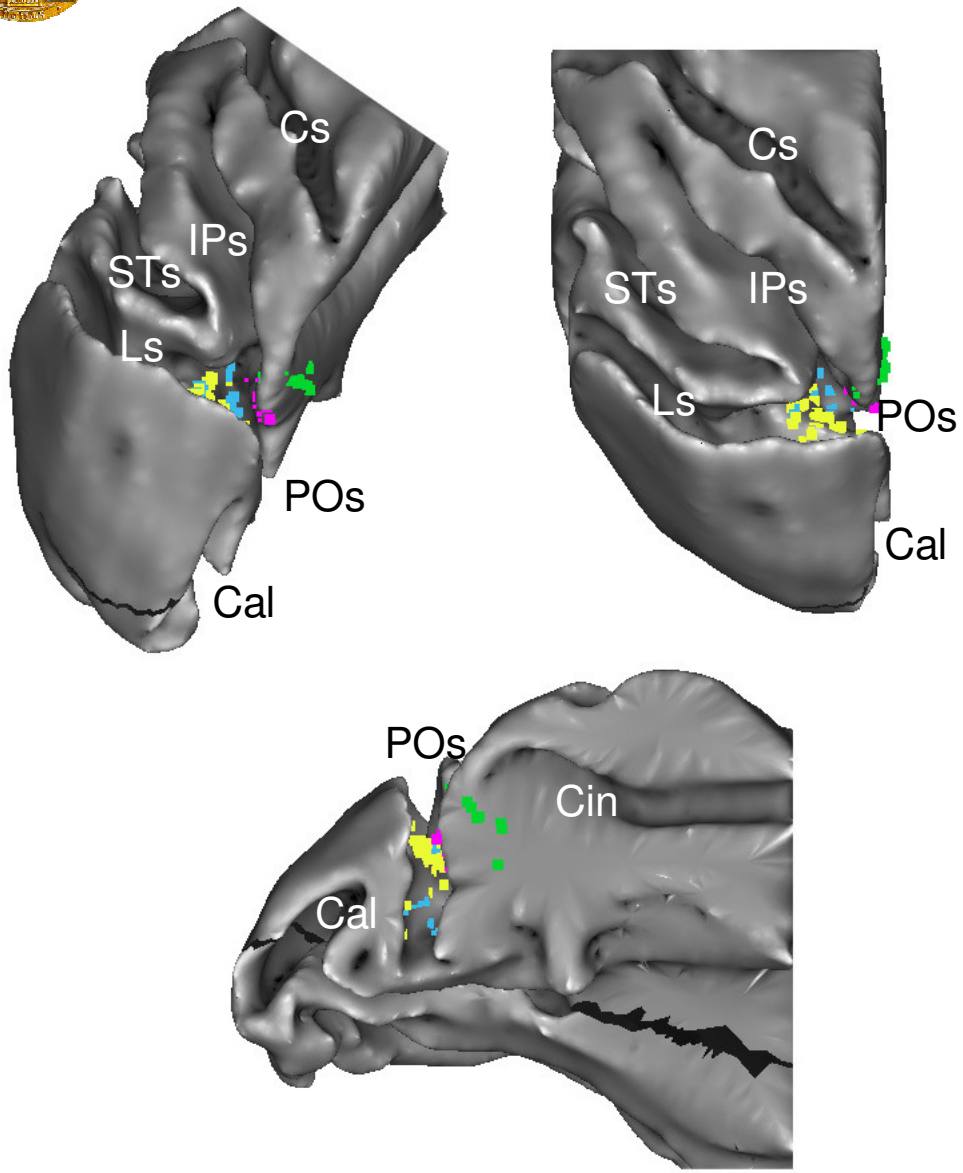
QuickTime™ e un
decompressore Video
sono necessari per visualizzare quest'immagine.



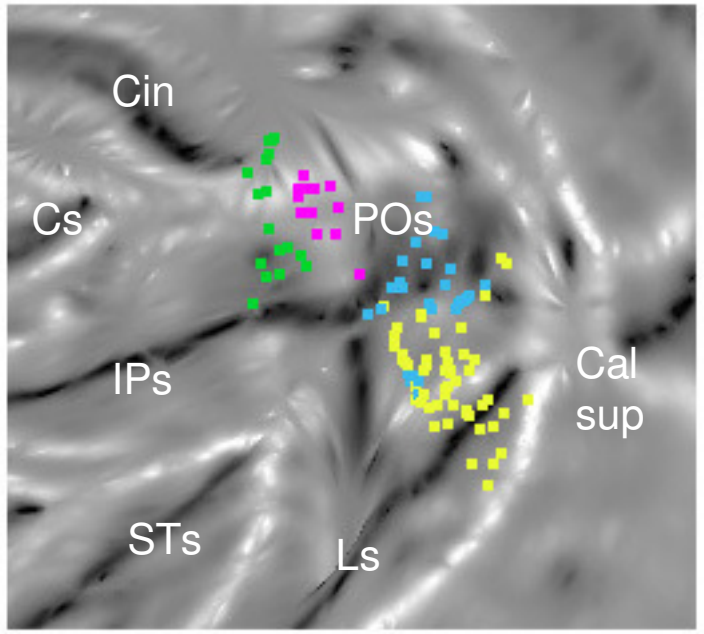
Retrograde labeled cells

Anatomical data

Functional data



Galletti et al. 2005



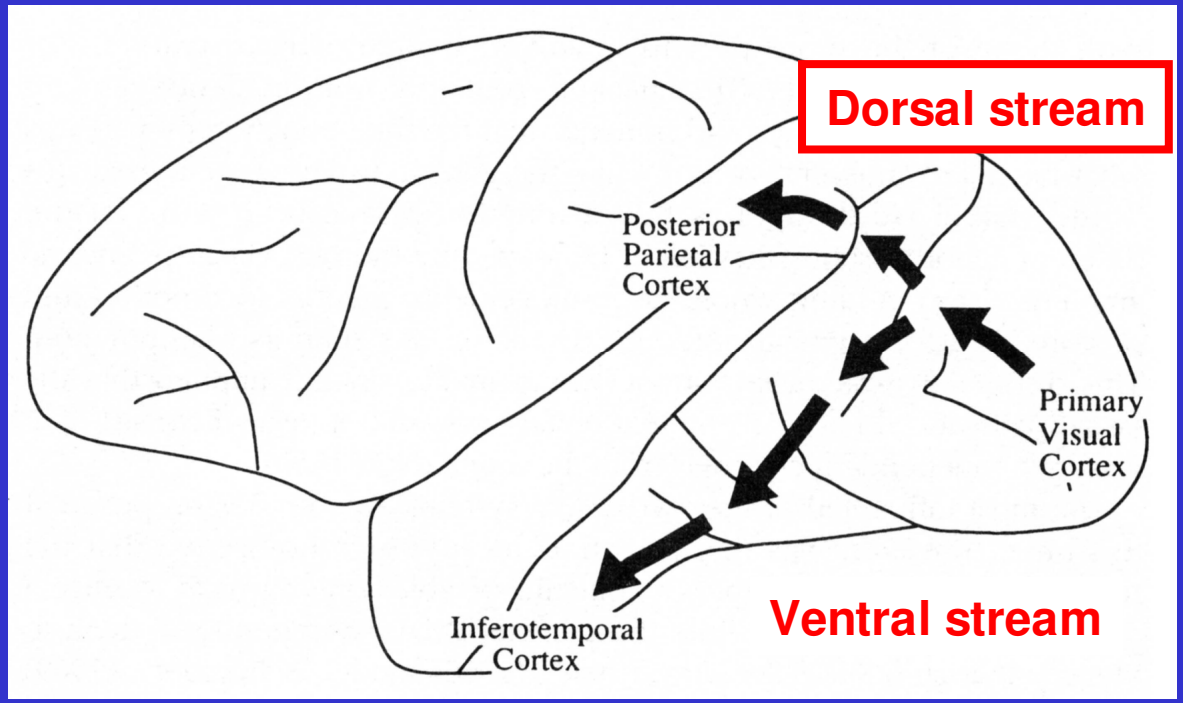
V6A cells

V6 cells

V2/V3 cells

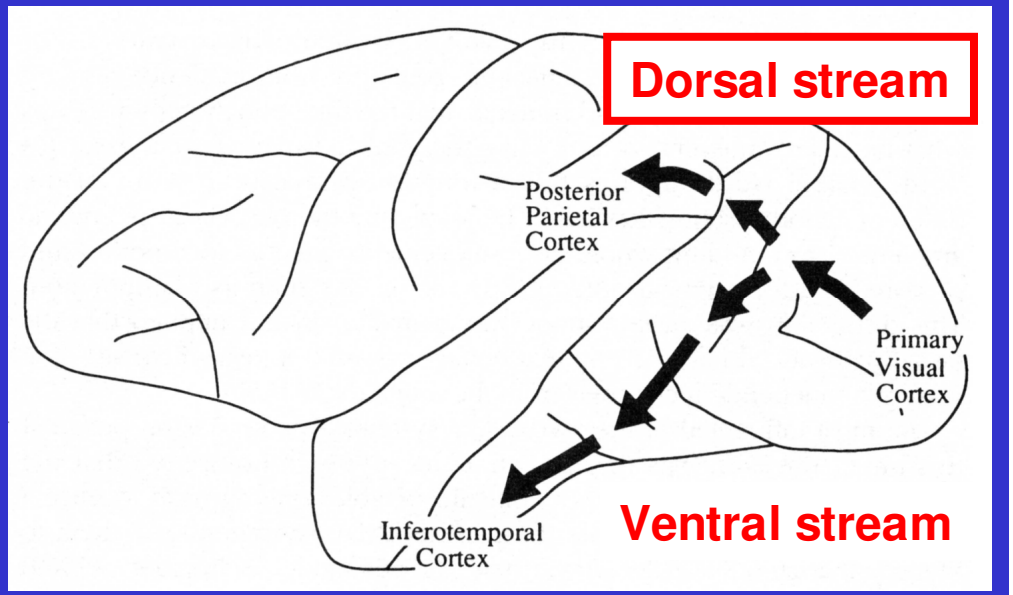
PEc/PGm cells

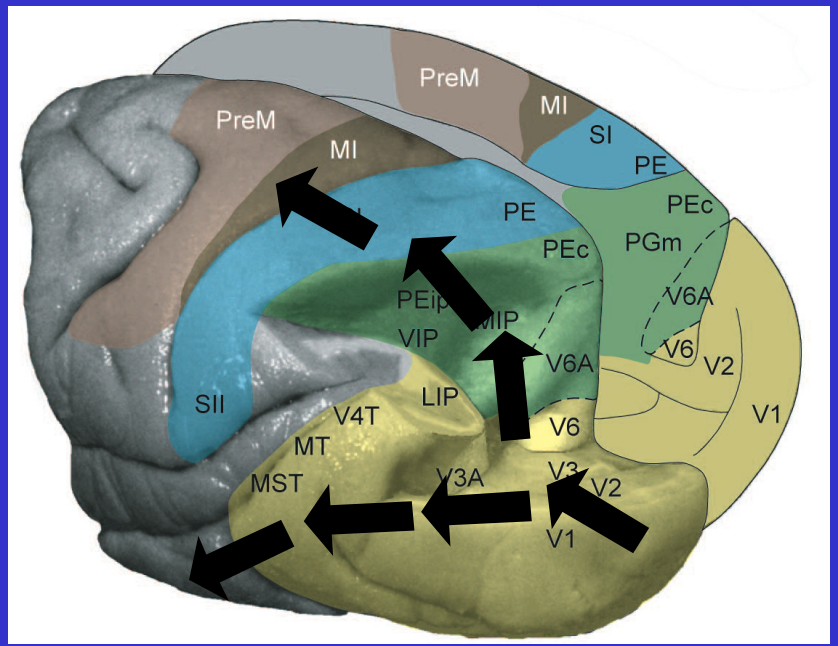
Vision for action



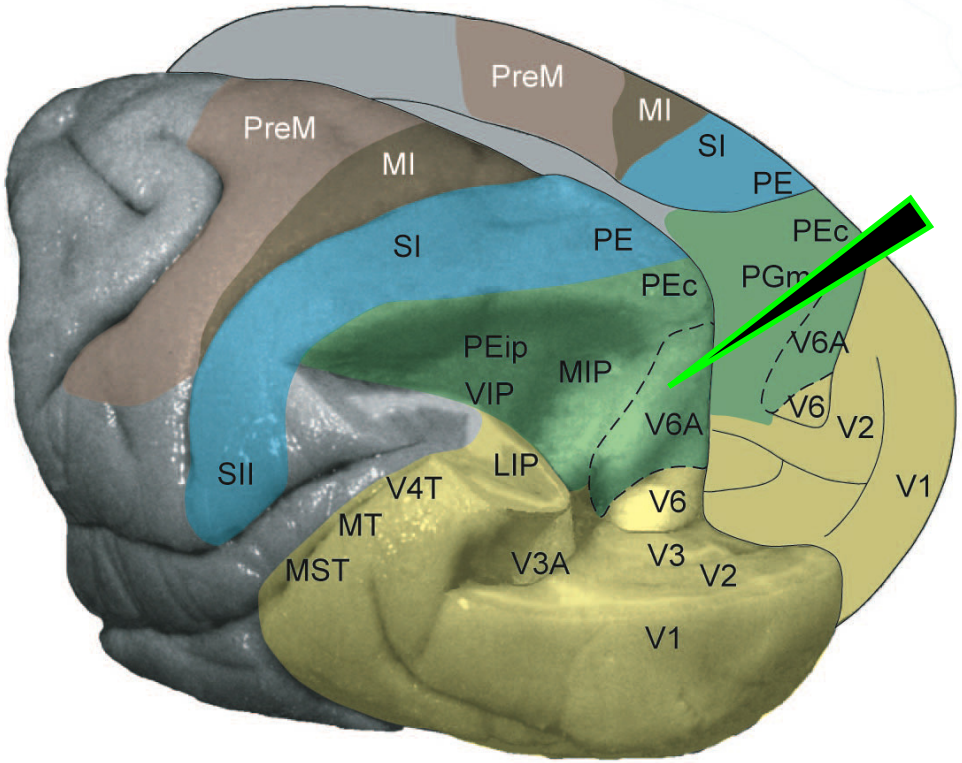
Ungerleider and Mishkin, 1982
Goodale and Milner, 1992

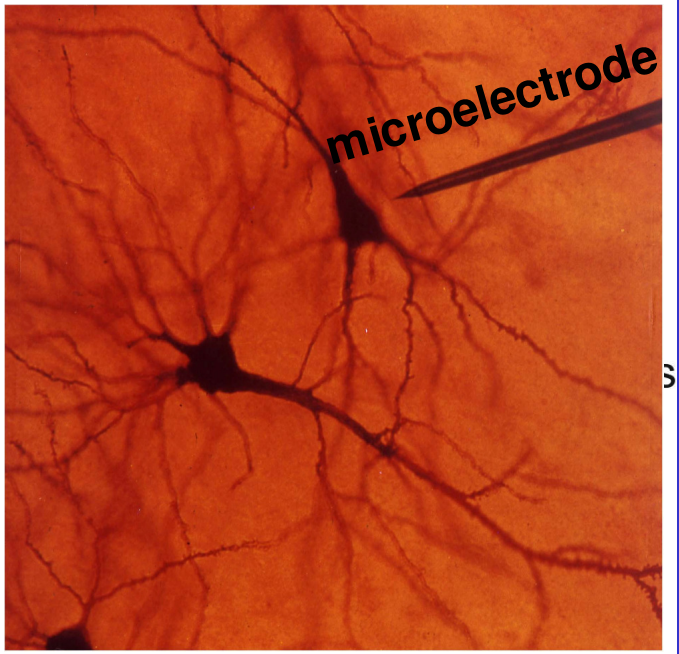
Within the dorsal stream



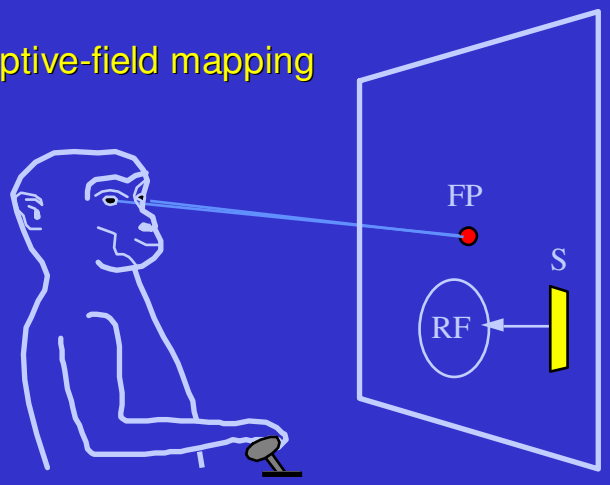


Ungerleider and Mishkin, 1982
Goodale and Milner, 1992

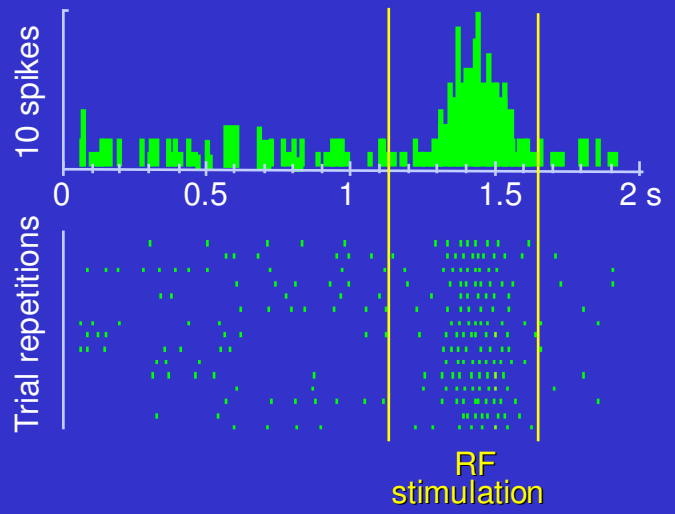




Visual receptive-field mapping



Neural response to visual stimulation

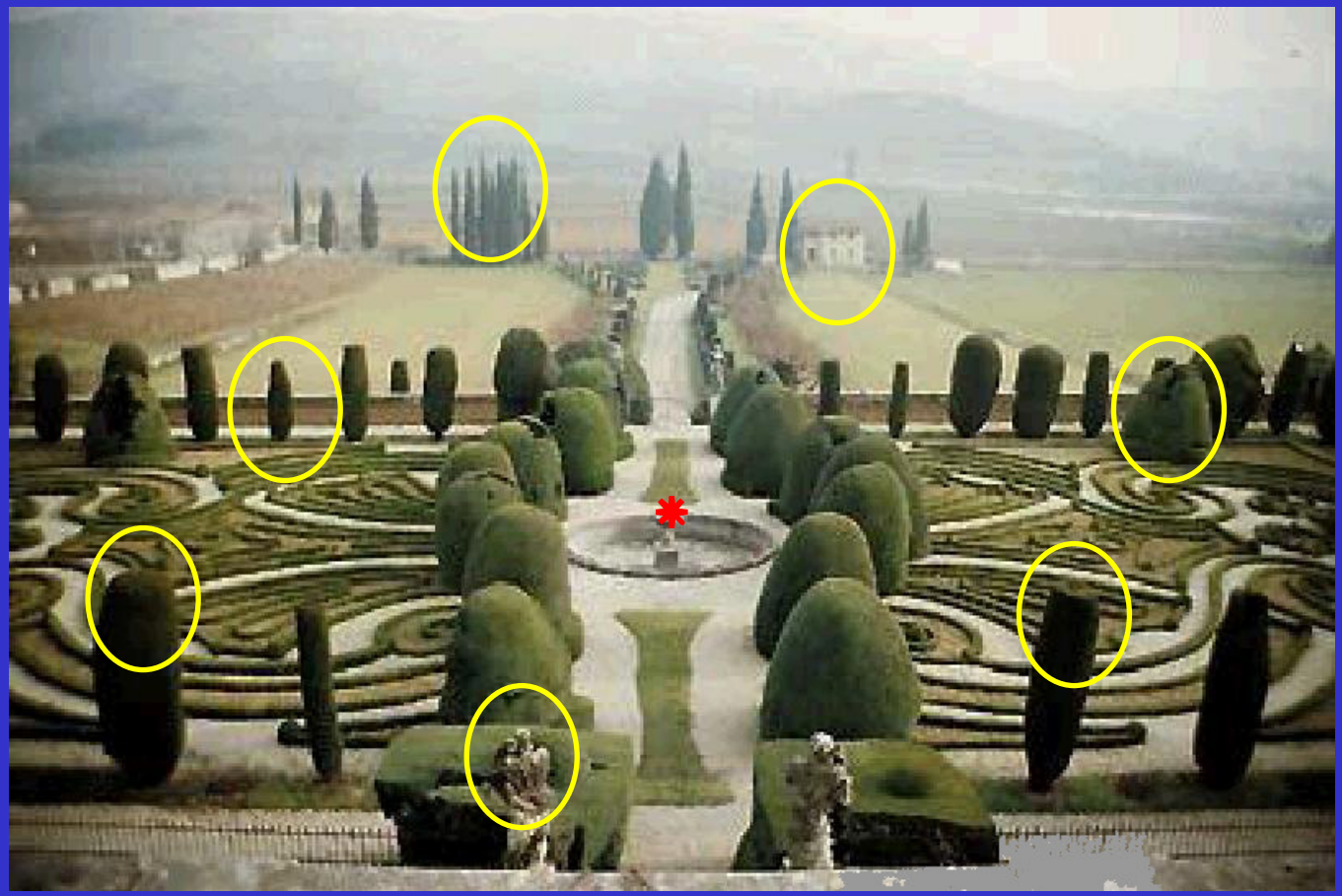


space

Eyes still (fixation)

Retinal image location

Perception of object location

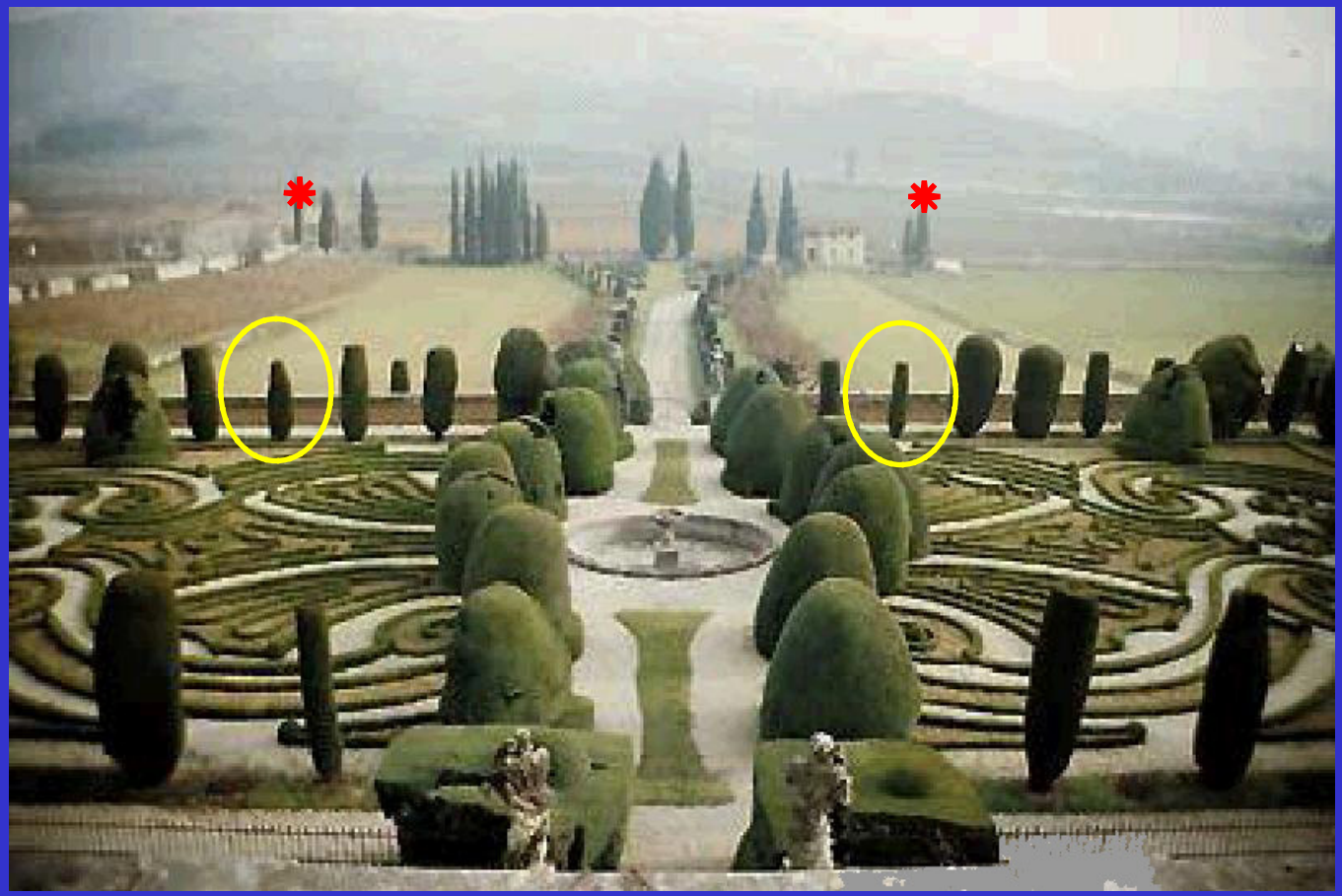


space

Change of gaze direction

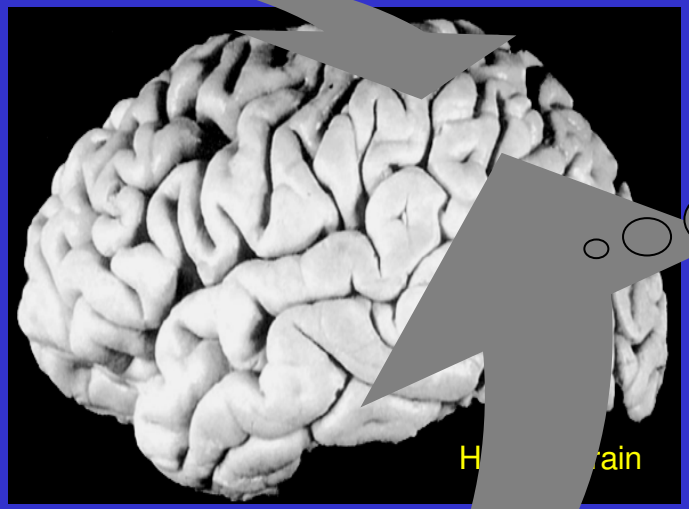
Retinal image location

Perception of object location



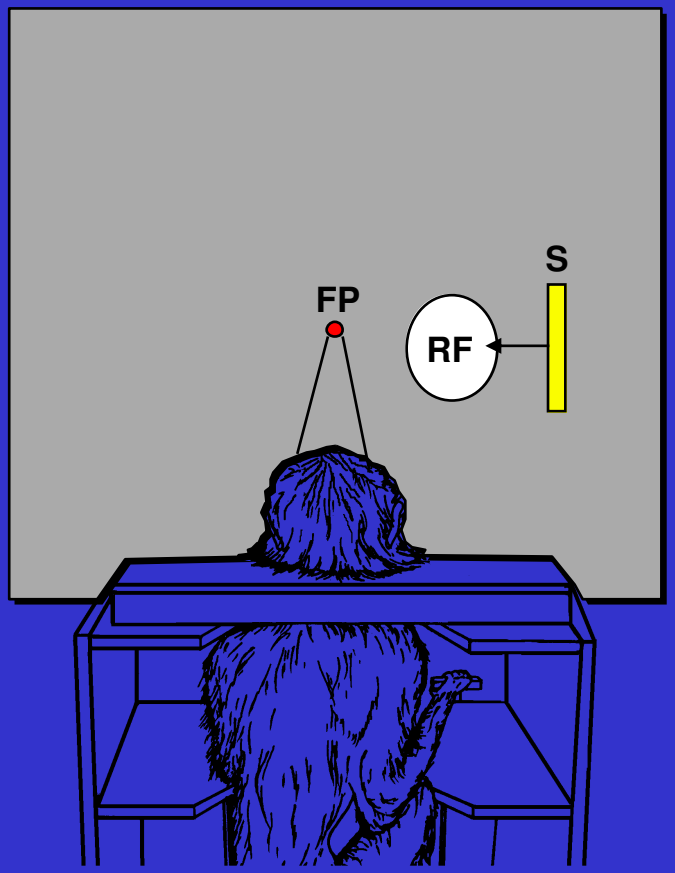
Retinal image location

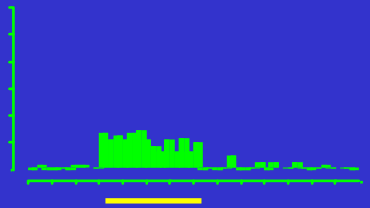
Direction of gaze



Perception of object location

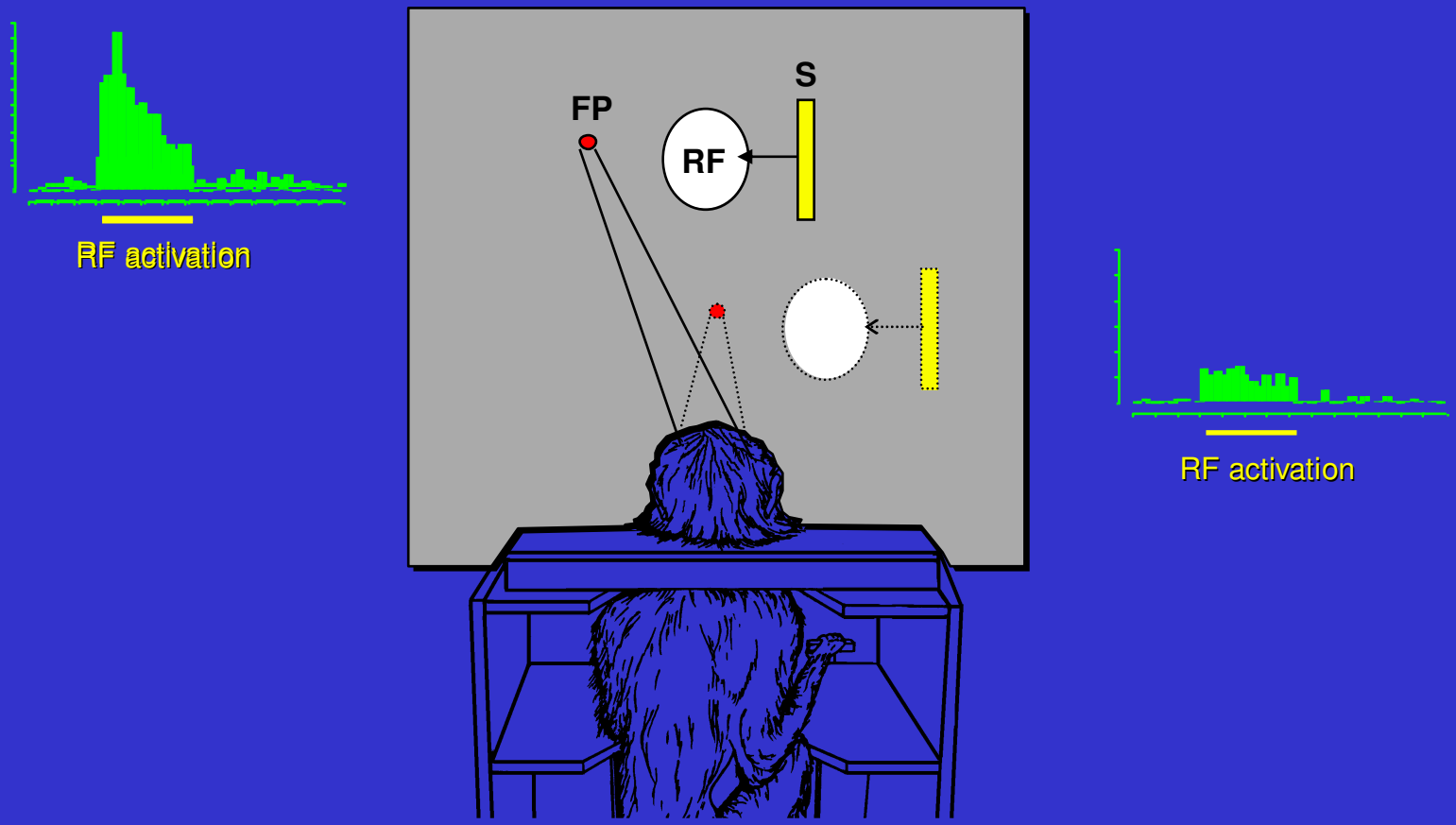
Visual responses



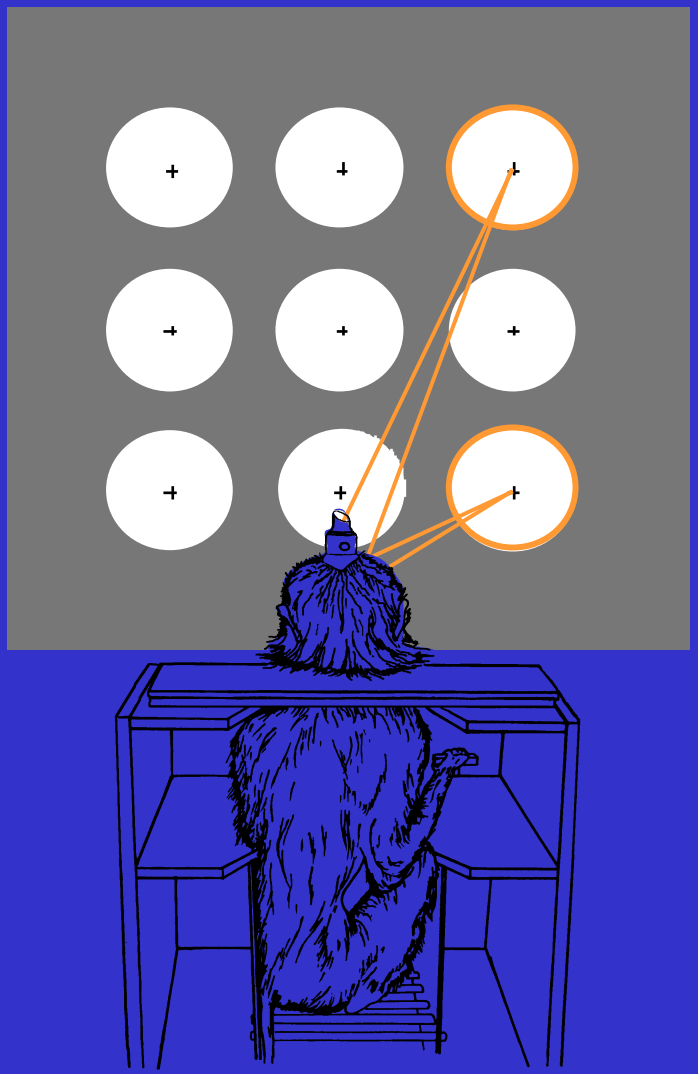


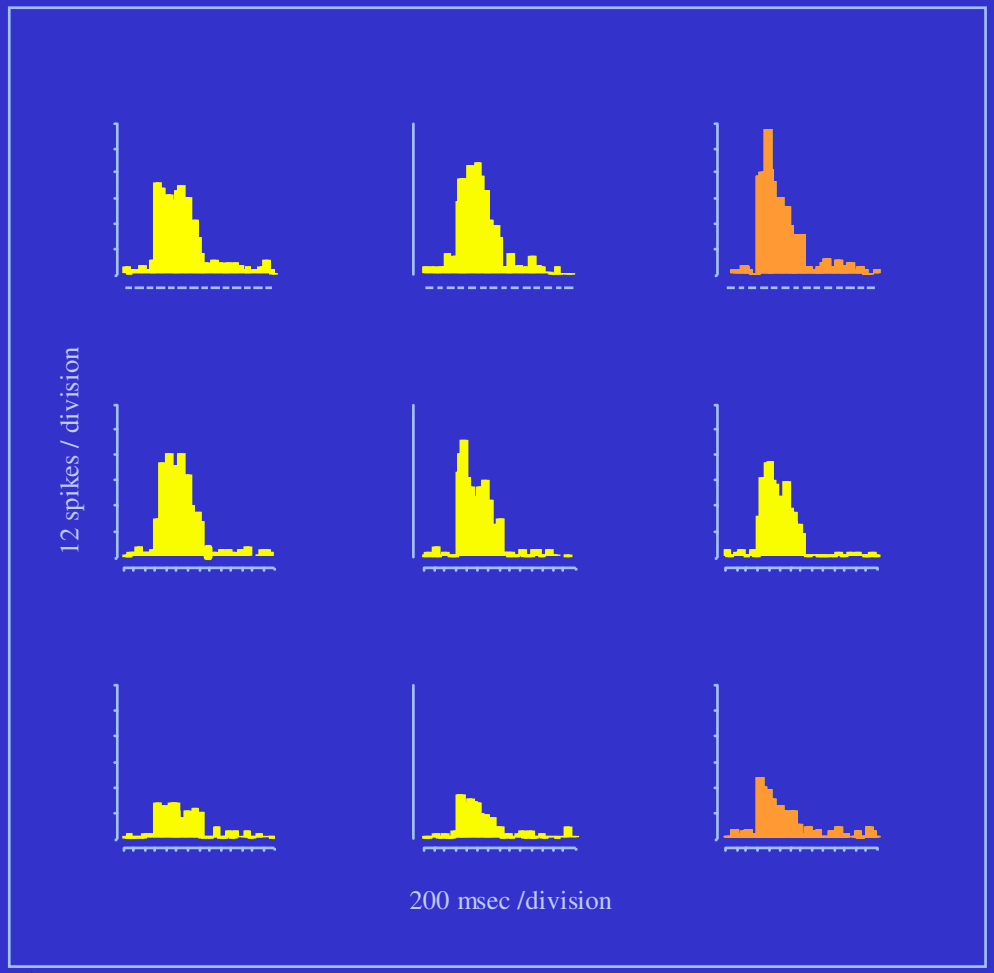
RF activation

Direction of gaze and visual responses



2D gain fields

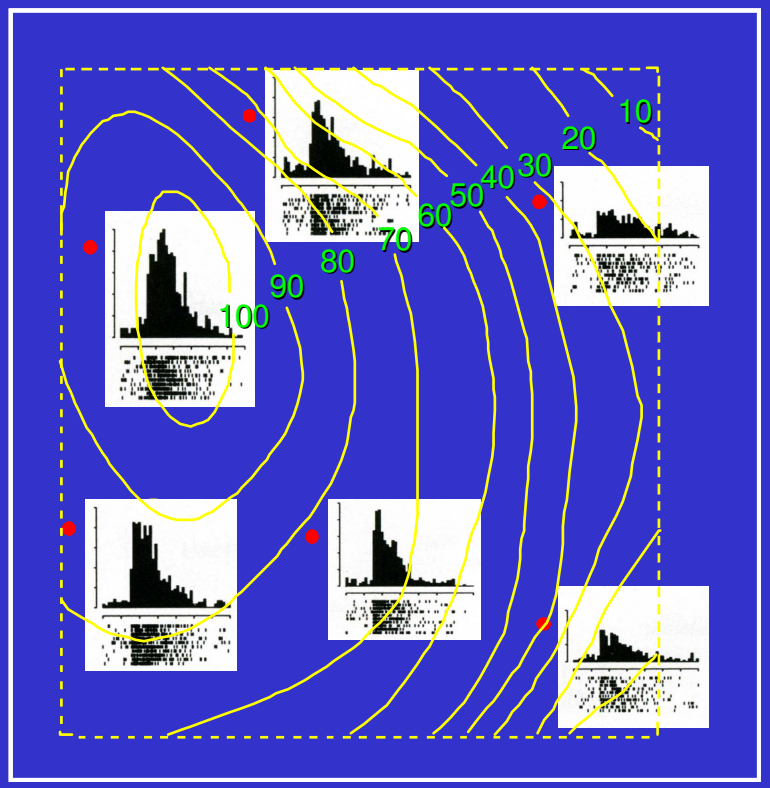


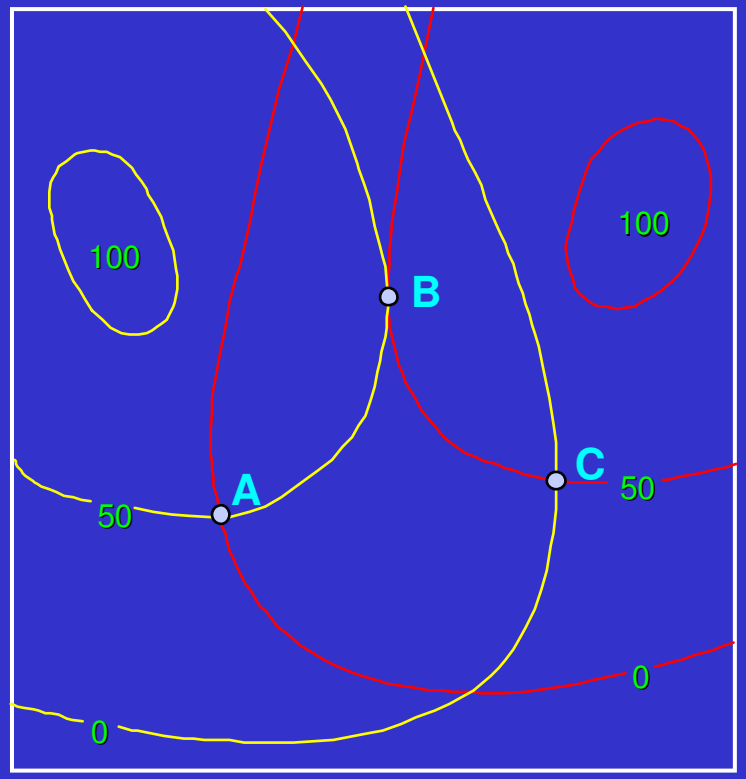


Unit 15,034

Galletti et al., 1995

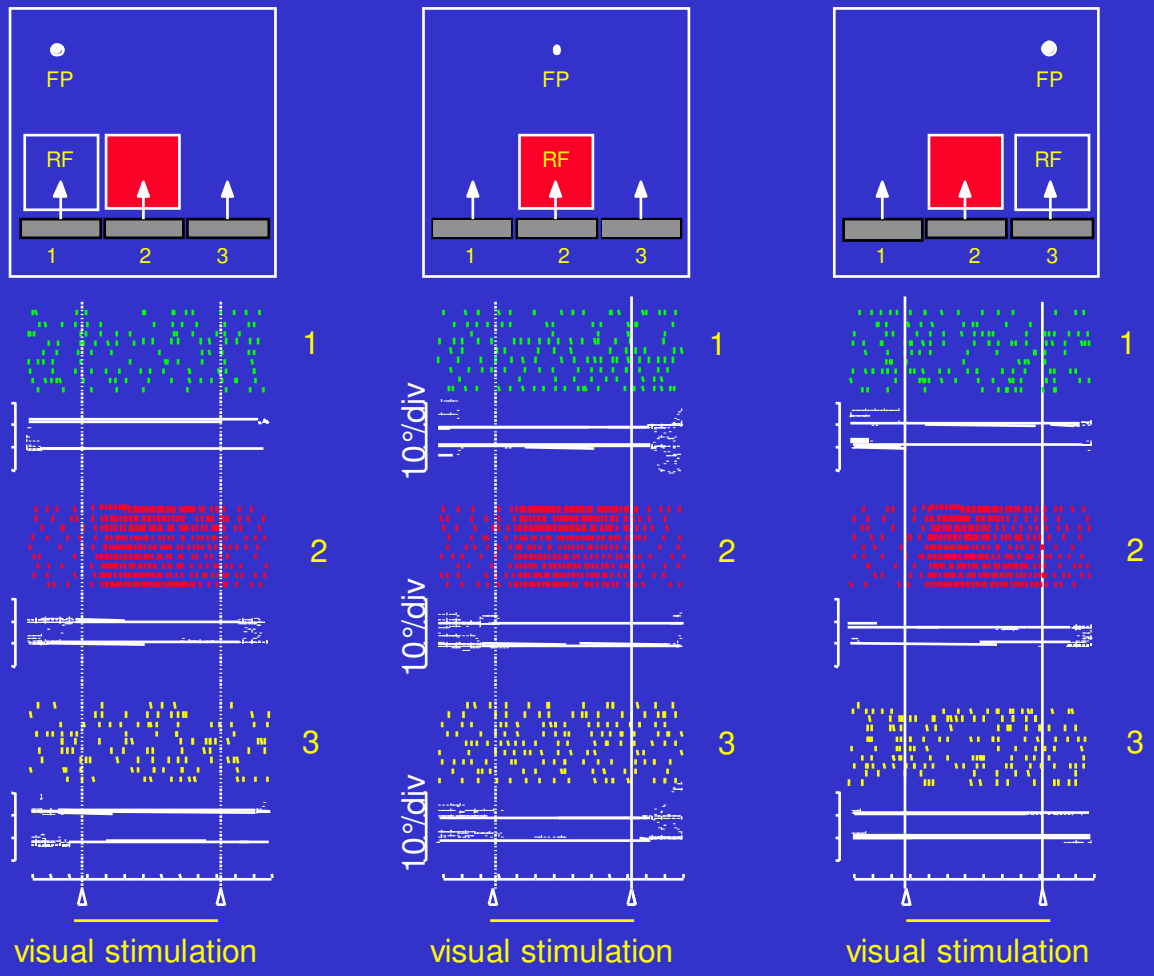
Encoding of the visual space



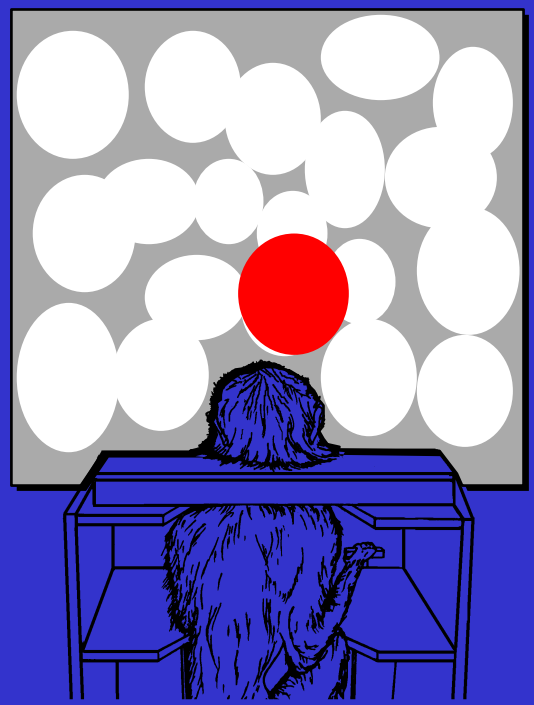


Are there cells that encode directly the visual space ?

Real-position cell



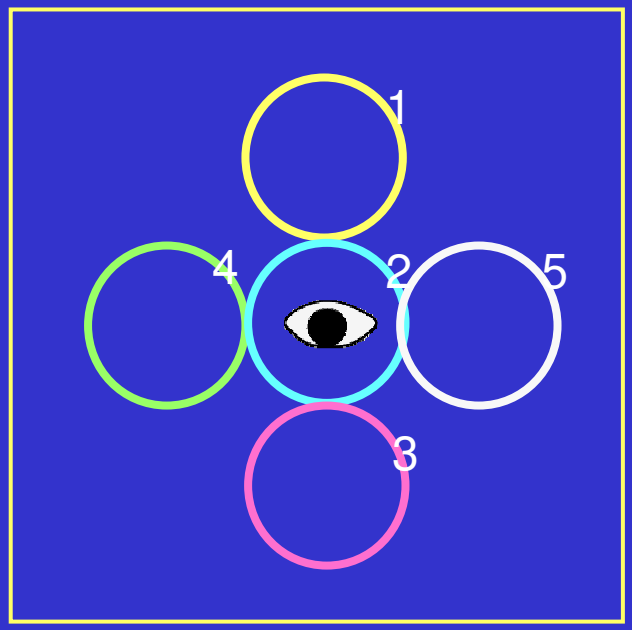
Encoding of visual space by real-position cells



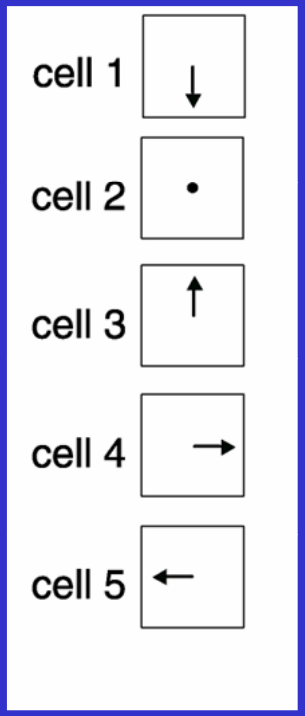
Galletti et al., 1993

- How can the RF remain stable in space despite eye movements?
- Hypothesis: this is due to the activity of gaze-dependent cells

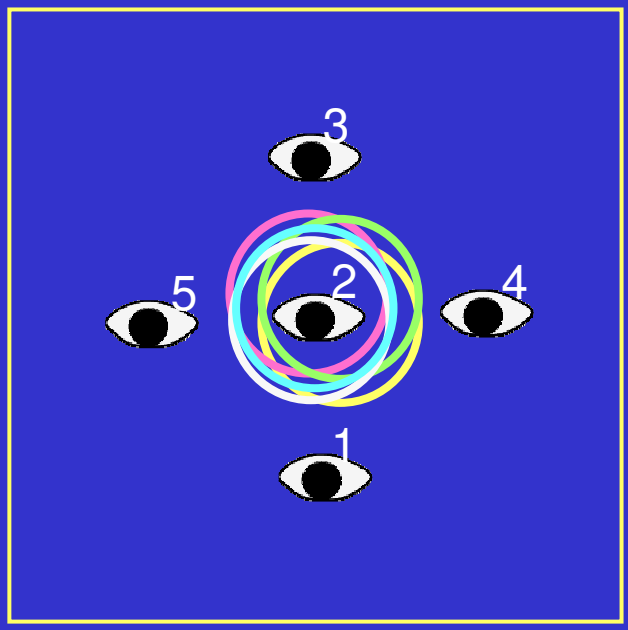
Receptive field locations



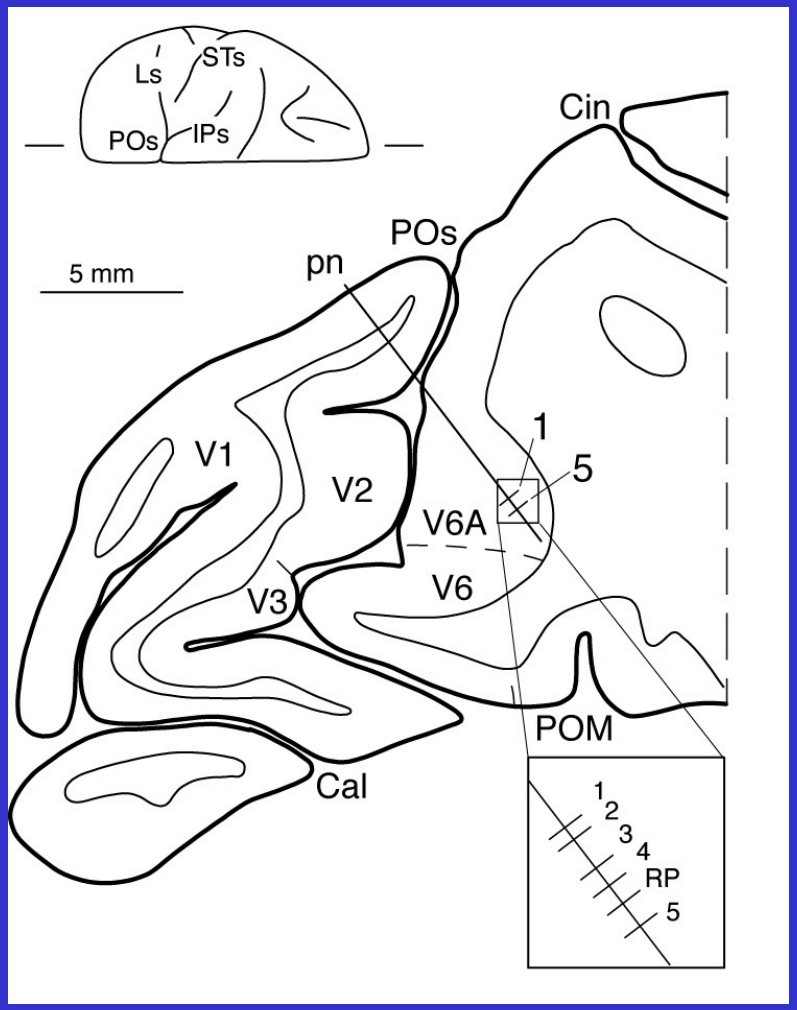
Preferred gaze directions



Real position behaviour

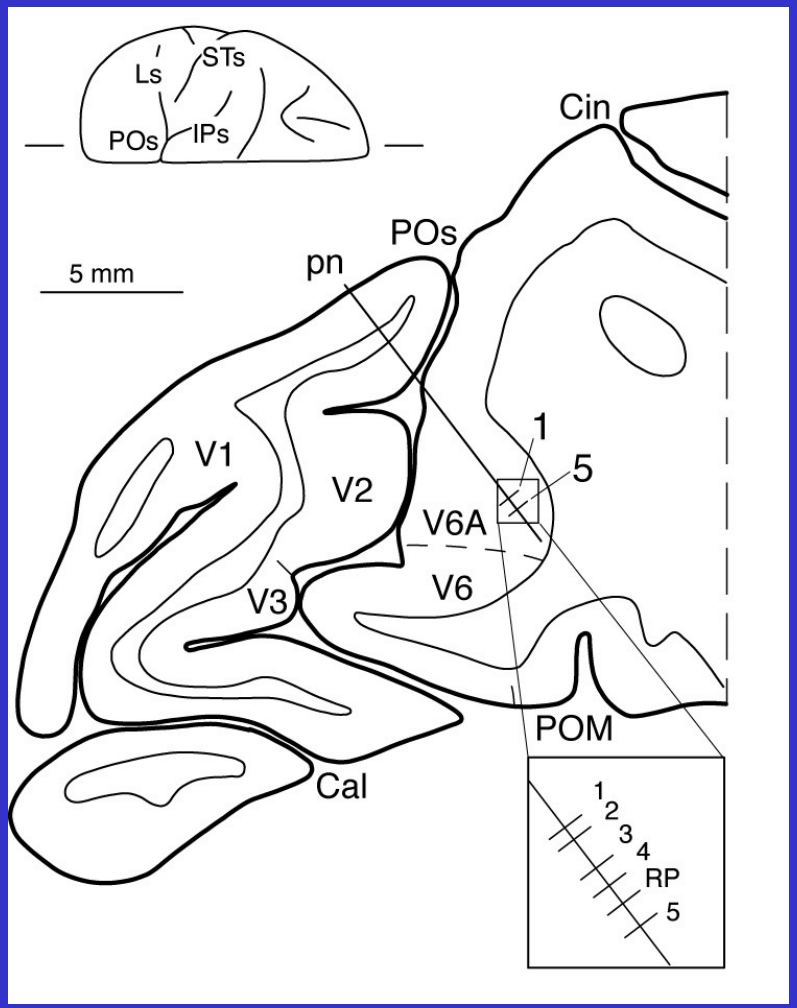


Experimental data confirming the hypothesis



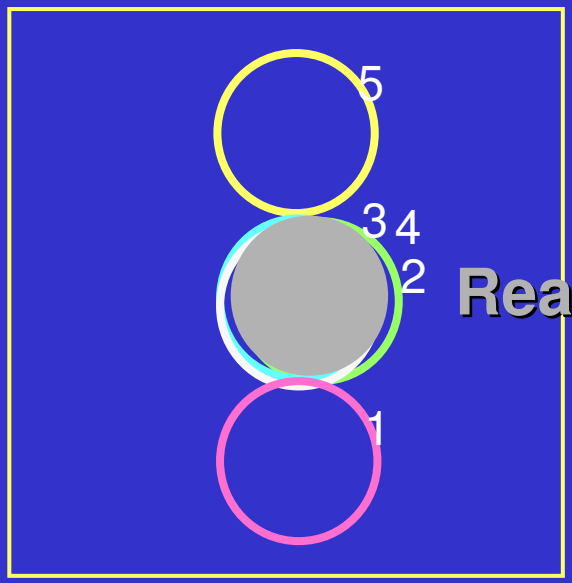
Galletti et al., 1995

Experimental data confirming the hypothesis

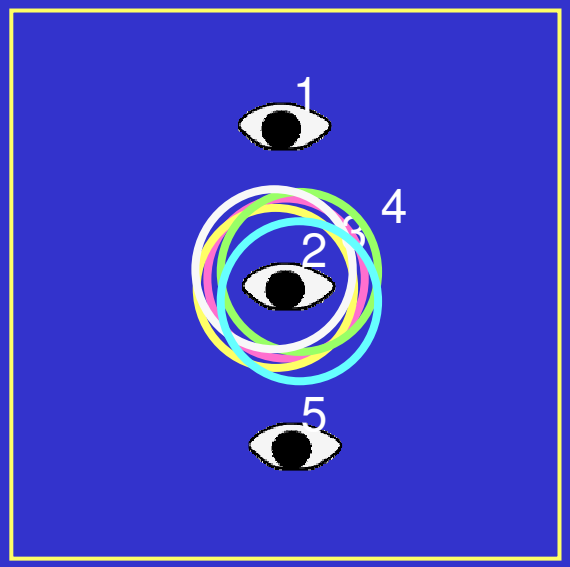


Galletti et al., 1995

Receptive field locations

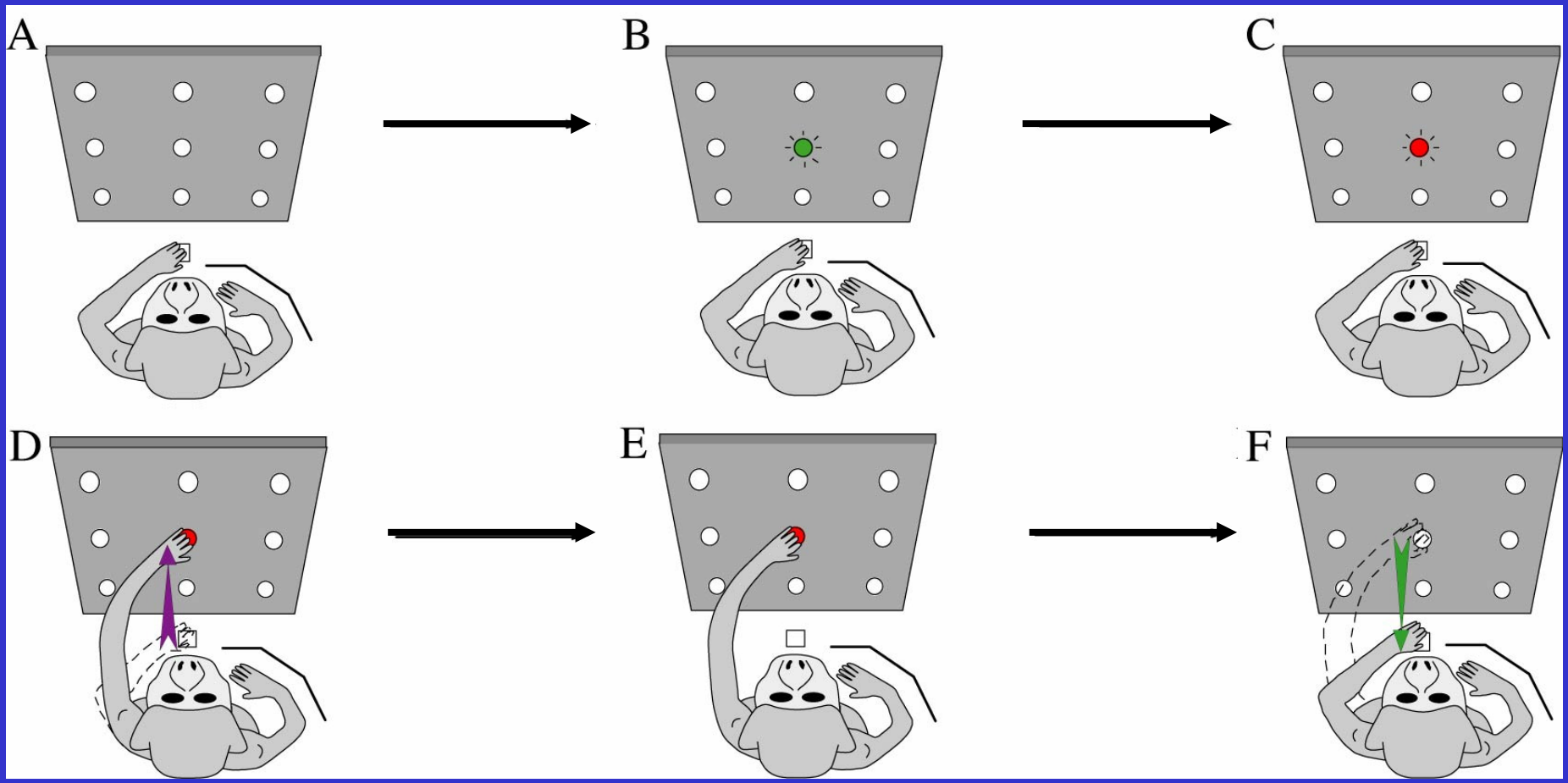


Preferred gaze directions



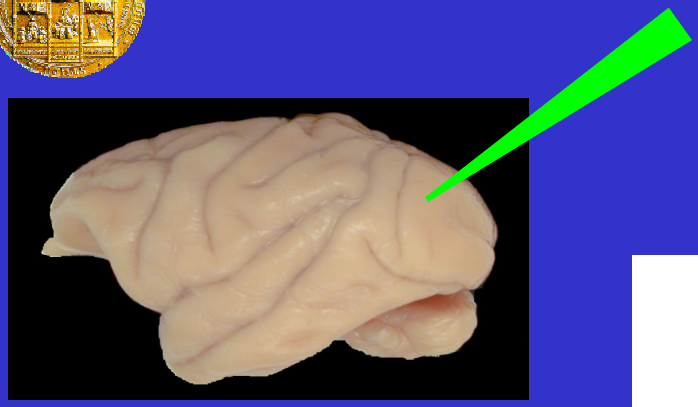
Reach-related activities in monkey medial parieto-occipital cortex

Instructed-delay reaching task



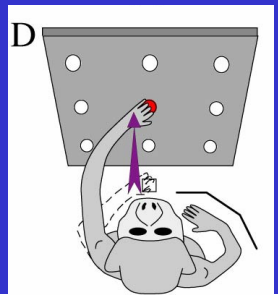
the task was performed with the contralateral arm

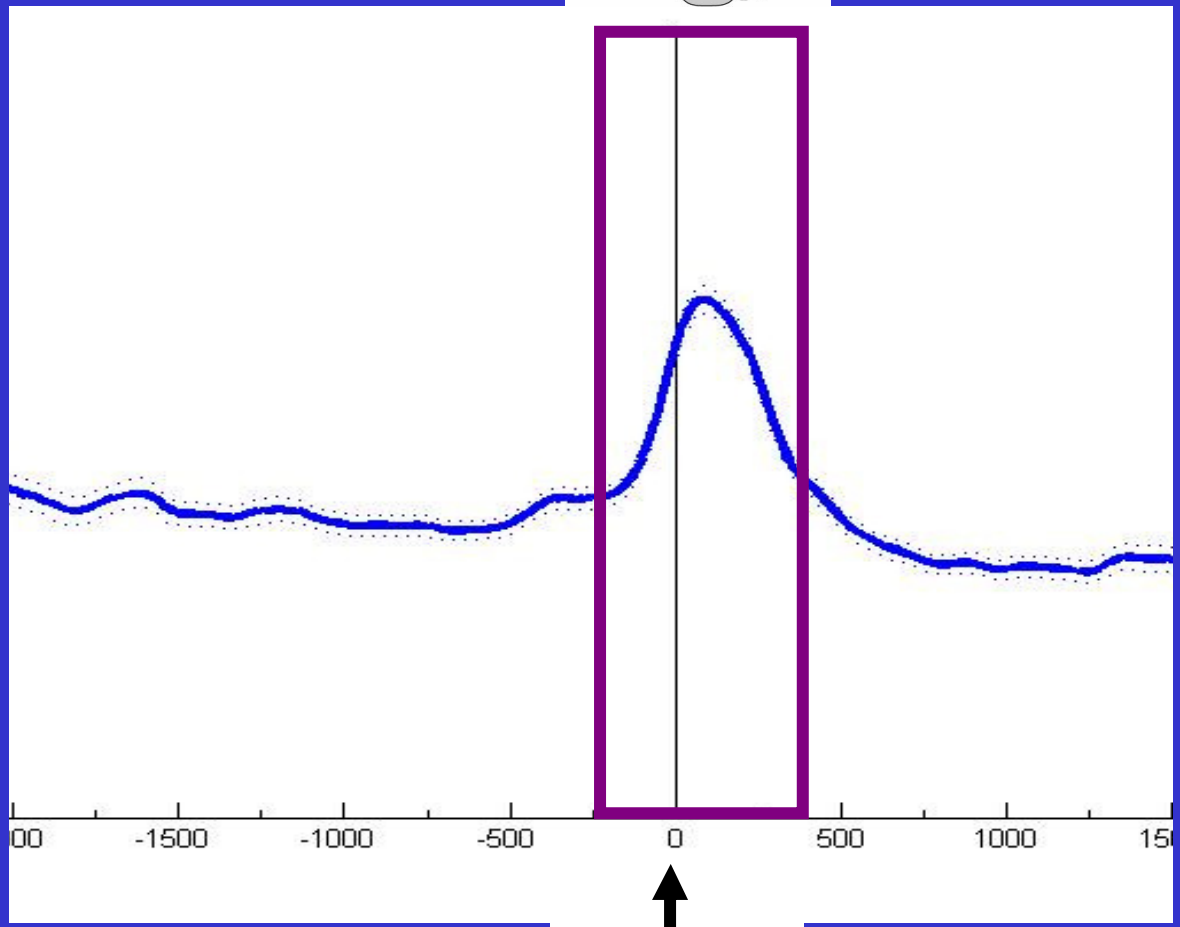
in darkness



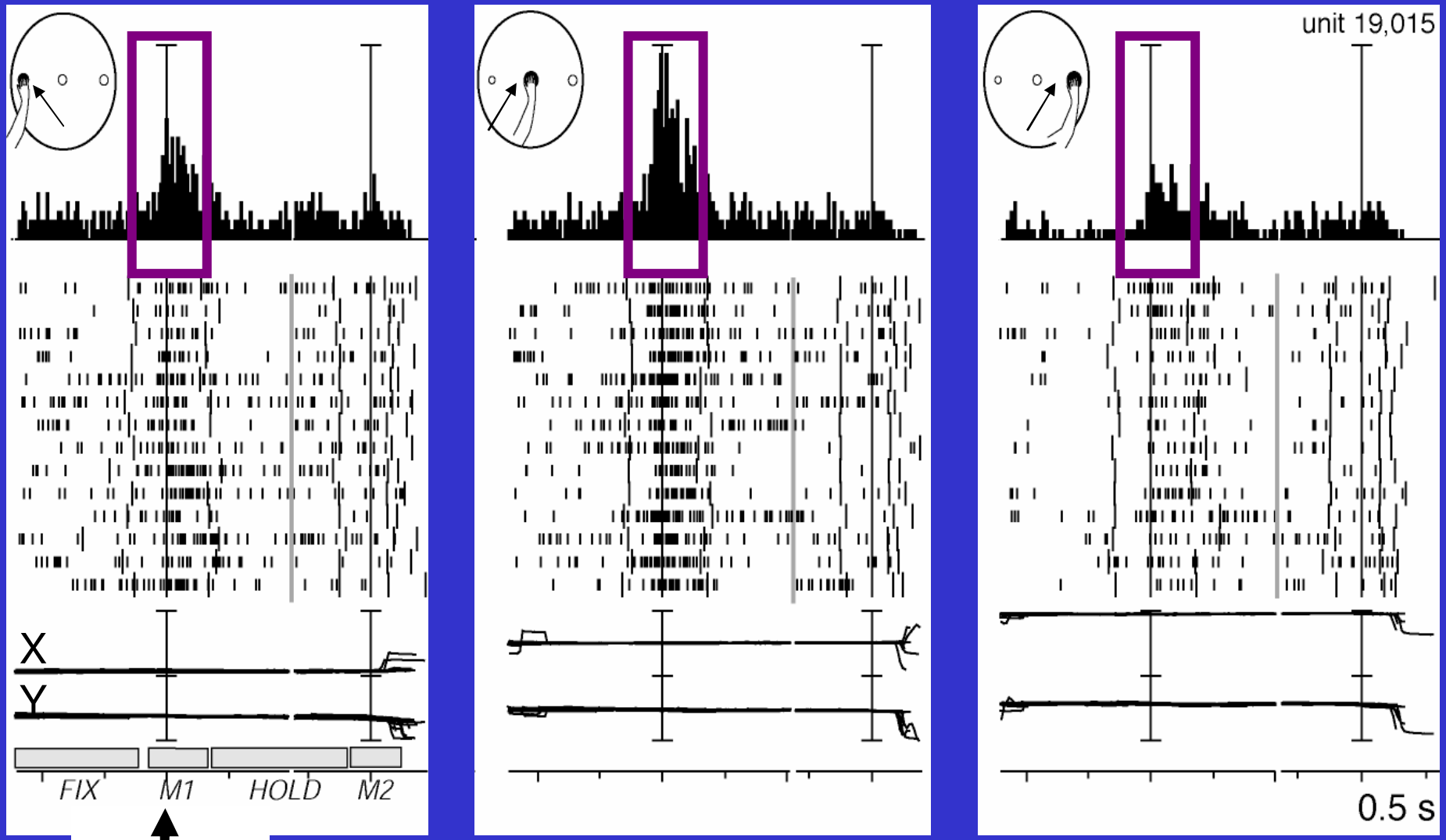
N=348 responses during forward arm reaching movement in at least one target location

How the population behave



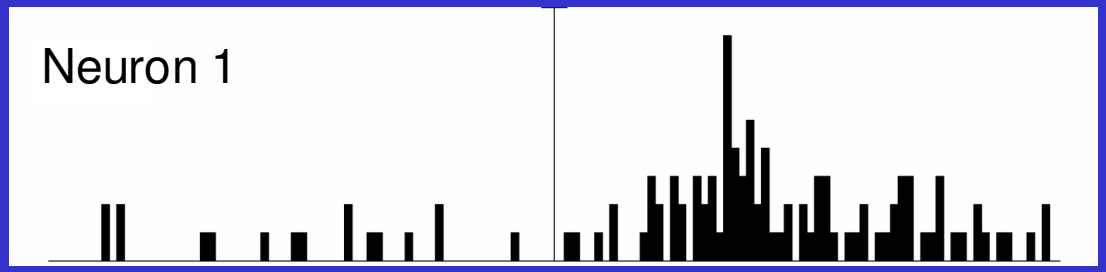


Example of a cell spatially tuned during forward arm-reaching movement

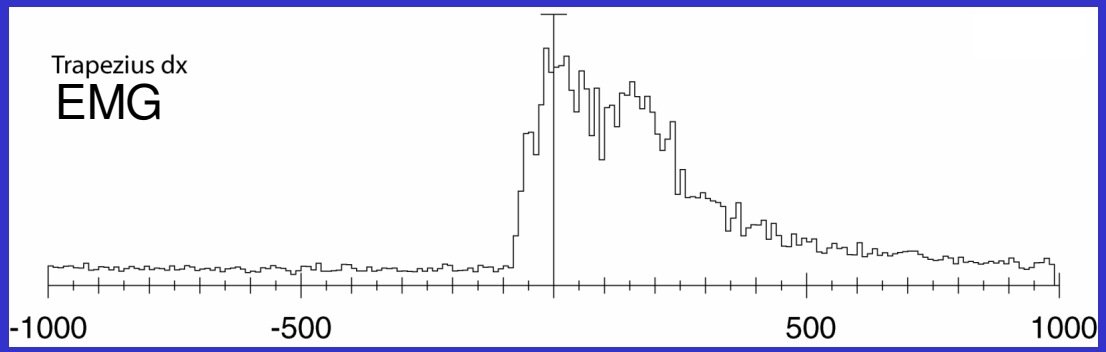


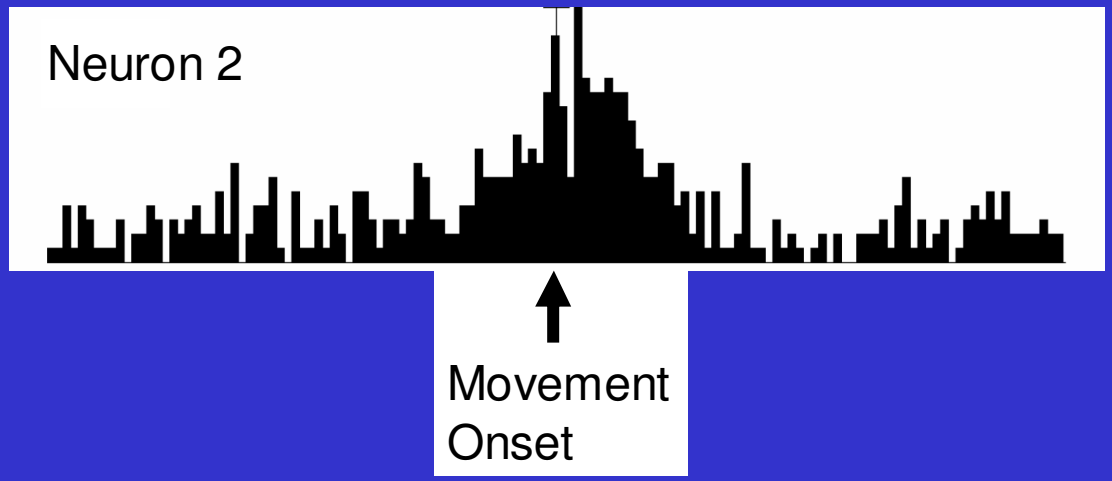
Fattori et al. *2005*

What is the source of the arm-related discharge?



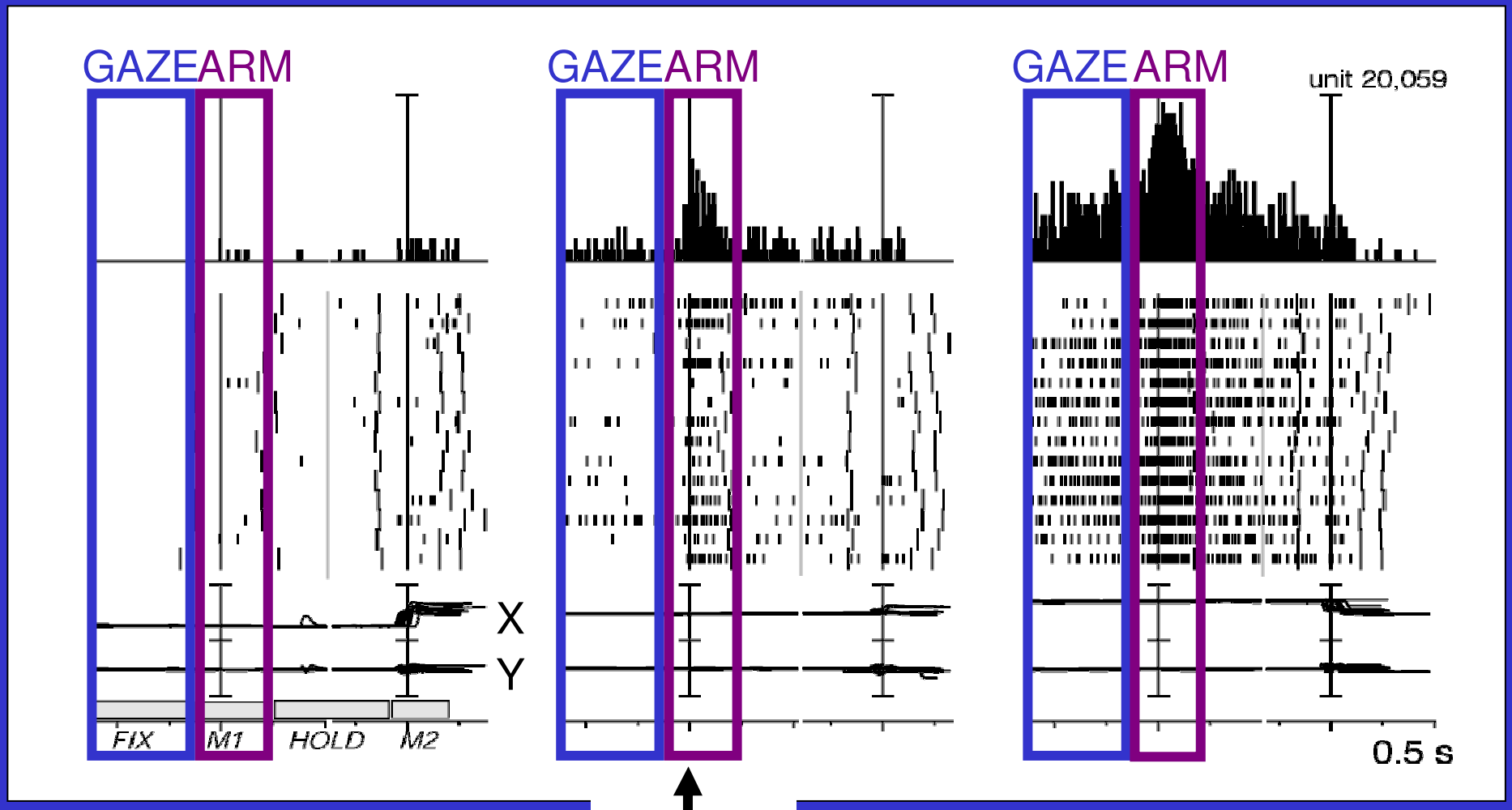
This cell started discharging after the beginning of EMG activity





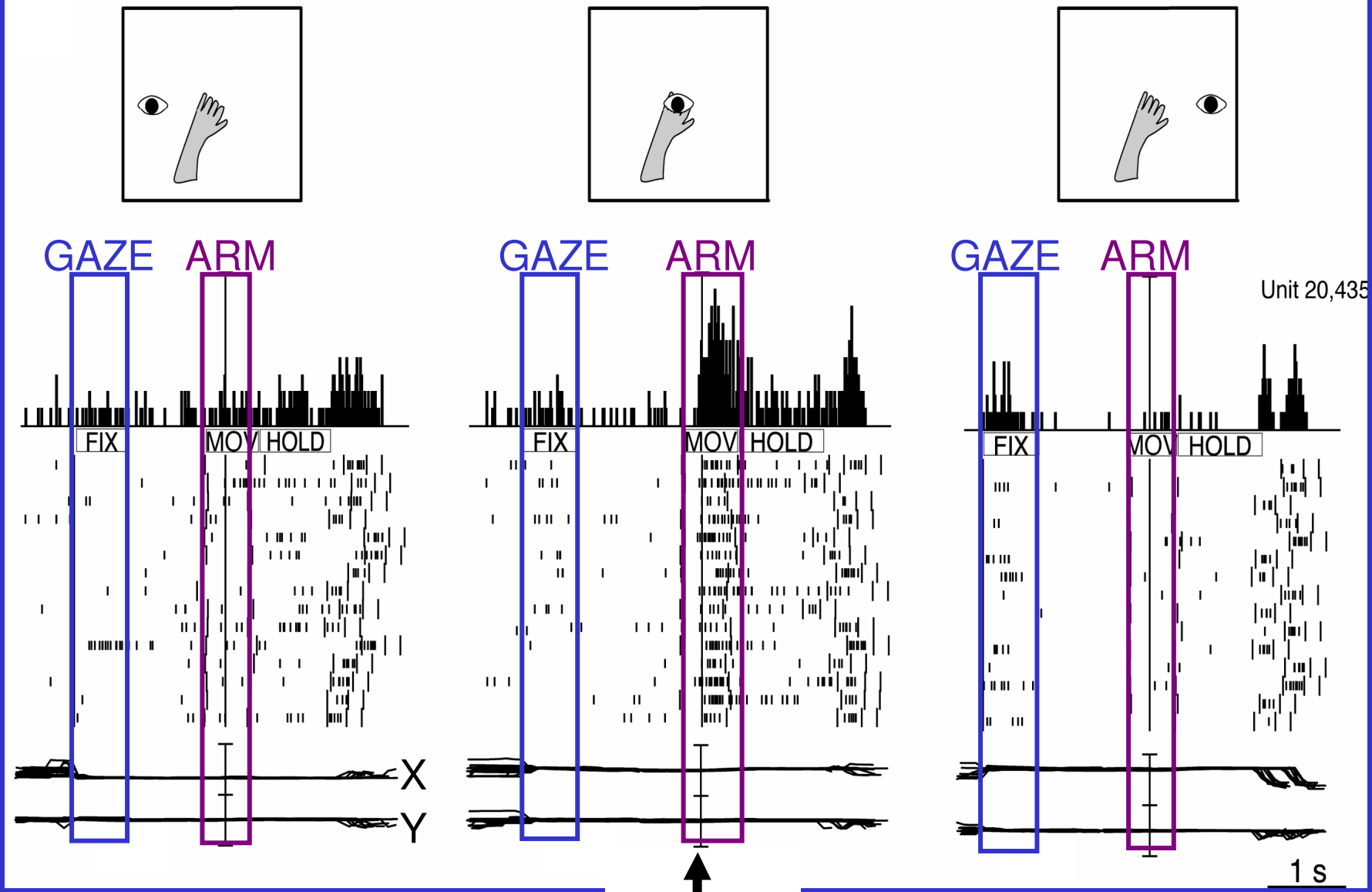
This cell started discharging before the beginning of EMG activity

Example of a cell receiving arm and gaze influences

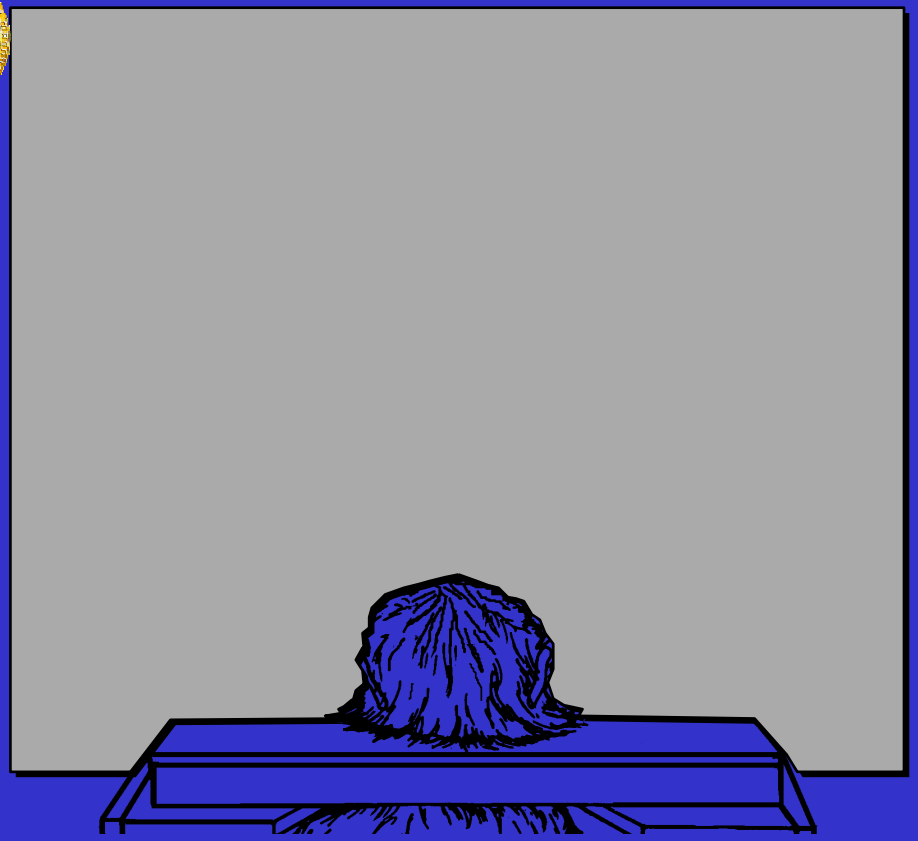


Fattori et al. *2005*

Example of a gaze modulation of the arm-reaching discharge



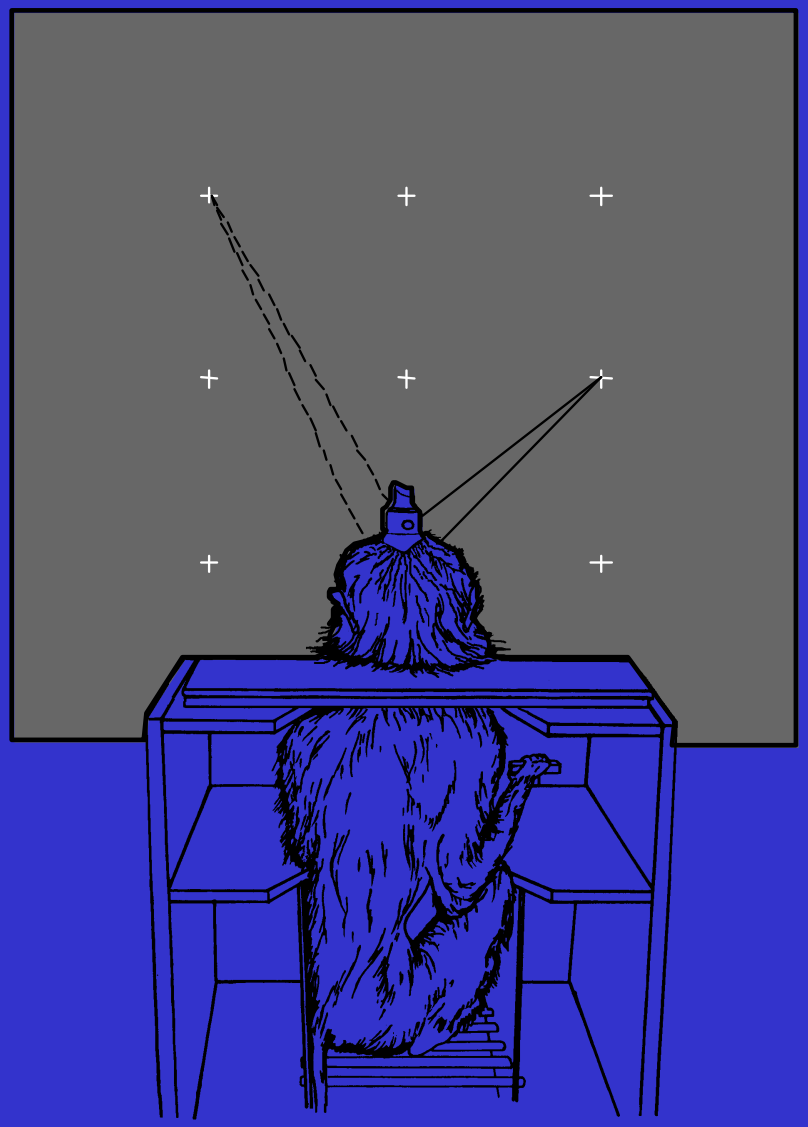
Marzocchi et al. *2008*

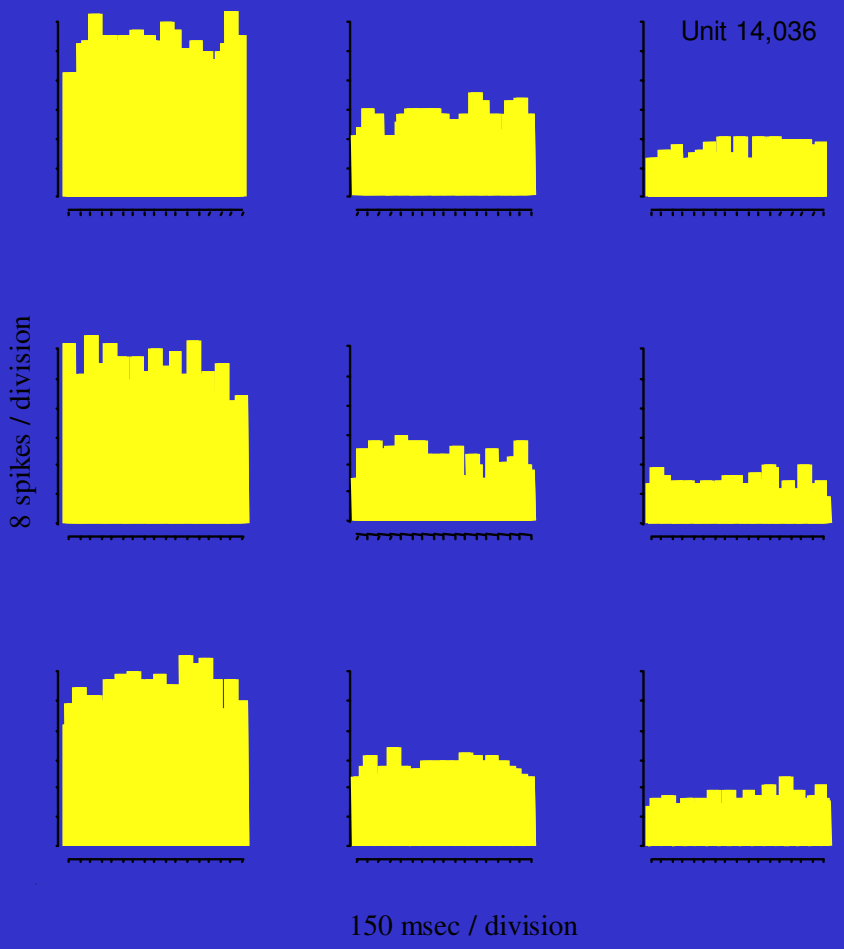


EYESHOTS
planned activities

Main goal:
experimental characterization of the neural correlates of multisensory 3D representation, in order to provide architectural guidelines for the production of biologically-inspired artificial intelligence systems able to interact with the 3D world

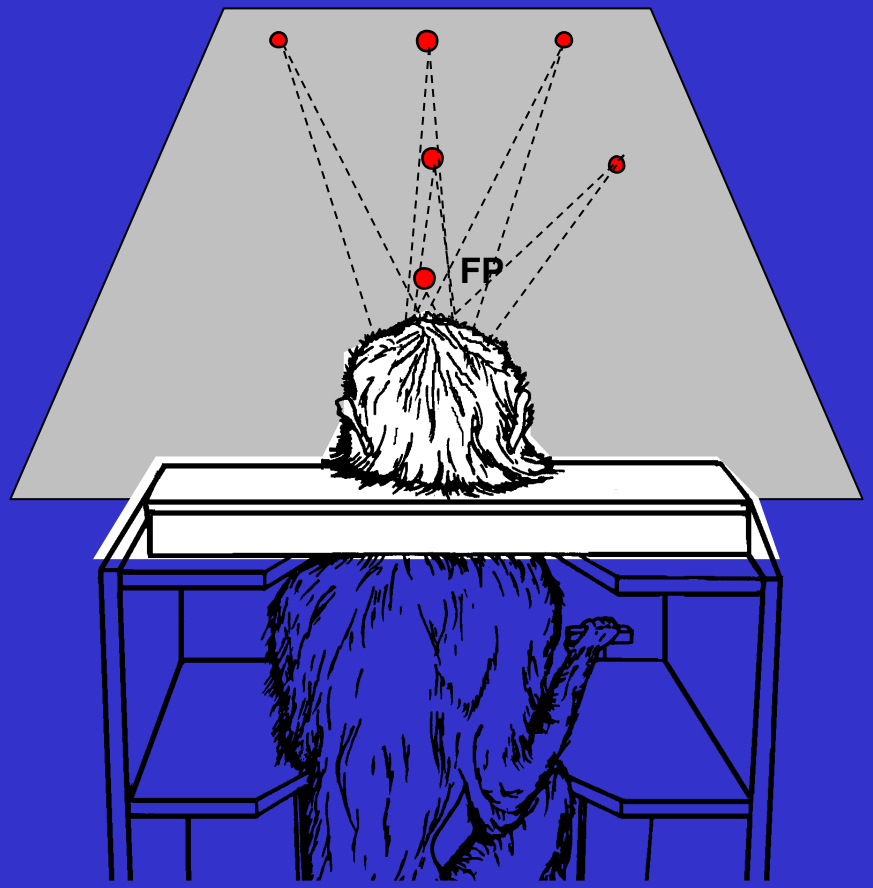
2D eye-position fields





Galletti et al., 1995

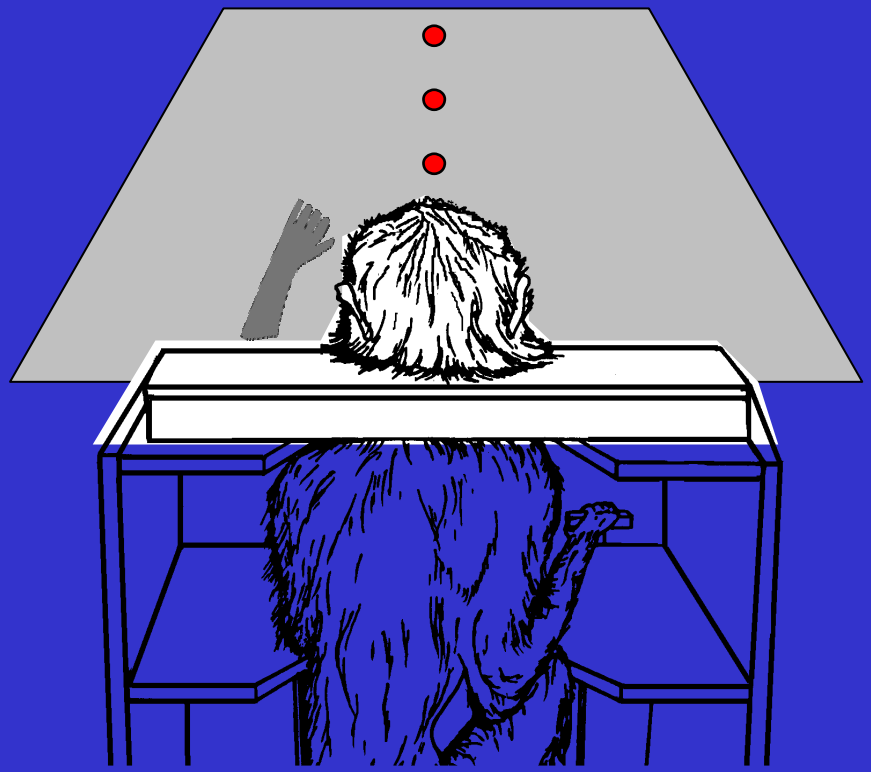
EYESHOTS Task 5.1 activities



Experimental characterization of

3D eye-position fields of neurons of medial parieto-occipital cortex.

EYESHOTS: Task 5.2 activities



Active exploration of the peripersonal space through active ocular and arm movements