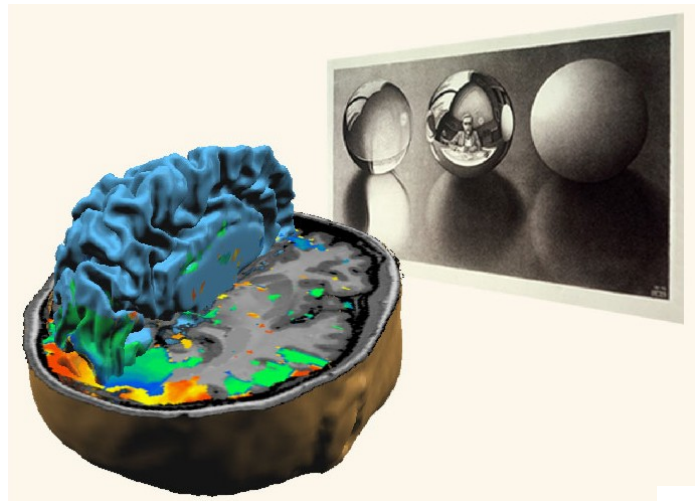


Seeing and thinking with the visual brain – even if the eyes don't work



Pieter R. Roelfsema

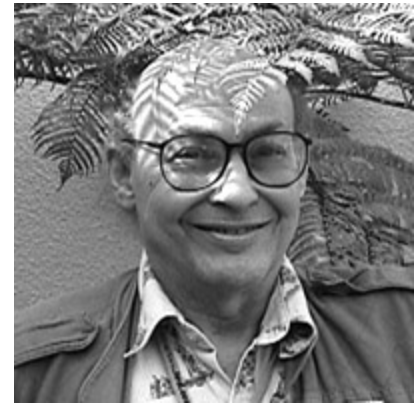
Dept. Vision & Cognition, Netherlands Institute for Neuroscience (KNAW)

The NIN aims to explain how **circuits** of neurons enable us to see the world and act upon it.



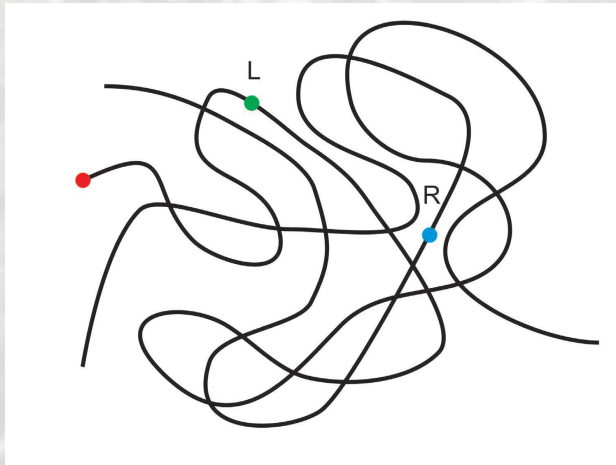
To explain the mind, we have to show how minds are built from mindless stuff, from parts that are much smaller and simpler than anything we'd consider smart.

Marvin Minsky, Society of Mind, 1985



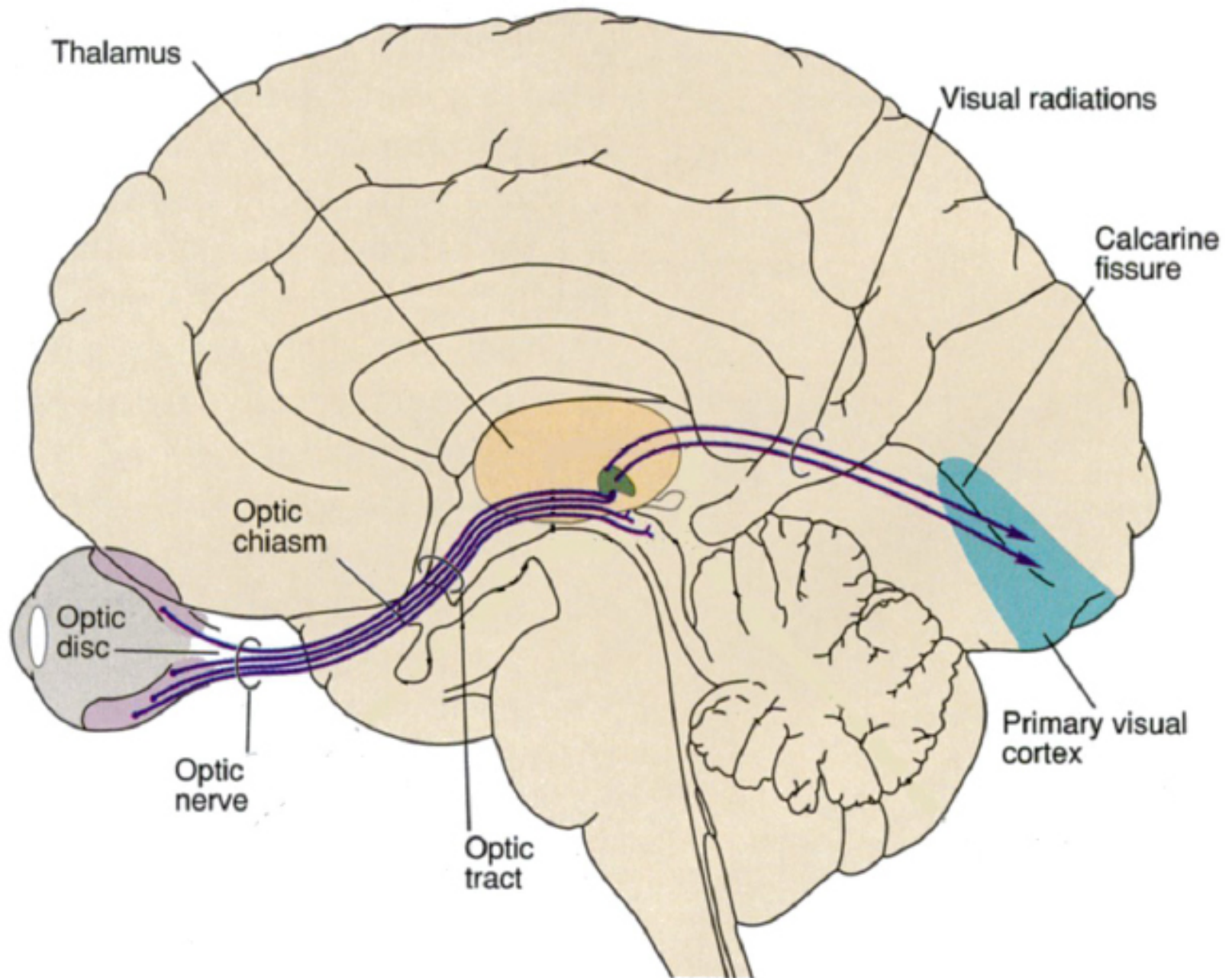
Introduction: visual cortex -- feedforward and feedback processing

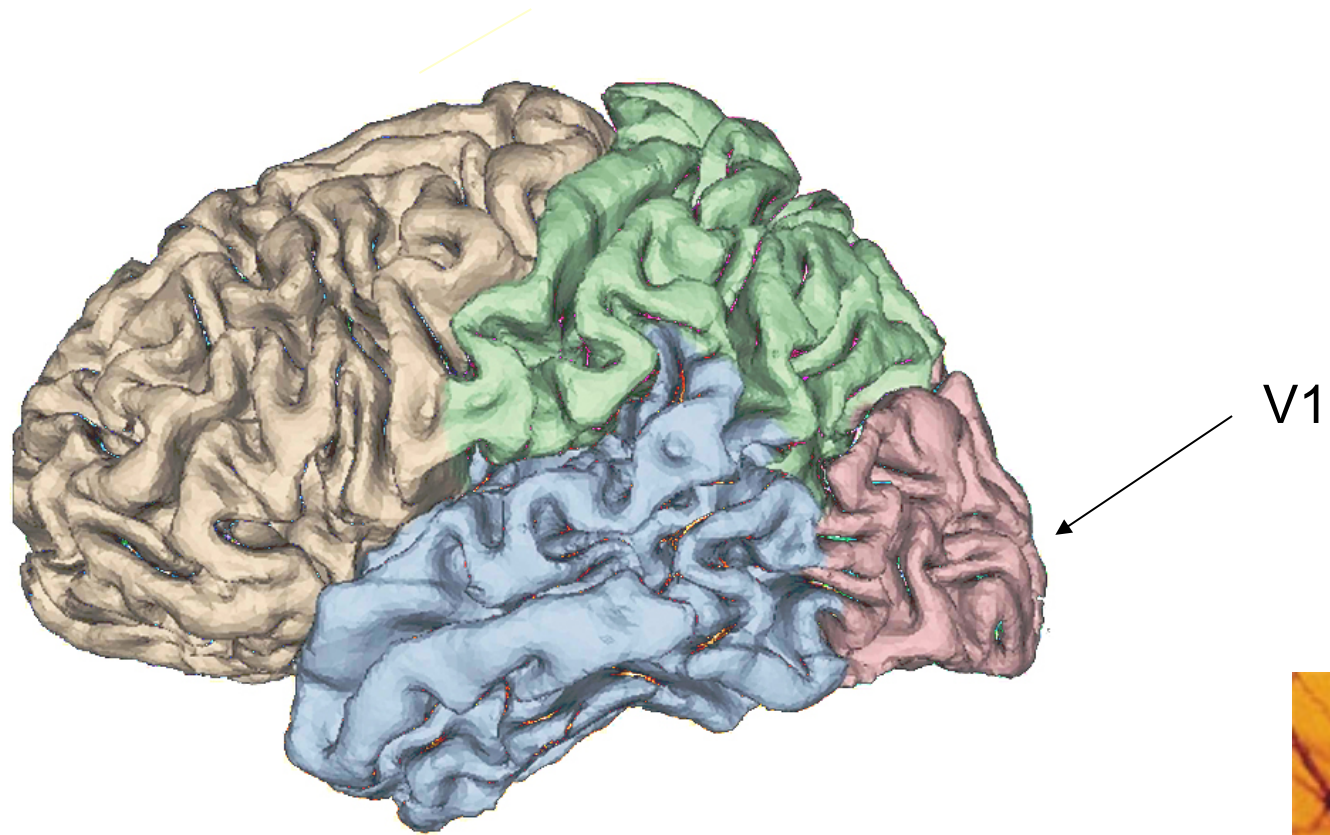
Contour grouping



Prosthesis

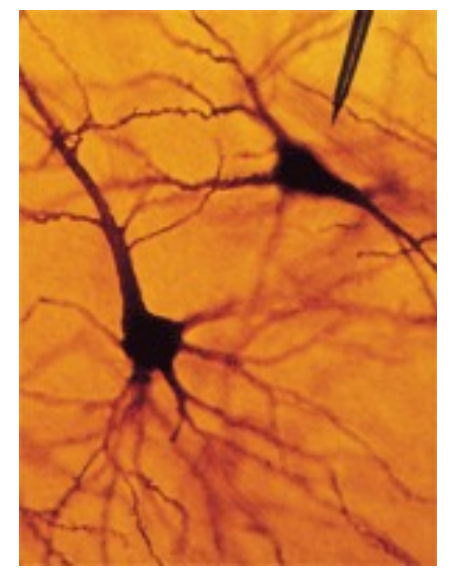




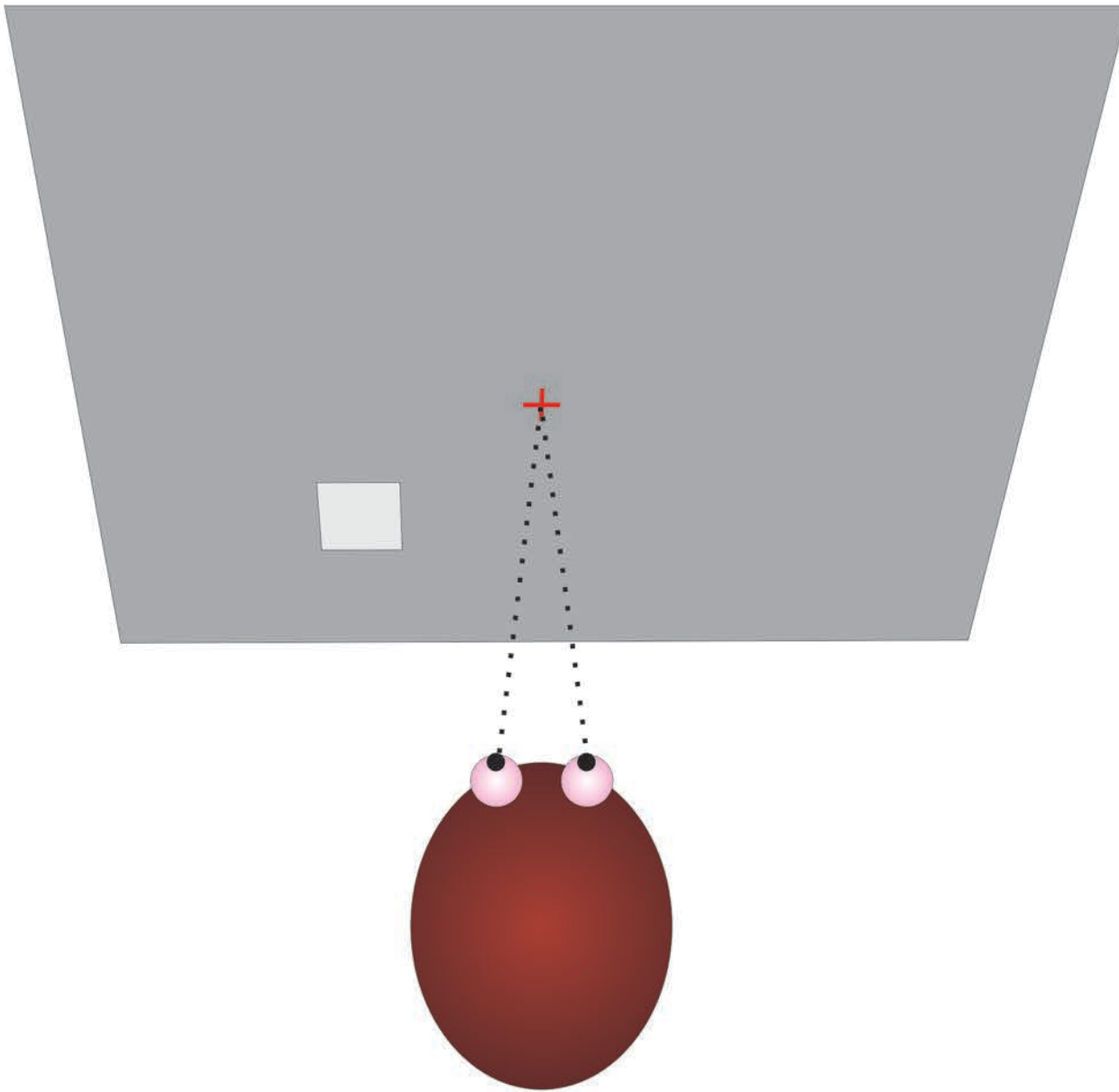


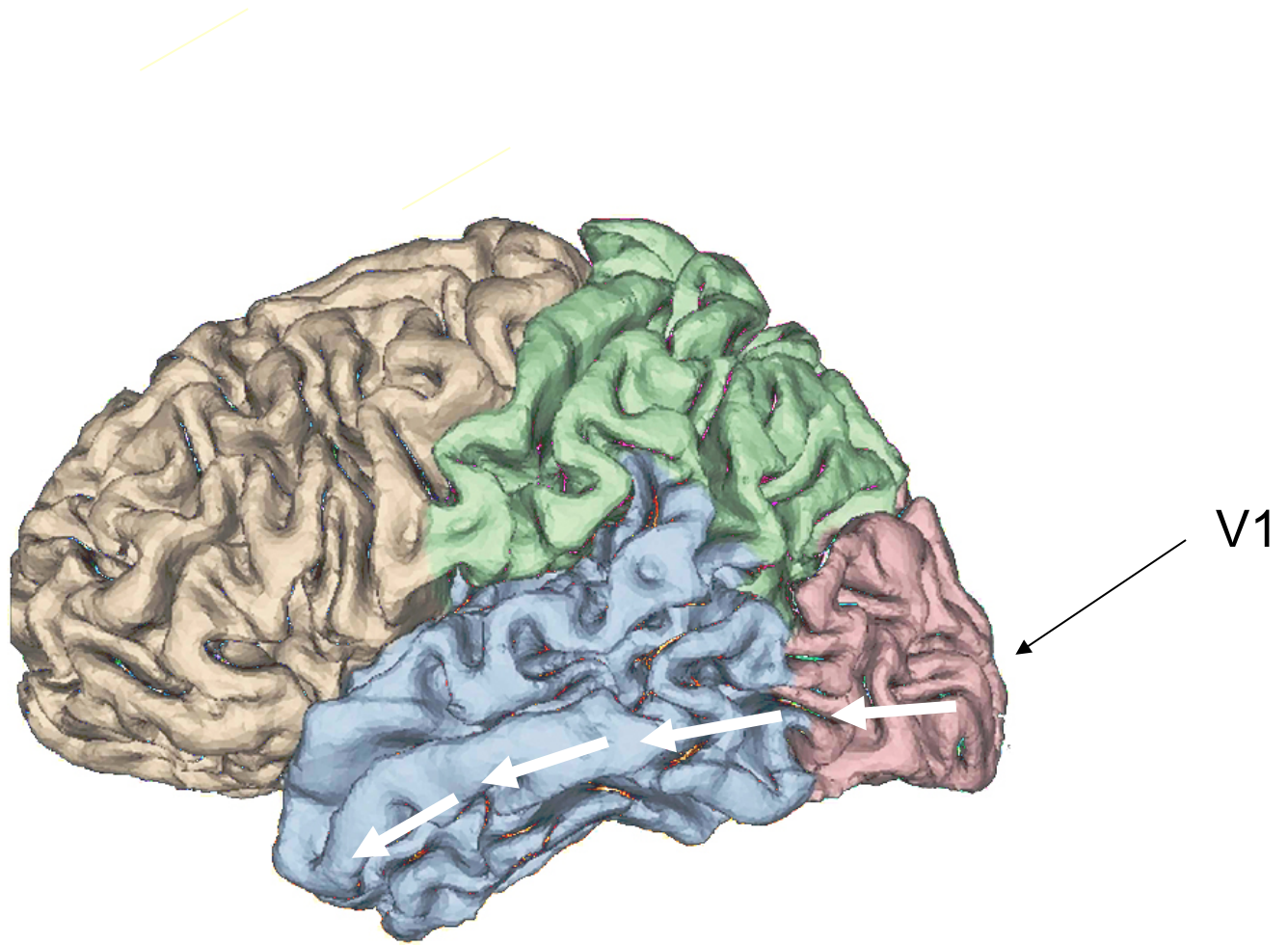
V1

Electrode

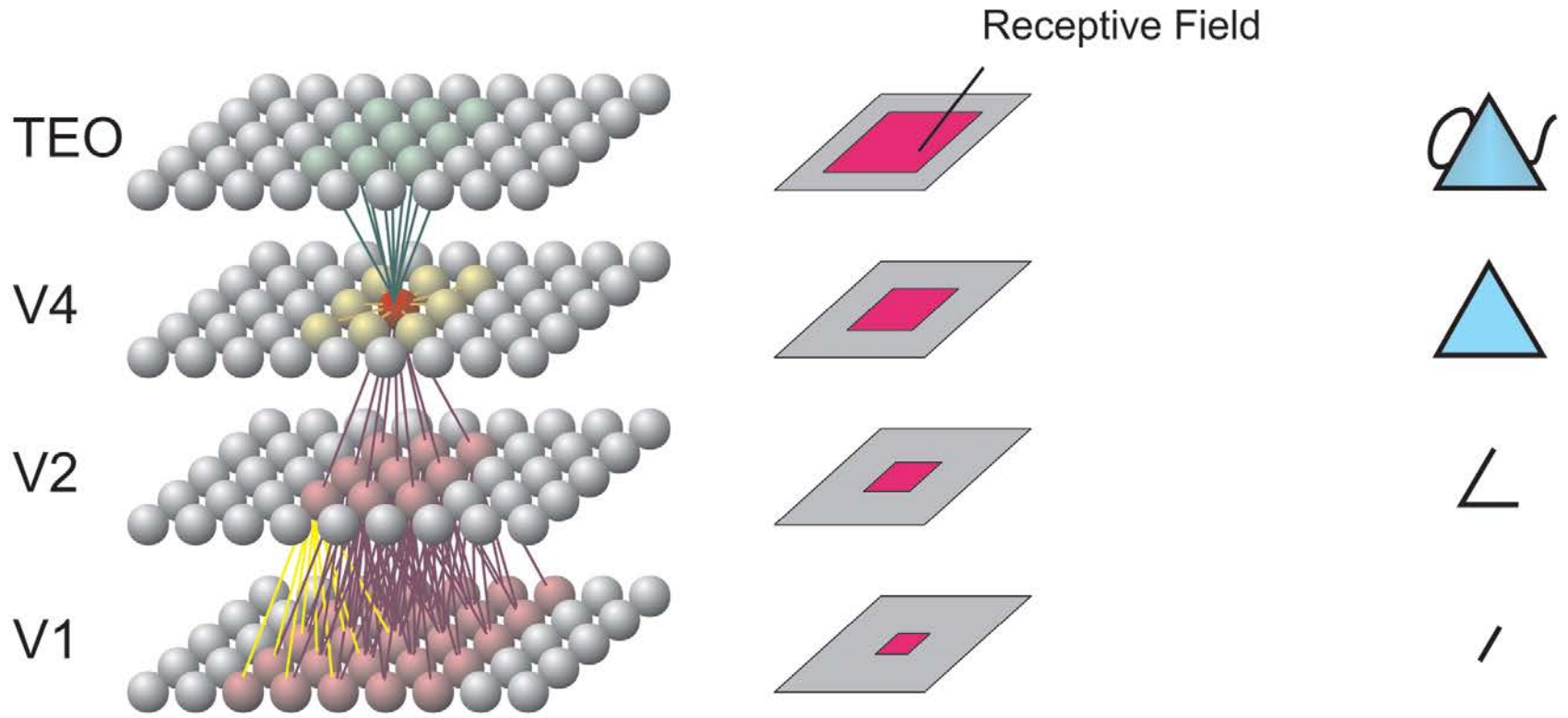


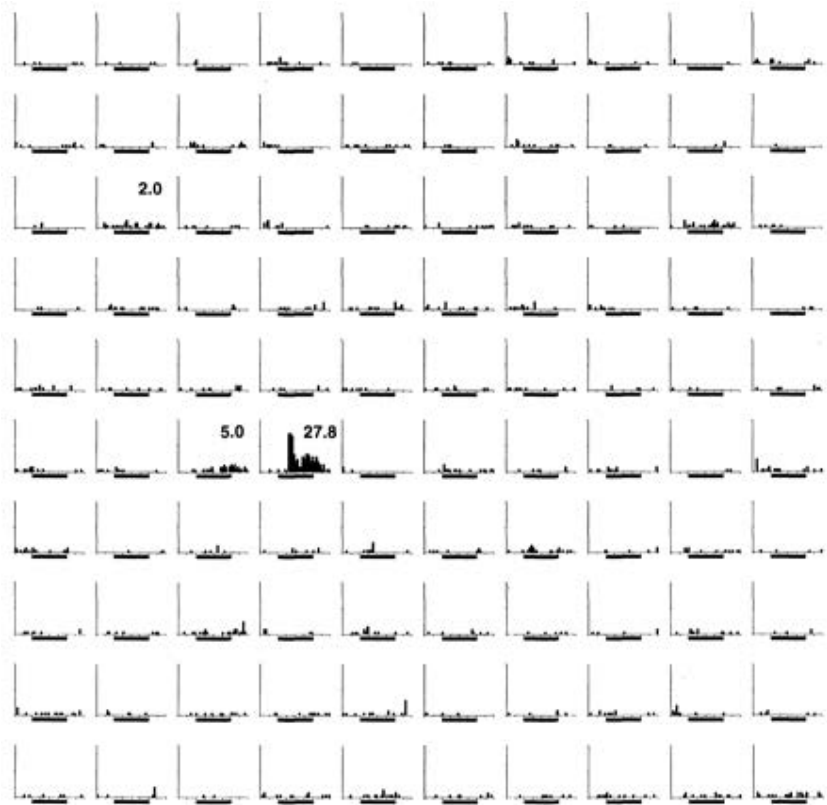
Single cell recording

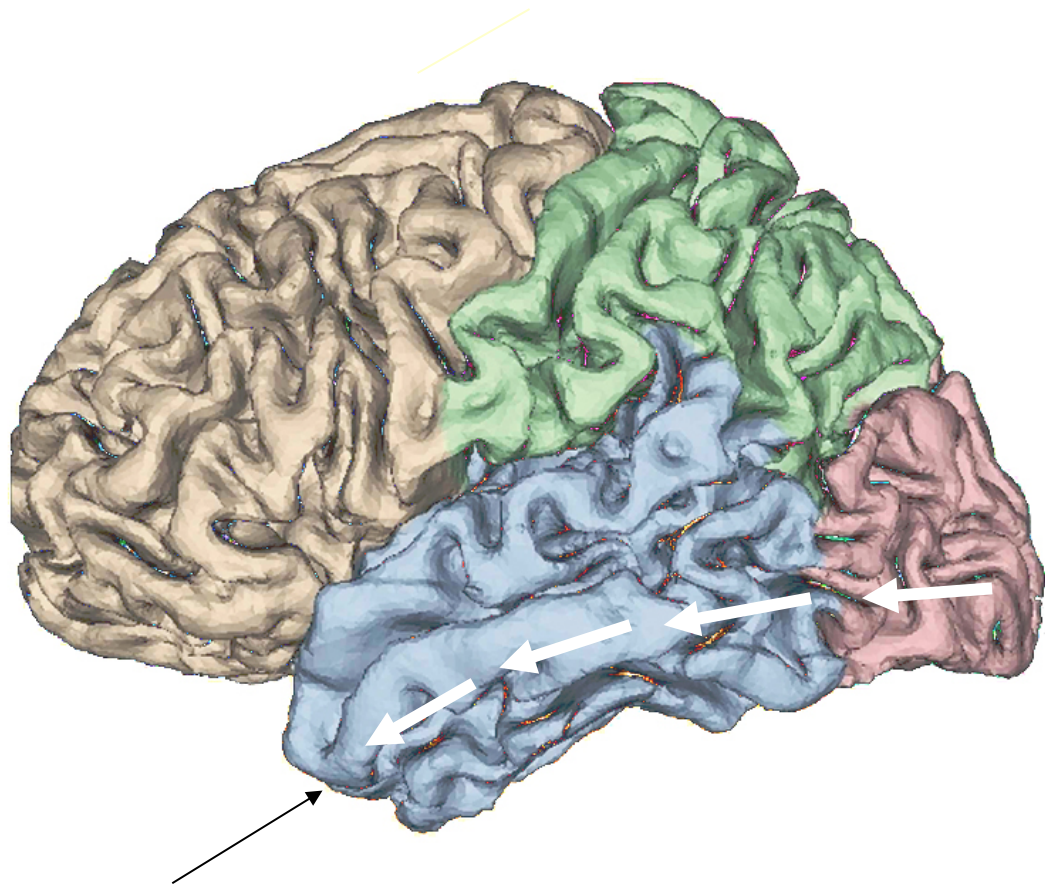




The visual cortical hierarchy



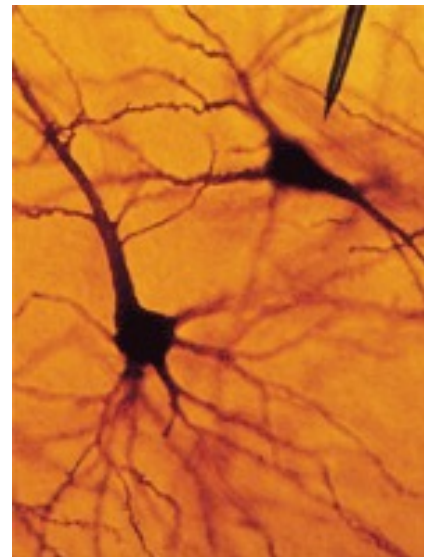


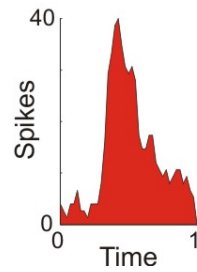
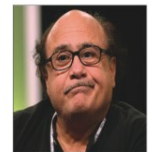
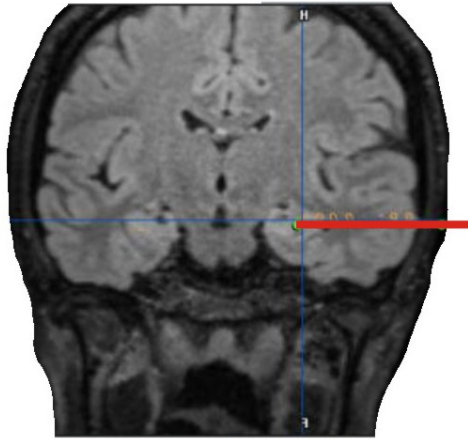
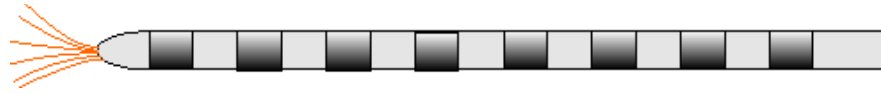


Medial temporal lobe

Single cell recording

Electrode





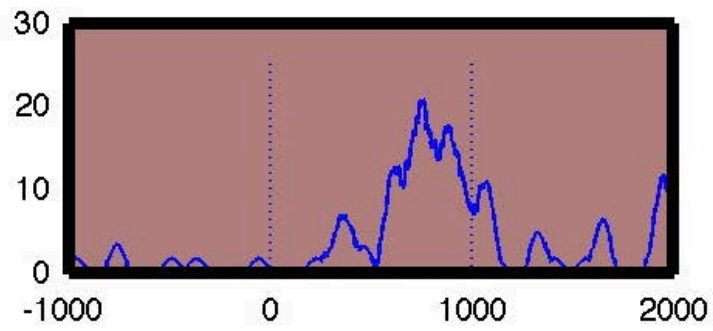
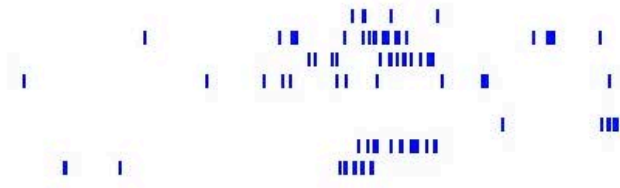
VU medisch centrum

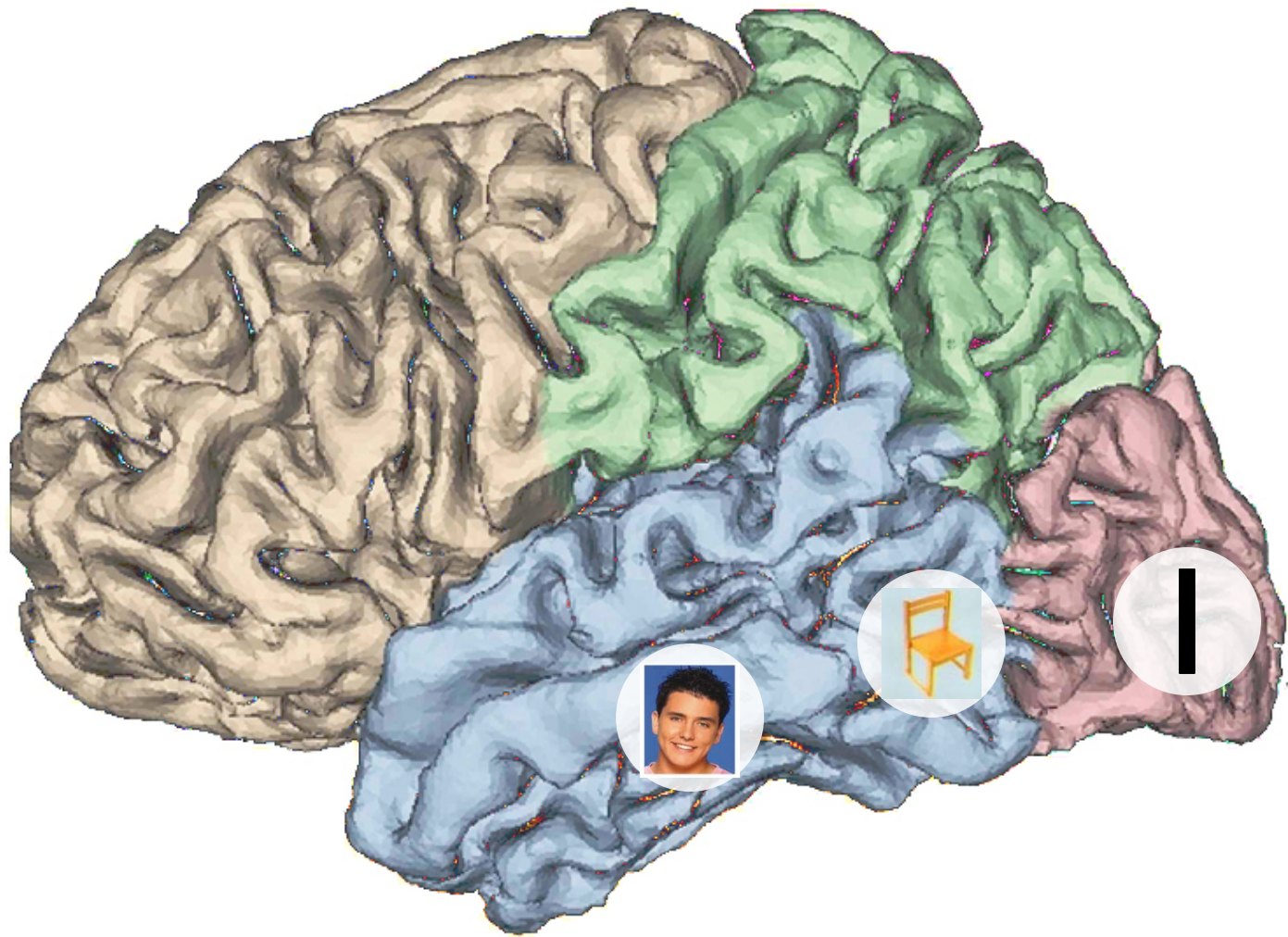


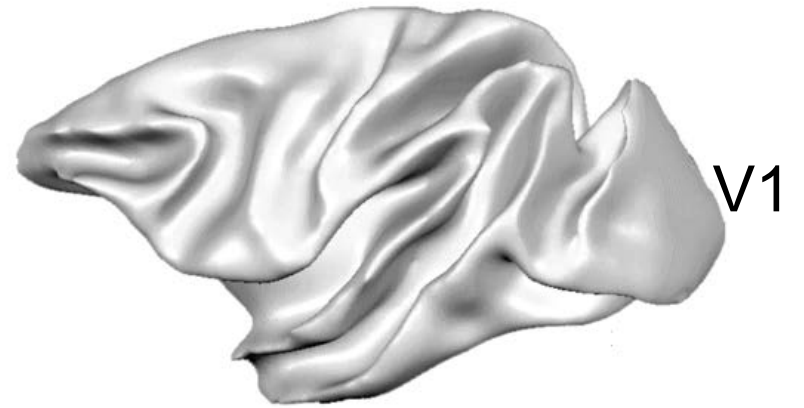
UMC Utrecht

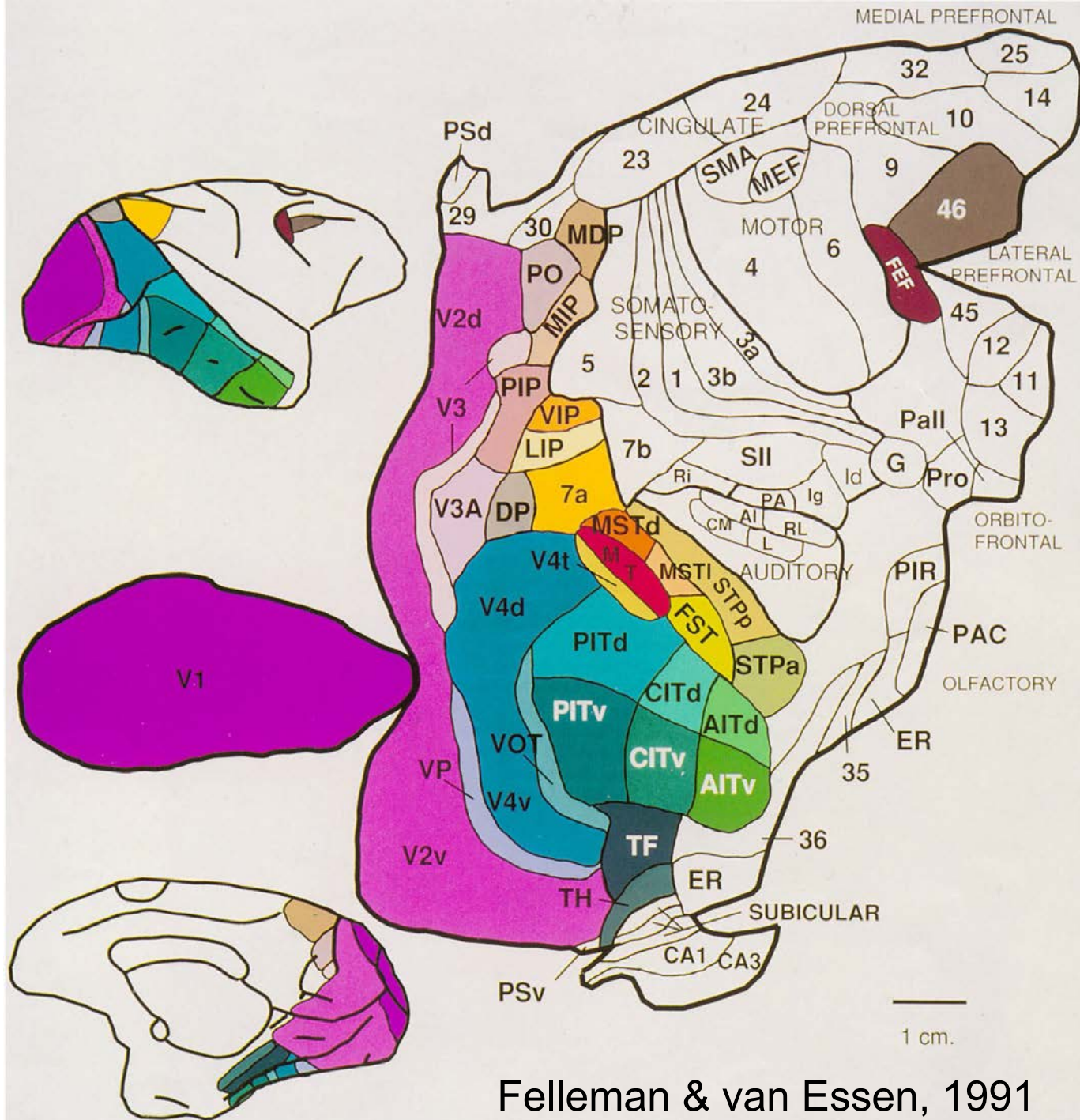


NETHERLANDS
INSTITUTE
FOR NEUROSCIENCE
Master the mind

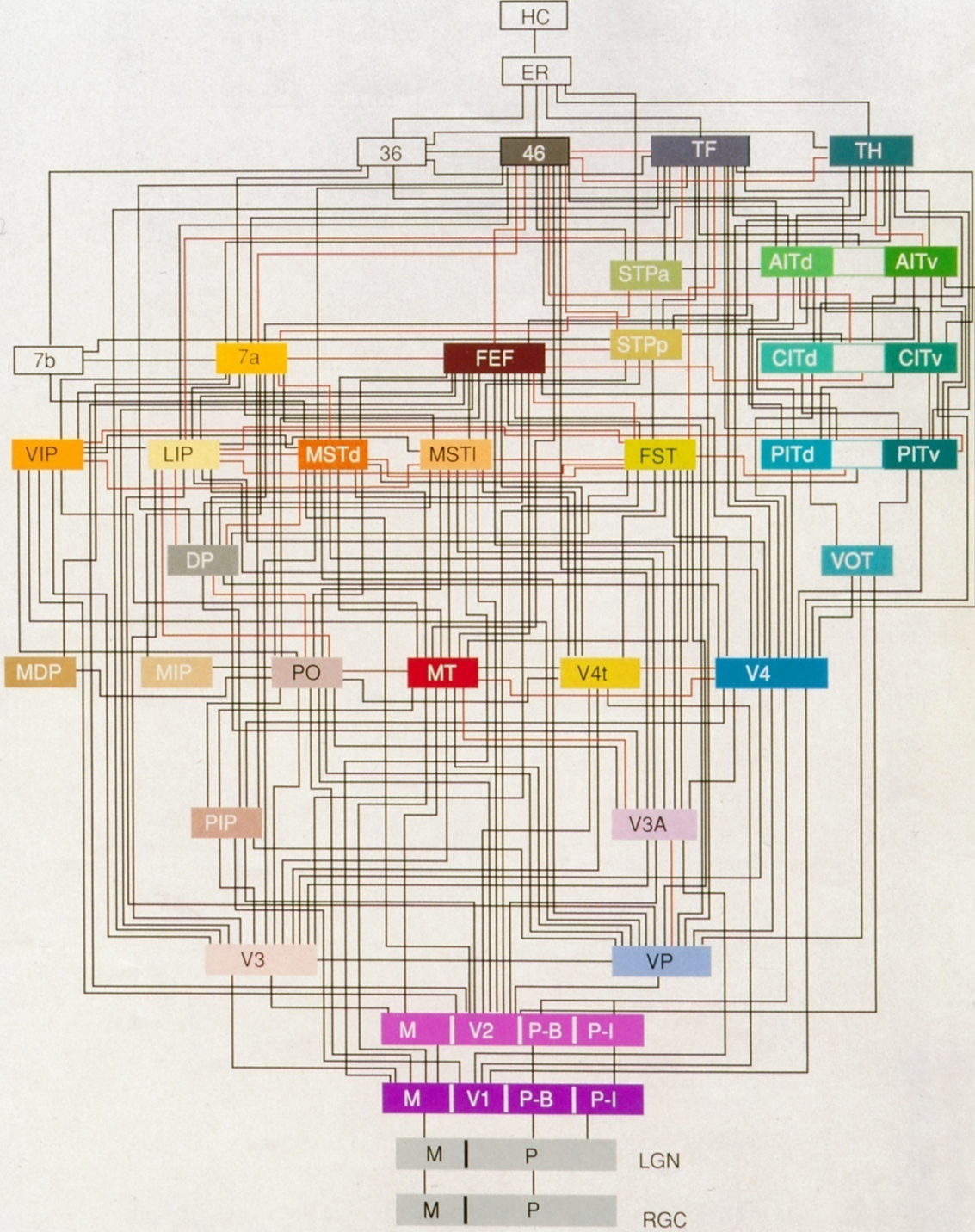




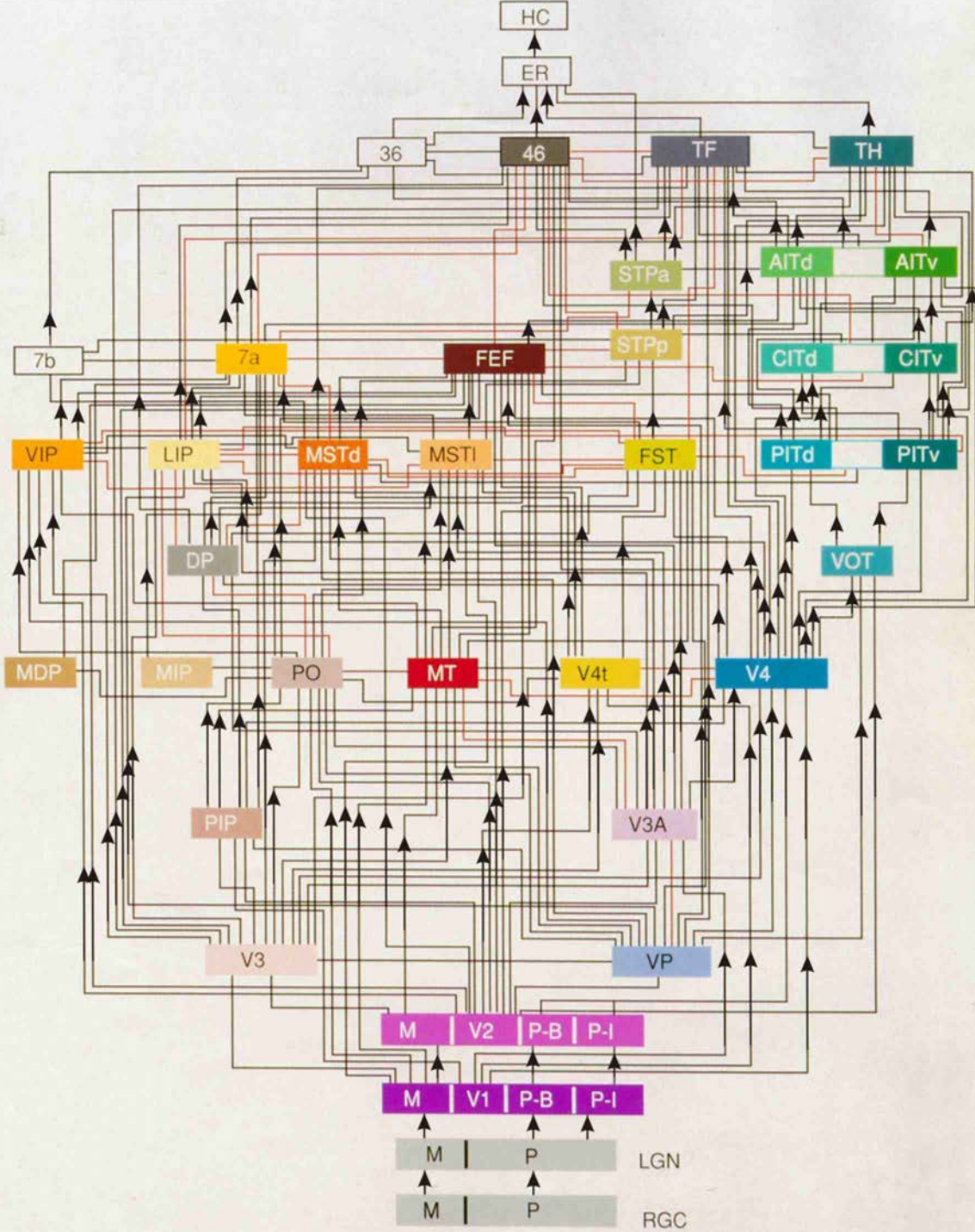




Felleman & van Essen, 1991



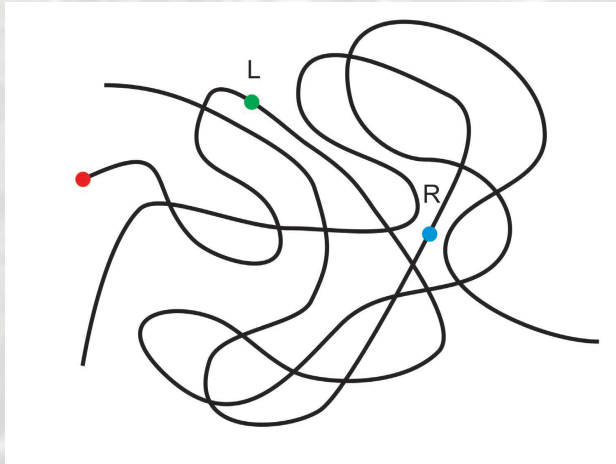
Feedforward



|

Introduction: visual cortex -- feedforward and feedback processing

Contour grouping

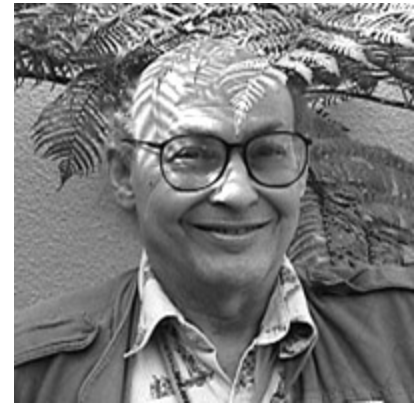


Prosthesis



To explain the mind, we have to show how minds are built from mindless stuff, from parts that are much smaller and simpler than anything we'd consider smart.

Marvin Minsky, Society of Mind, 1985

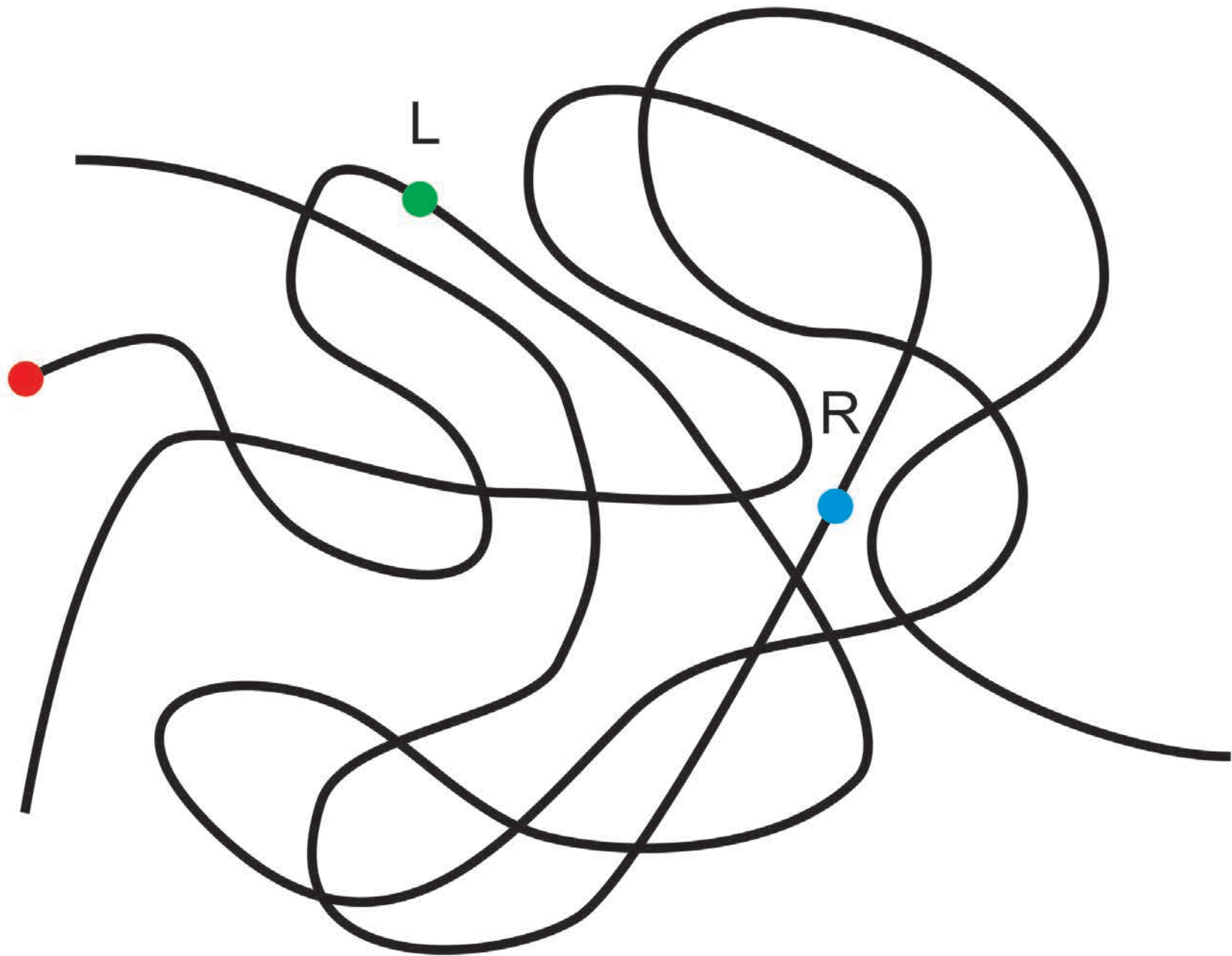


L



R

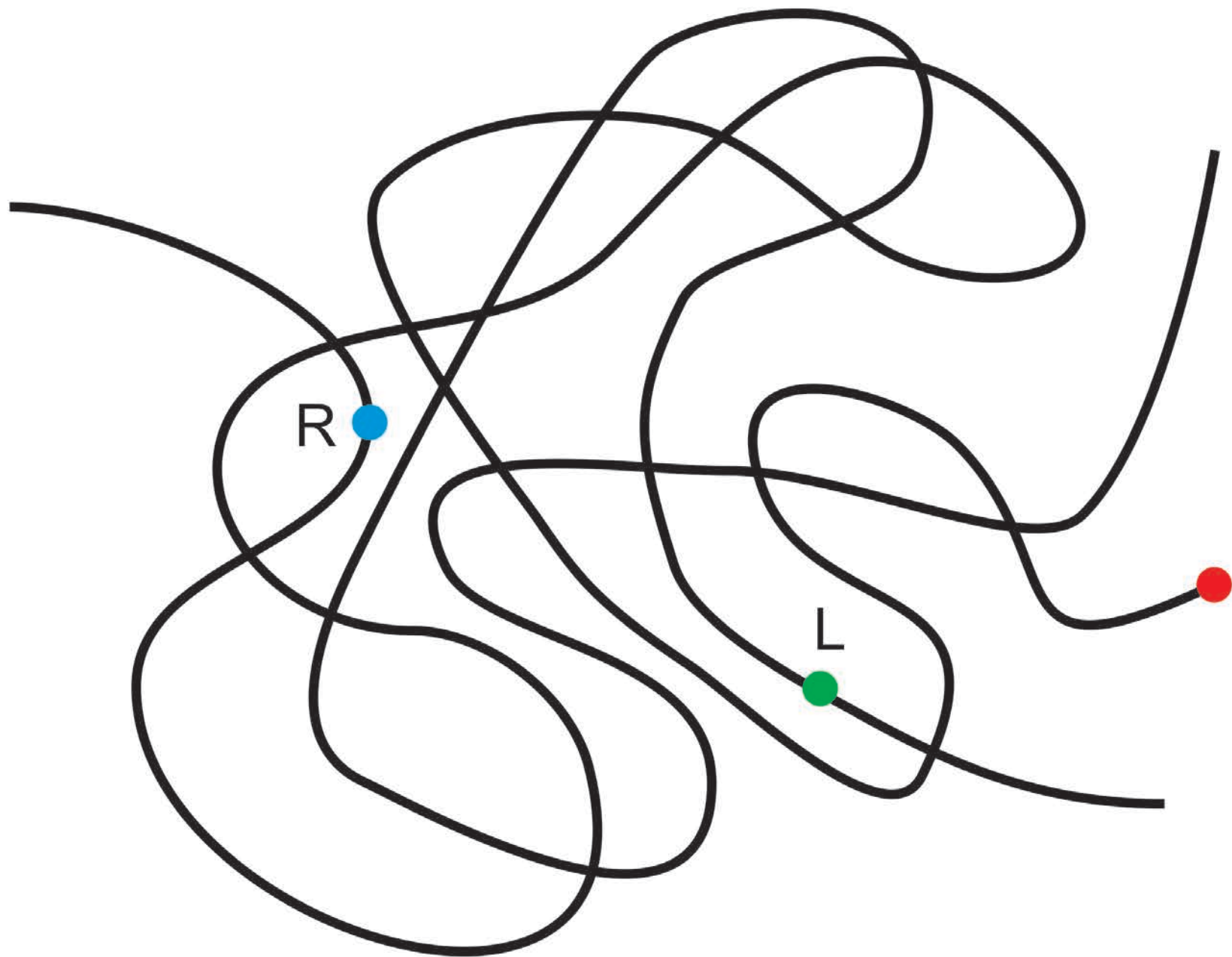




R ●

L ●



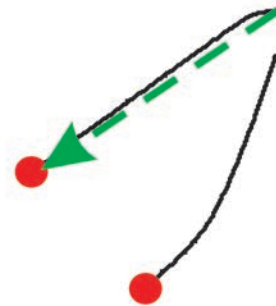
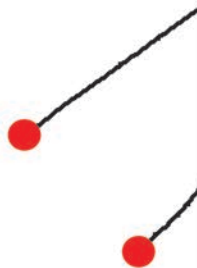


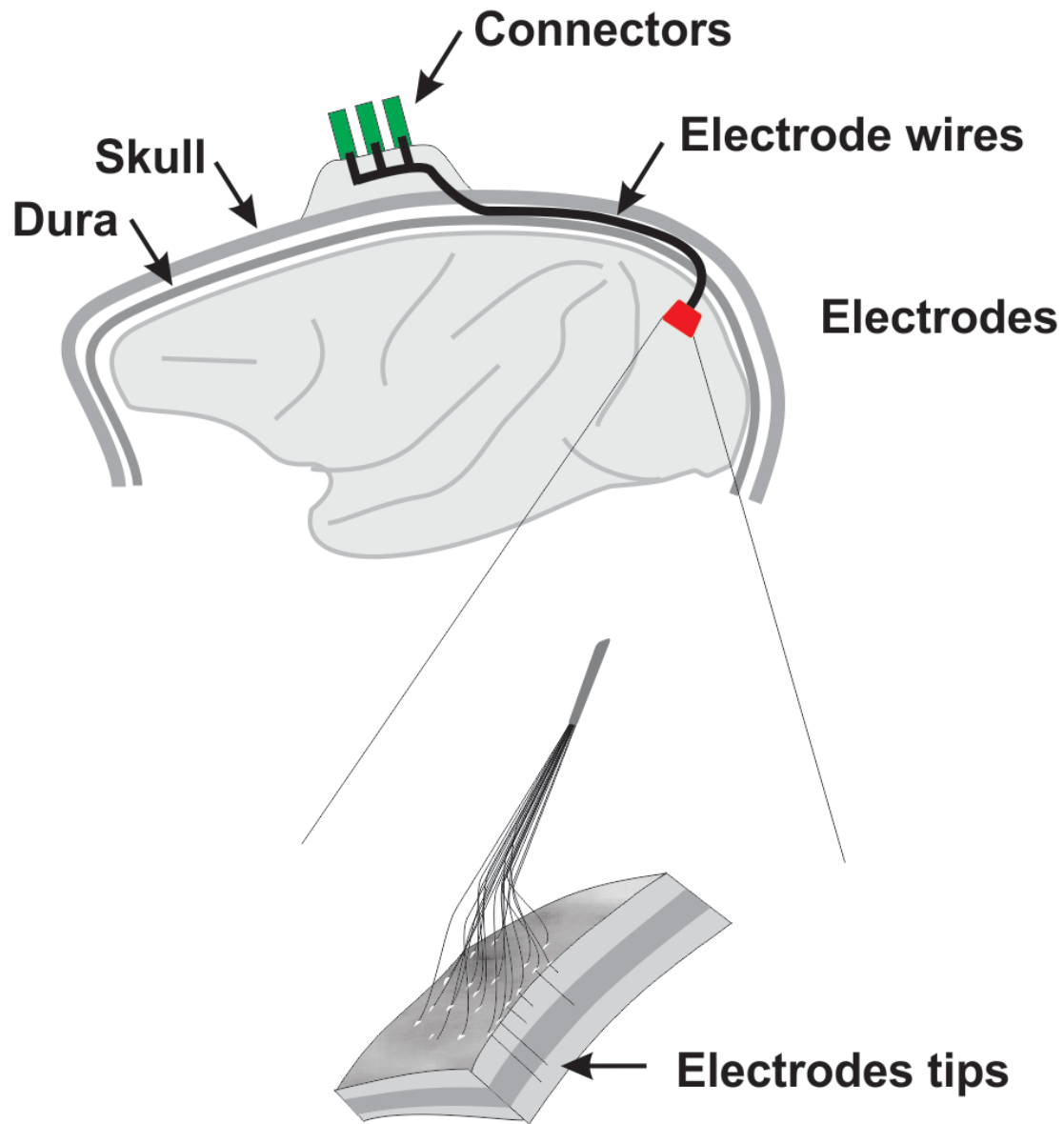
The task: a saccade to a target connected to the fixation point

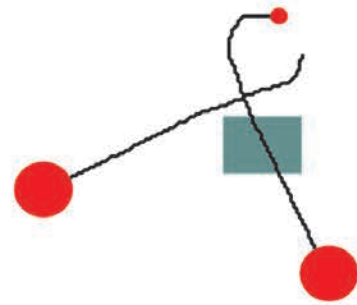
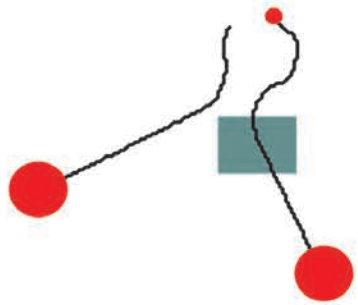
Fixation (300 ms)

Stimulus (600 ms)

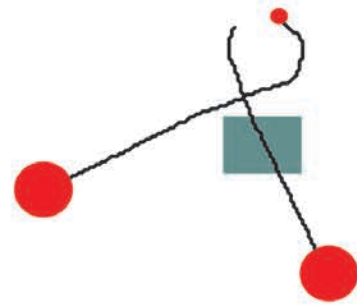
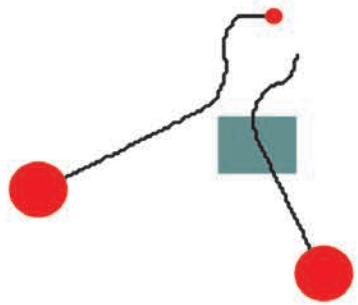
Saccade





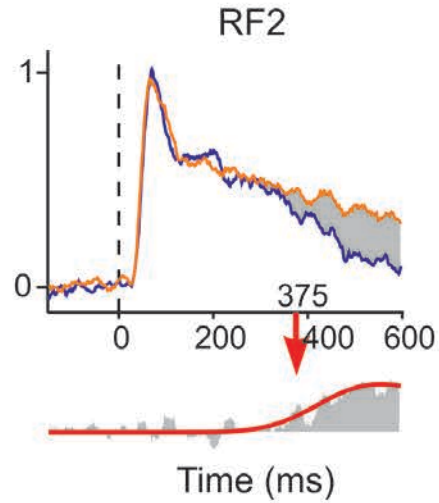
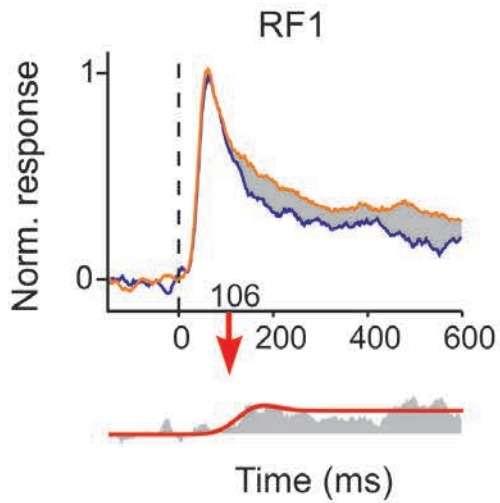
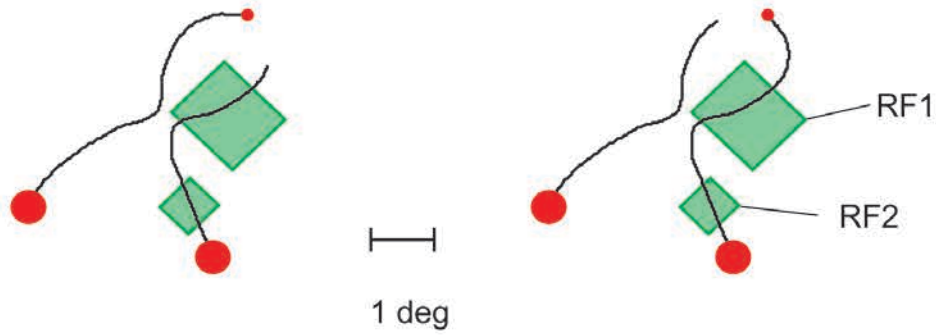


1 deg

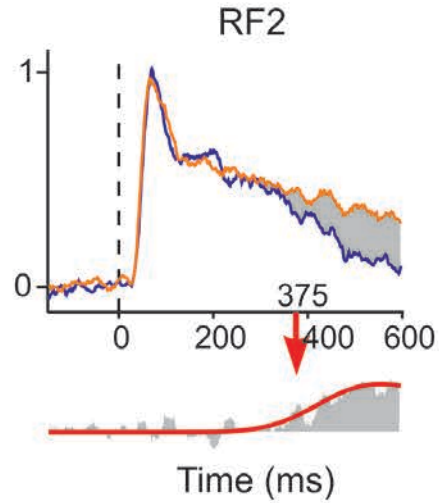
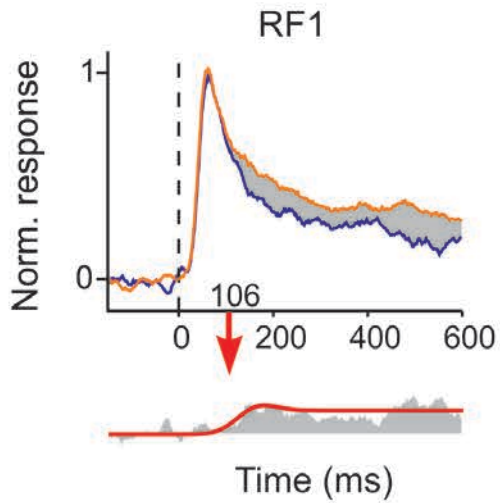
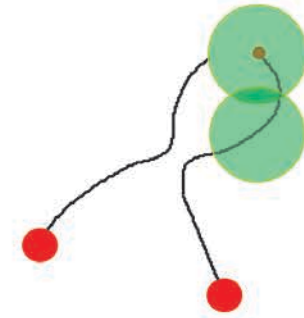
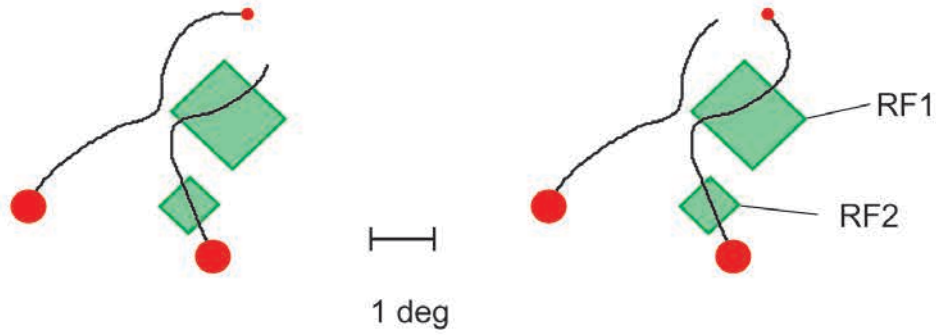




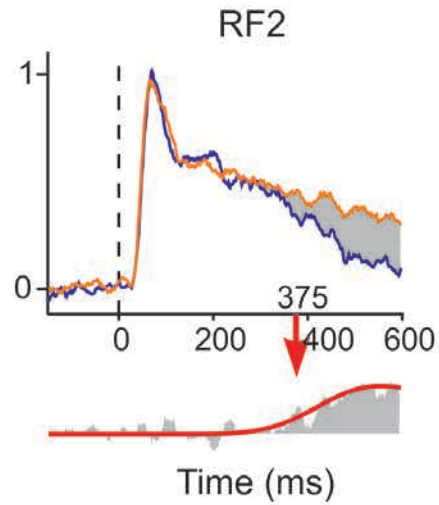
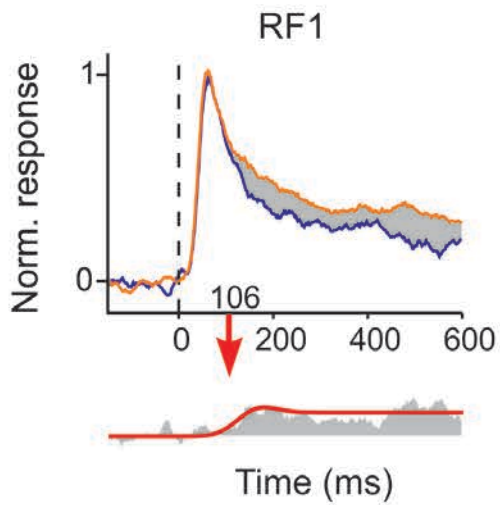
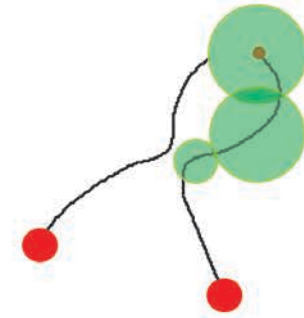
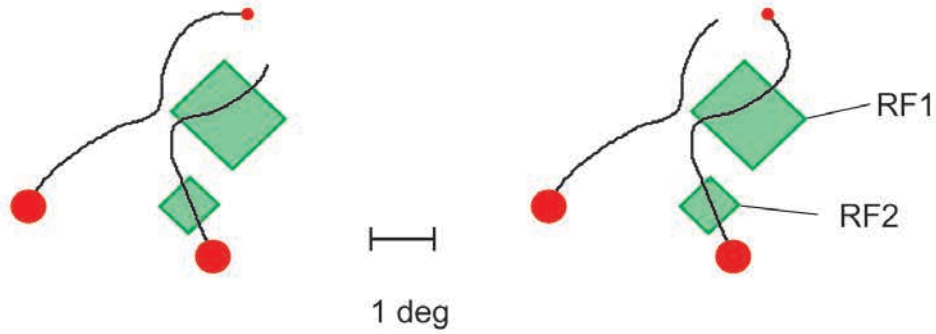
Arezoo Pooresmaeili



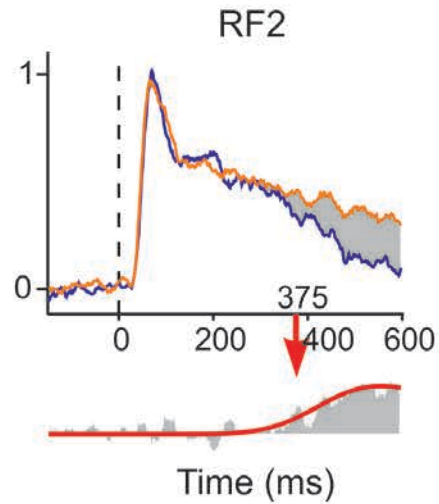
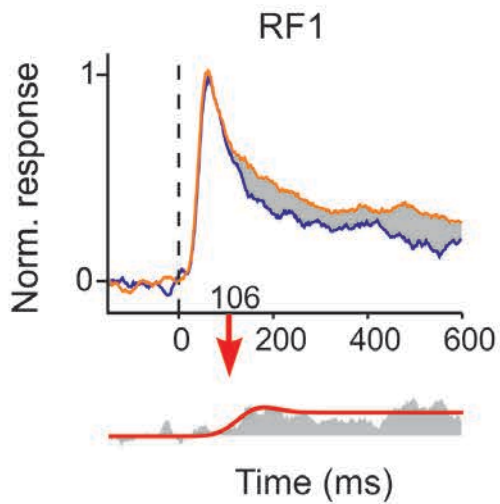
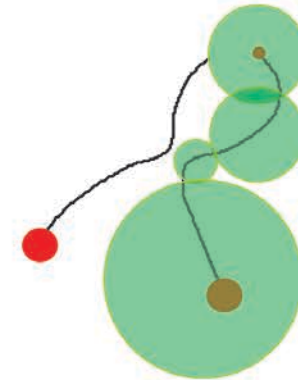
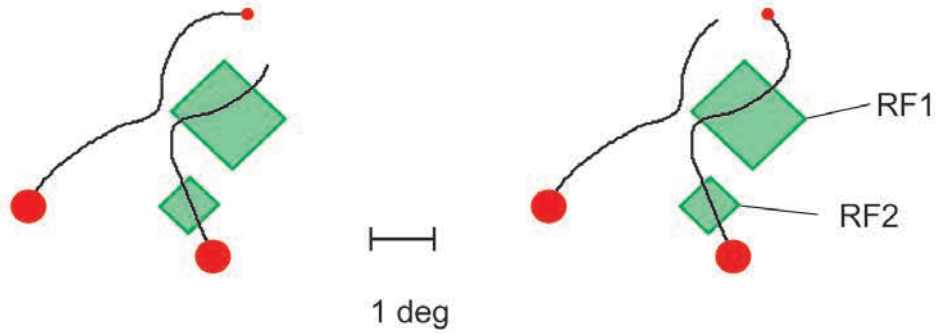
Growth cone

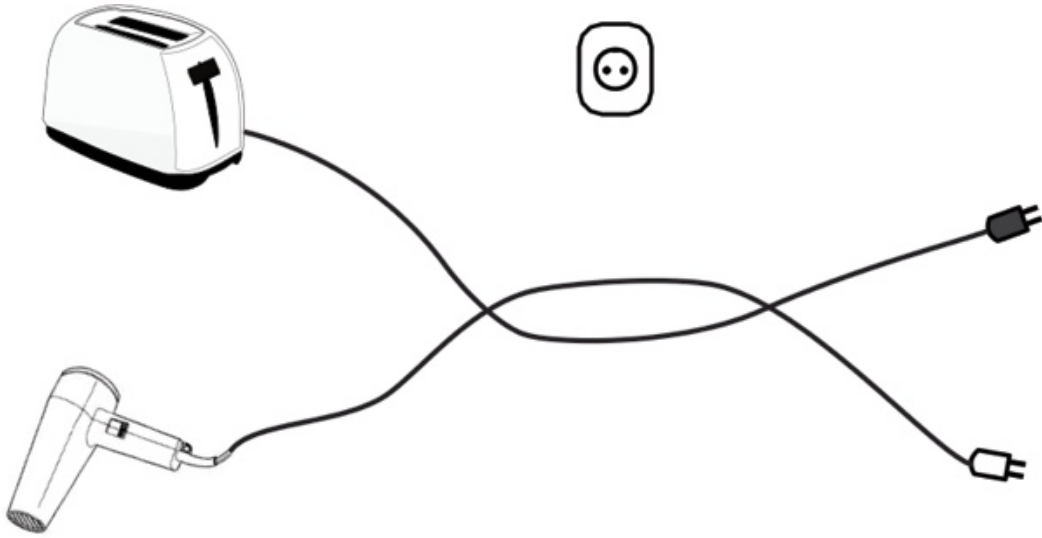


Growth cone

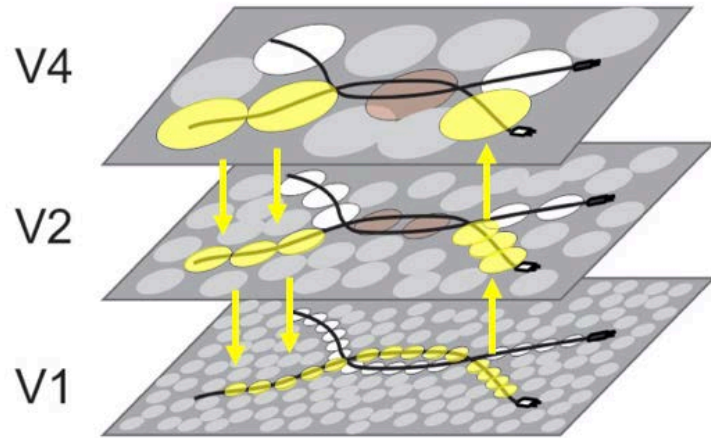


Growth cone

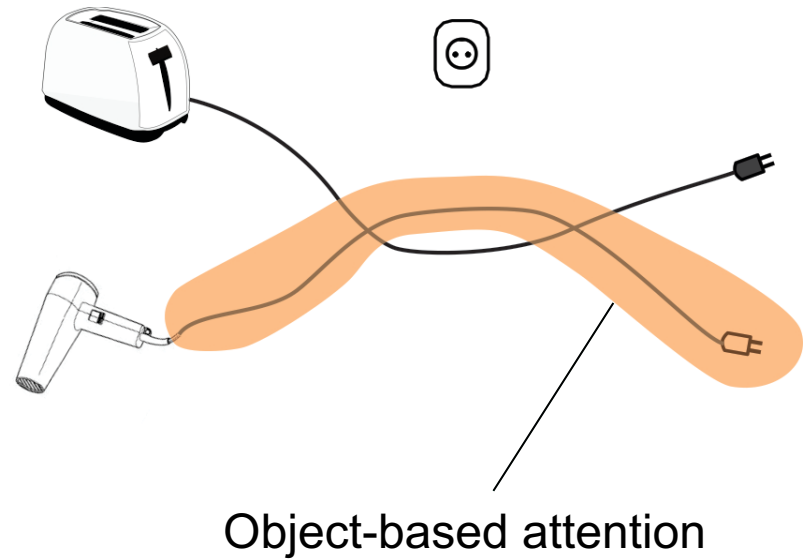




Neurophysiology



Psychology



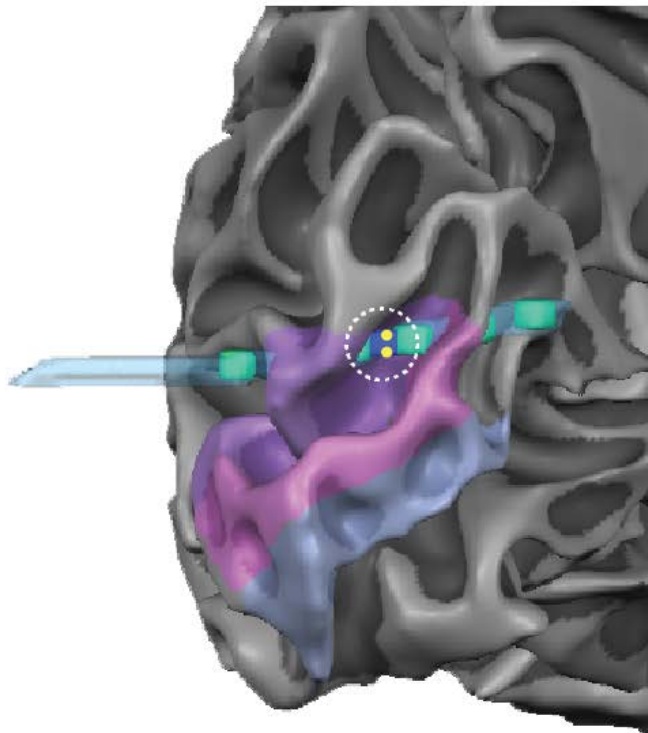
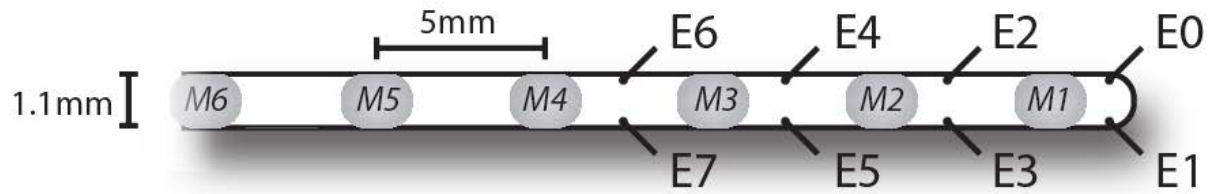


Matt Self, Jessy Possel, Judith Peters, Hans Baaijen

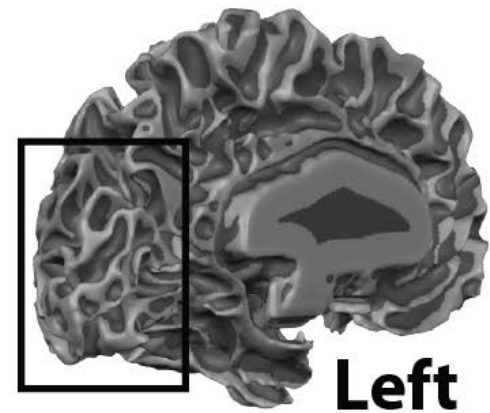


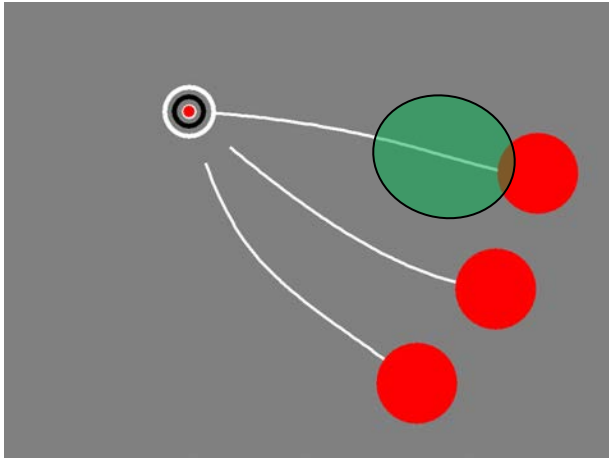
Human V3

MRI electrode localisation

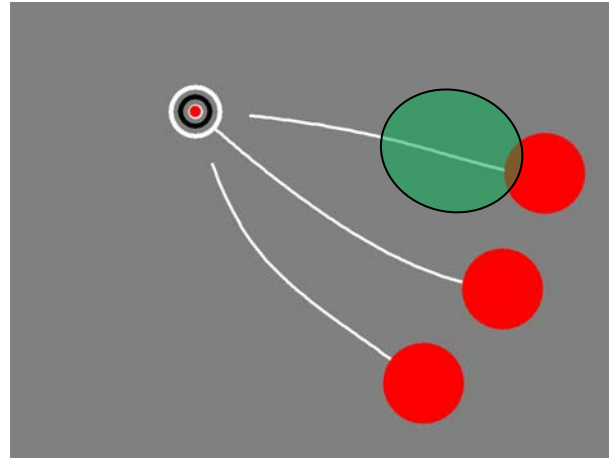


- V1d
- V2d
- V3d

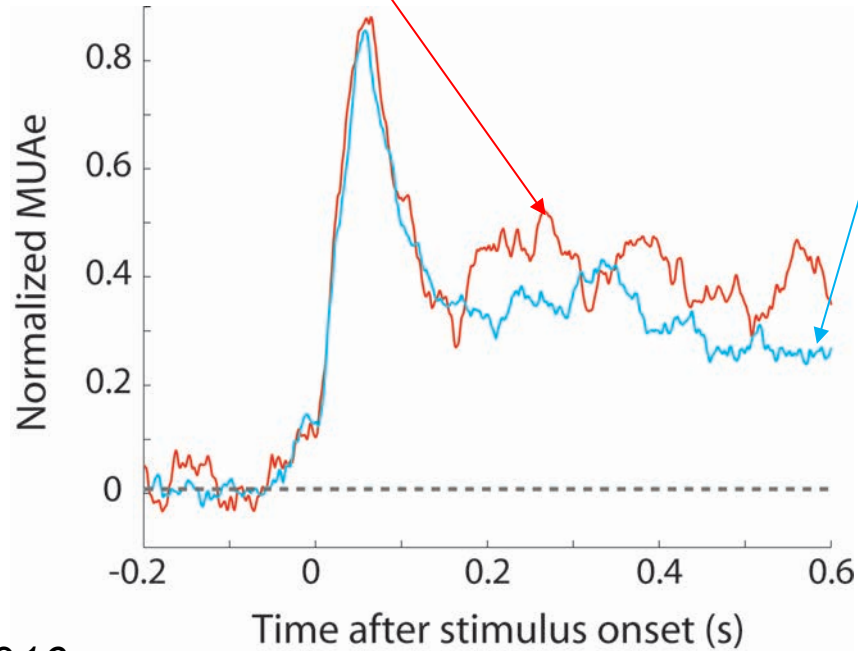




Target



Distracter



To explain the mind, we have to show how minds are built from mindless stuff, from parts that are much smaller and simpler than anything we'd consider smart.

Marvin Minsky, Society of Mind, 1985

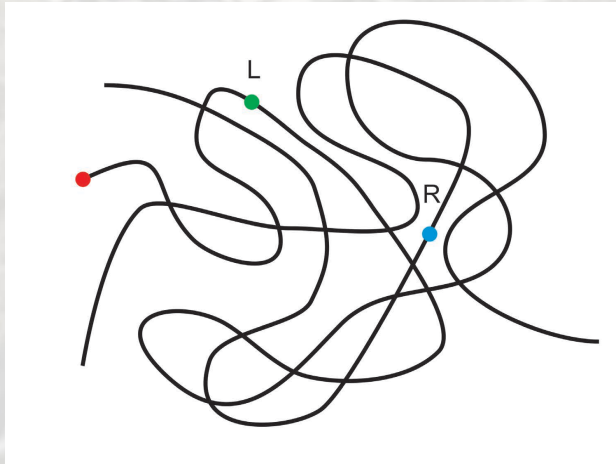


Neurons in the visual cortex are detectors for contours and complex shapes. They do not contain thoughts.

‘Thinking’ happens in the interaction between these nerve cells.

Introduction: visual cortex -- feedforward and feedback processing

Contour grouping



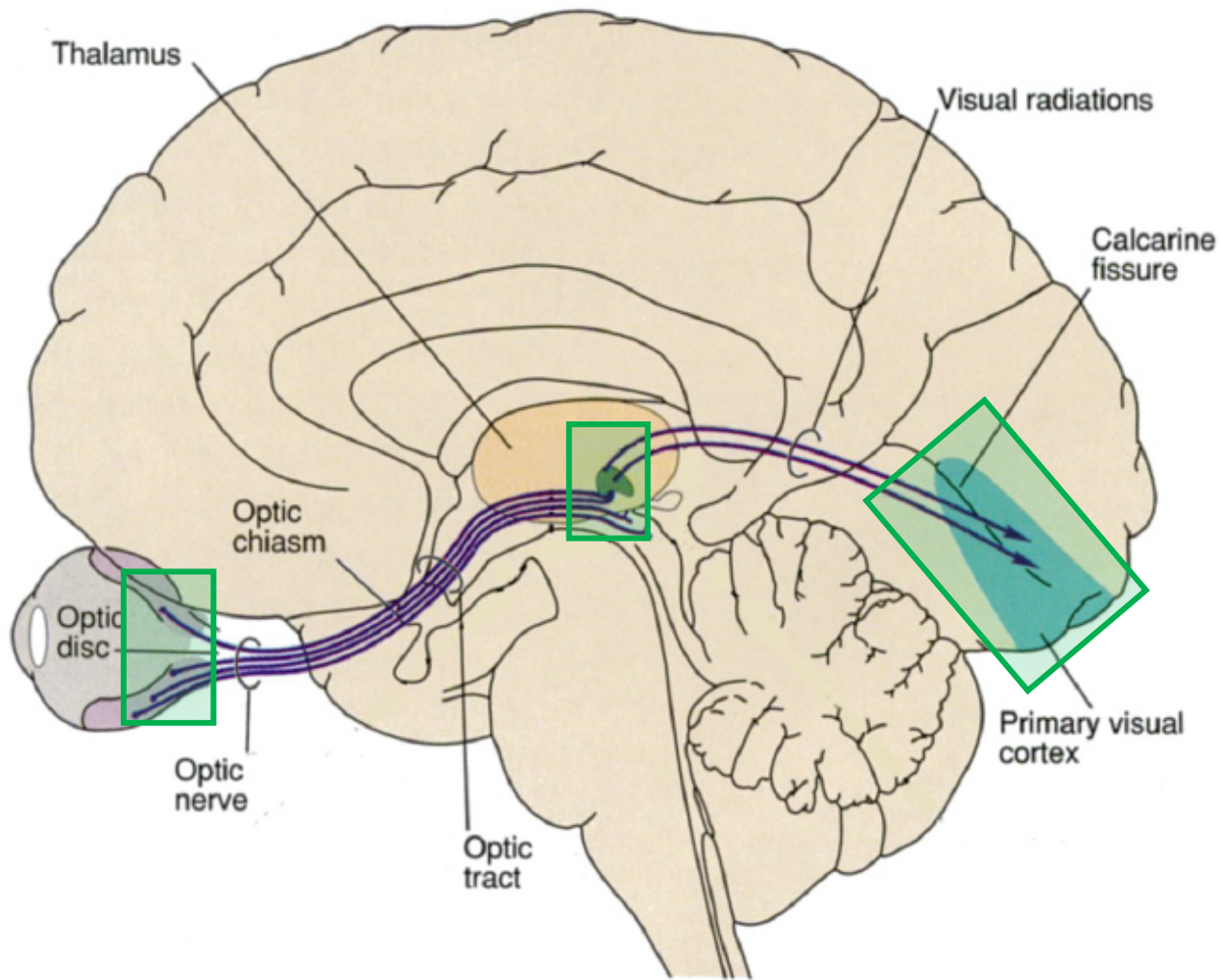
Prosthesis

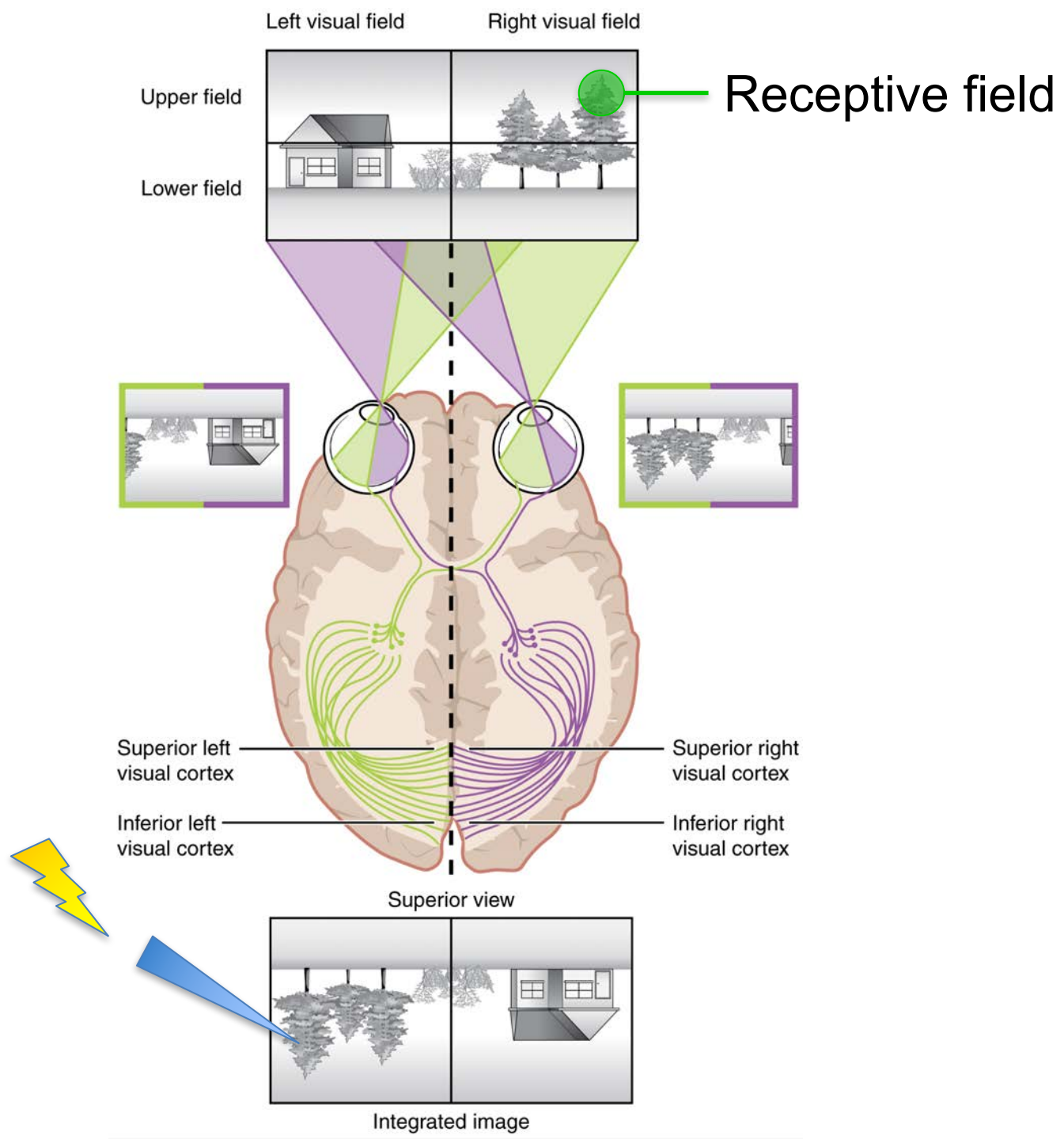




40,000,000 blind people

many will not benefit from retinal chip





Left visual field

Right visual field

Upper field

Lower field

Receptive field

Superior left visual cortex

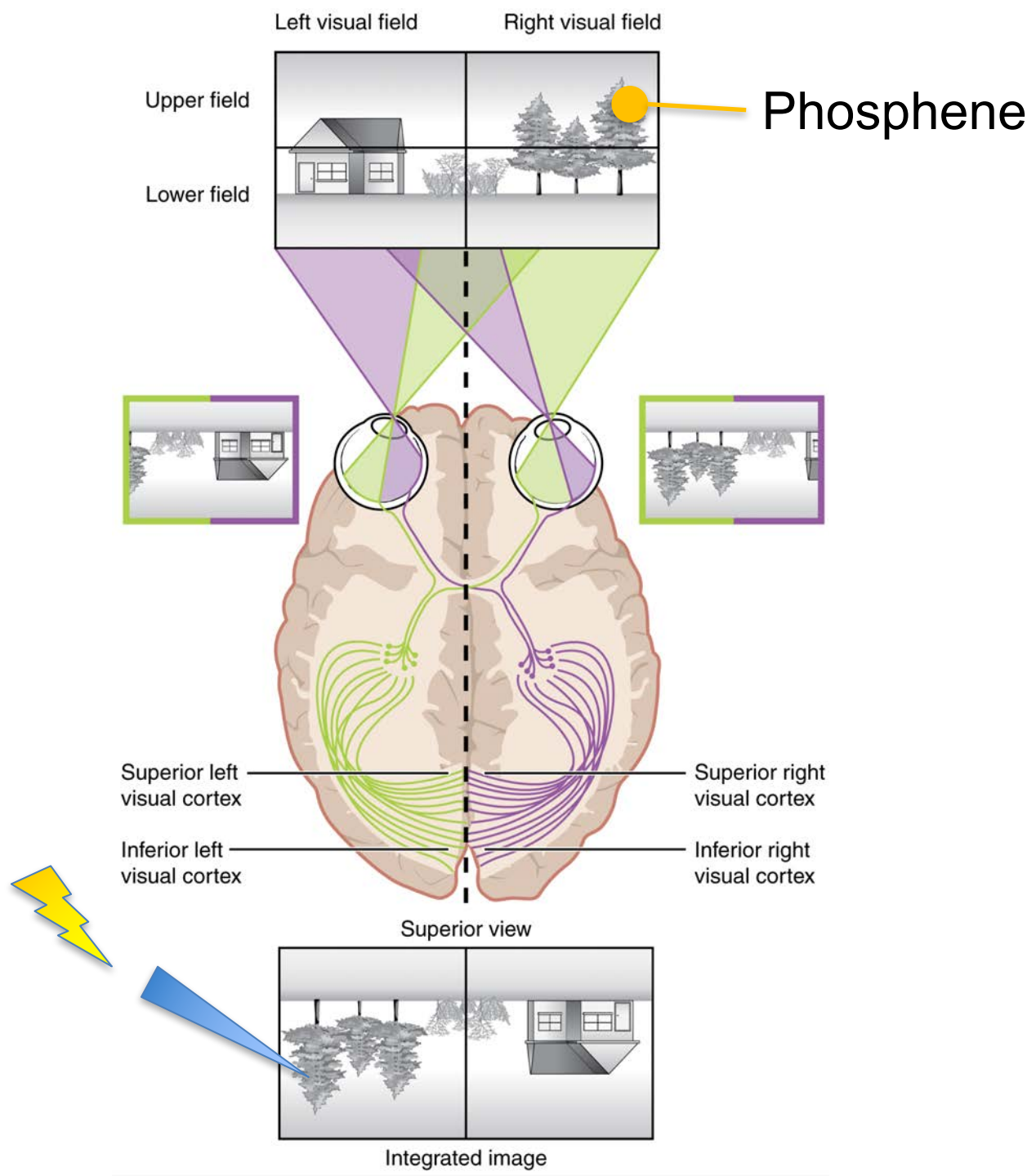
Inferior left visual cortex

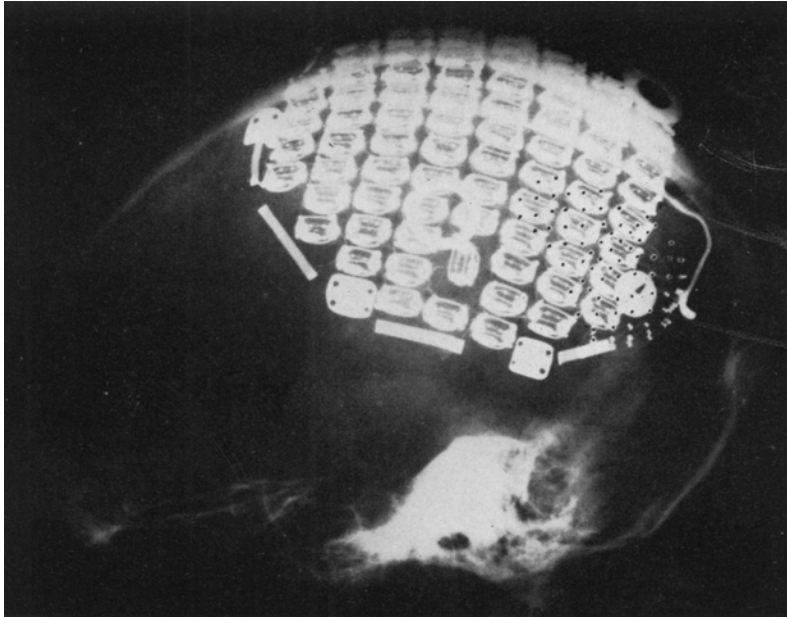
Superior right visual cortex

Inferior right visual cortex

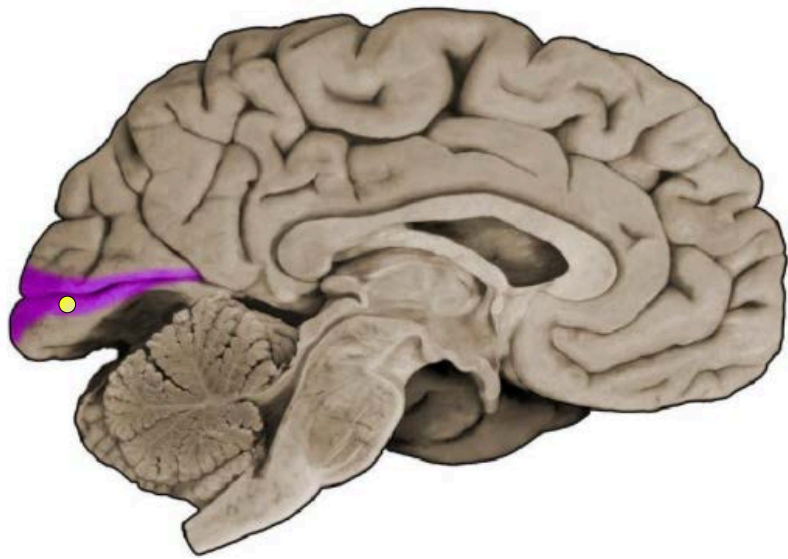
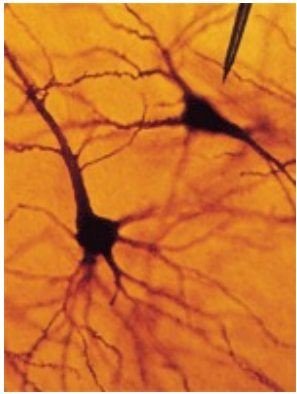
Superior view

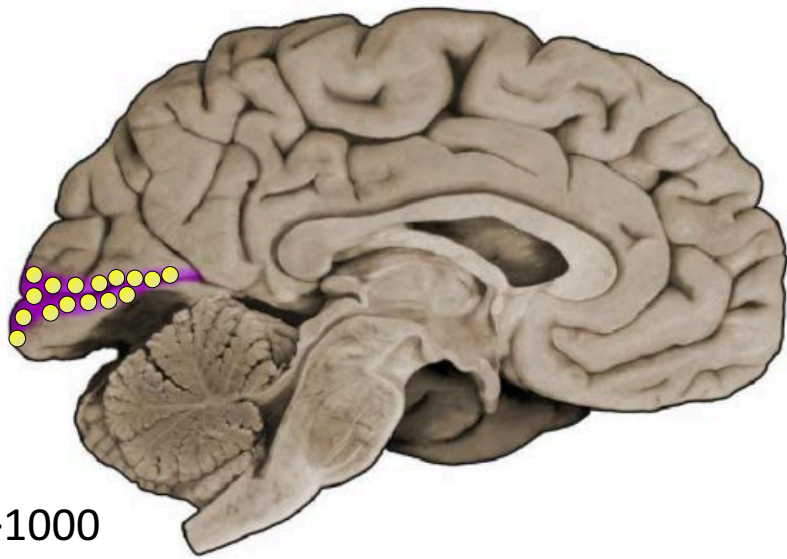
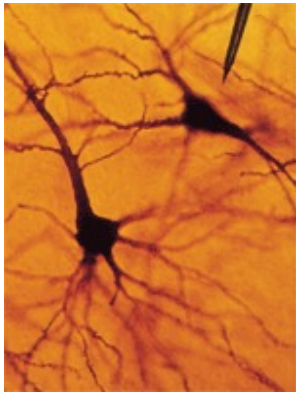
Integrated image



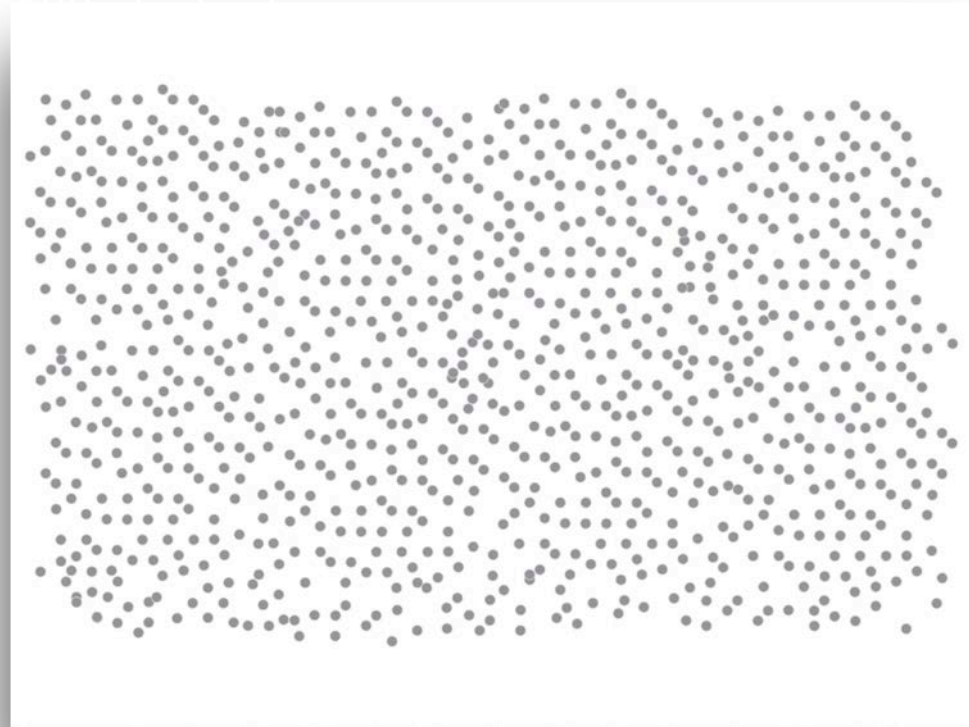


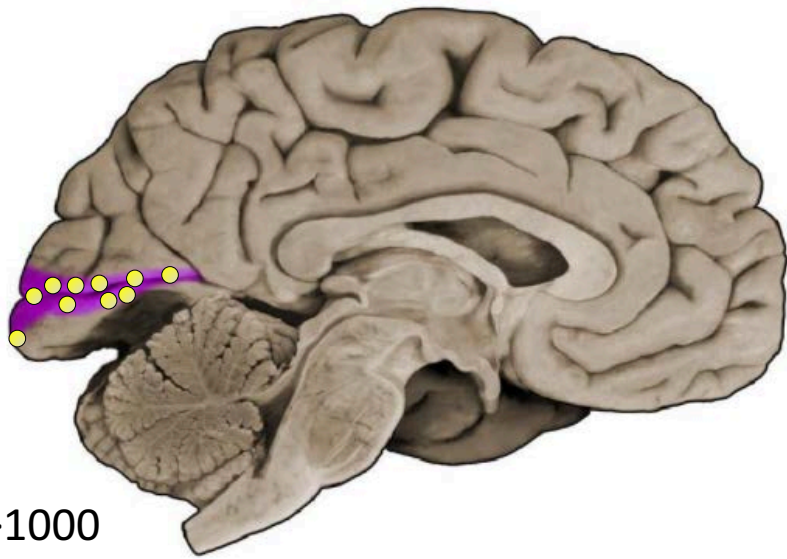
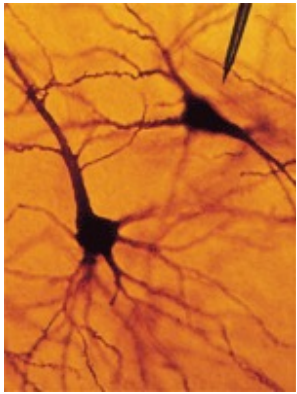
Giles Brindley et al., 1968, and later



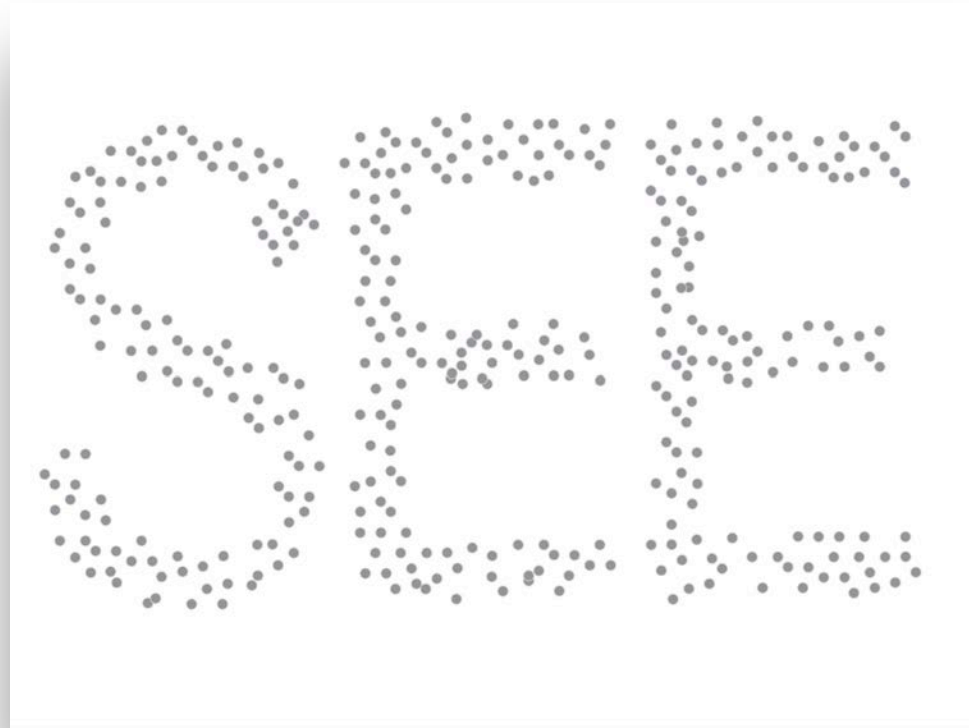


>1000

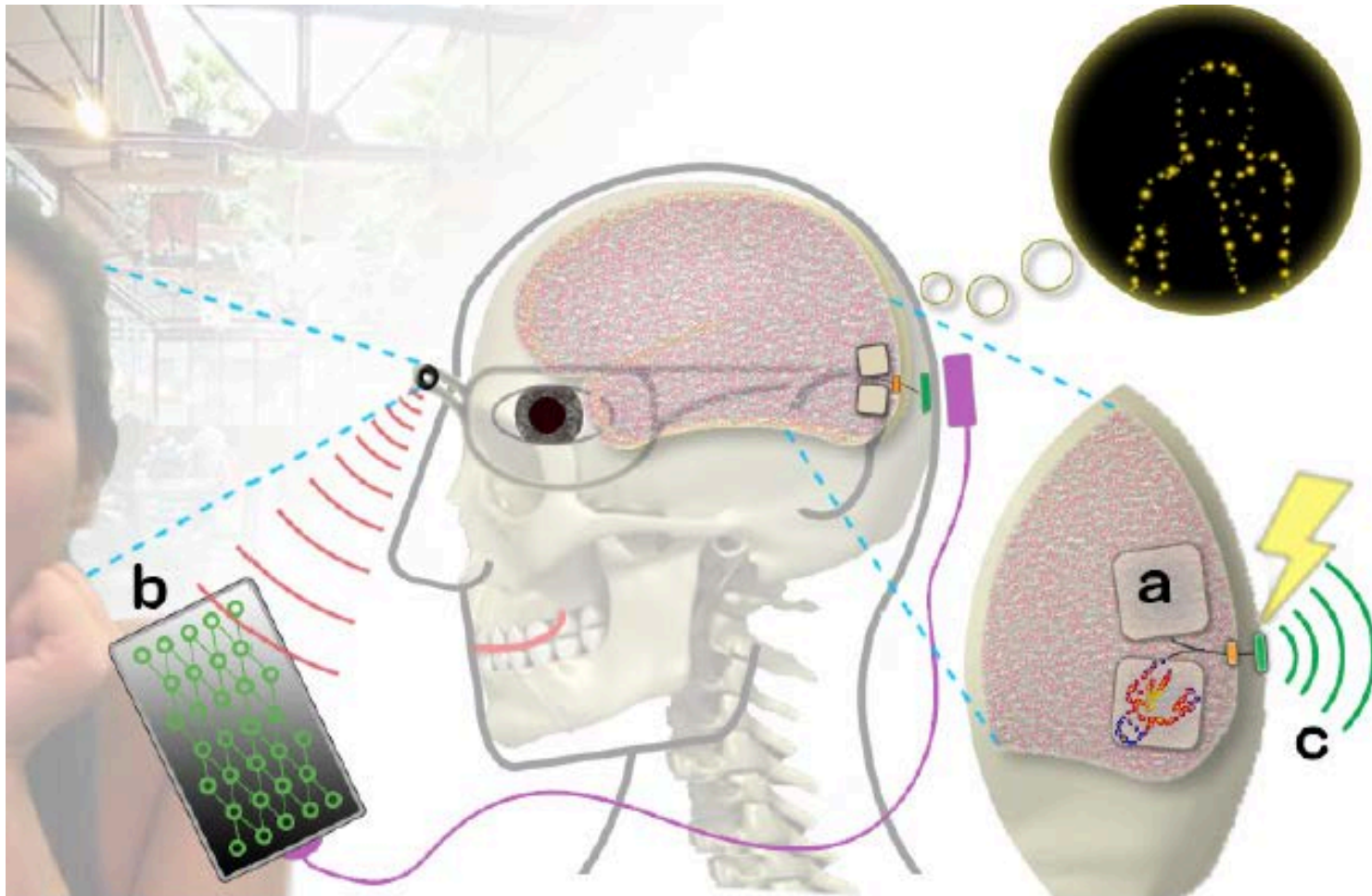


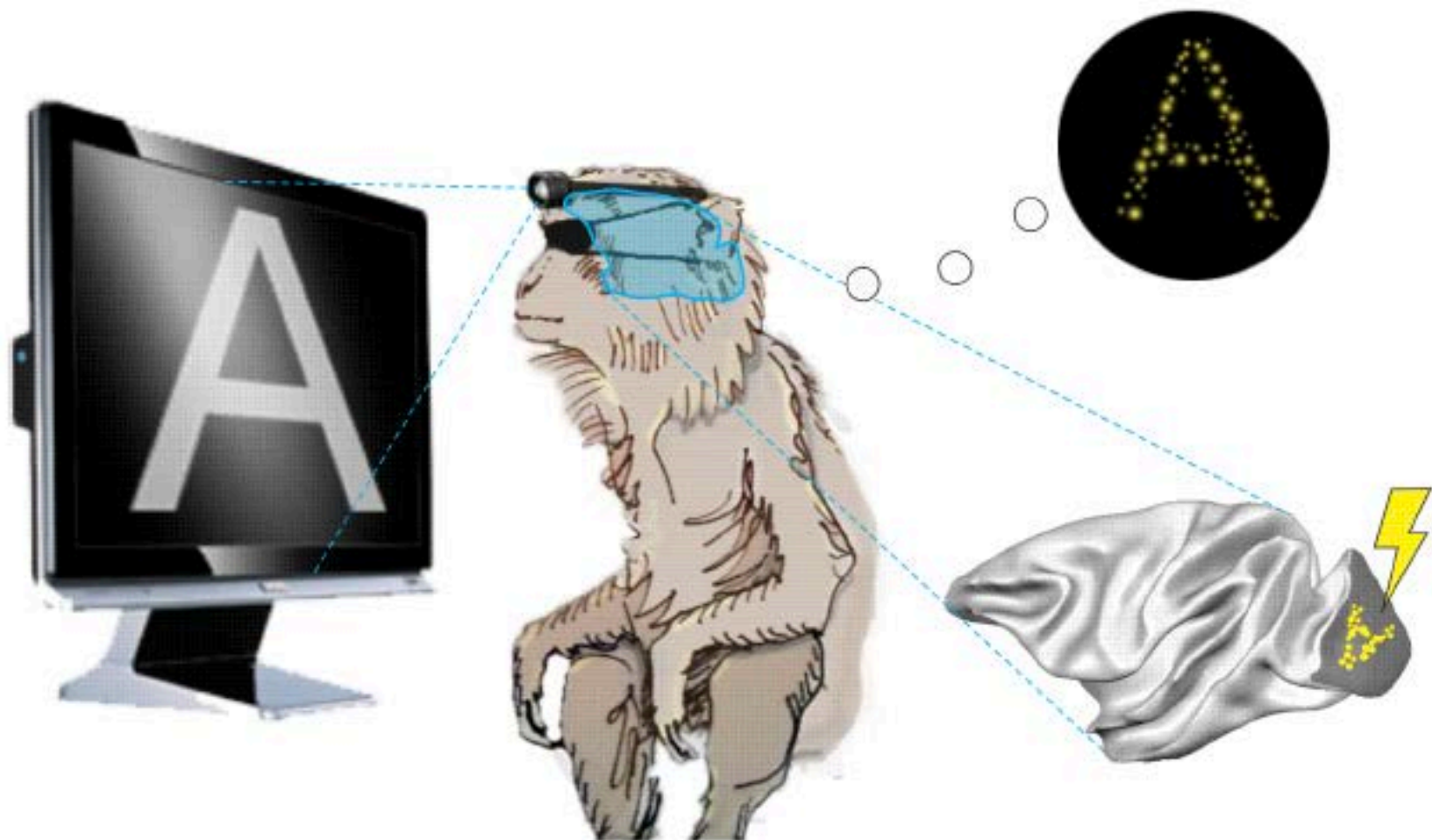


>1000

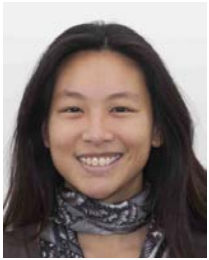
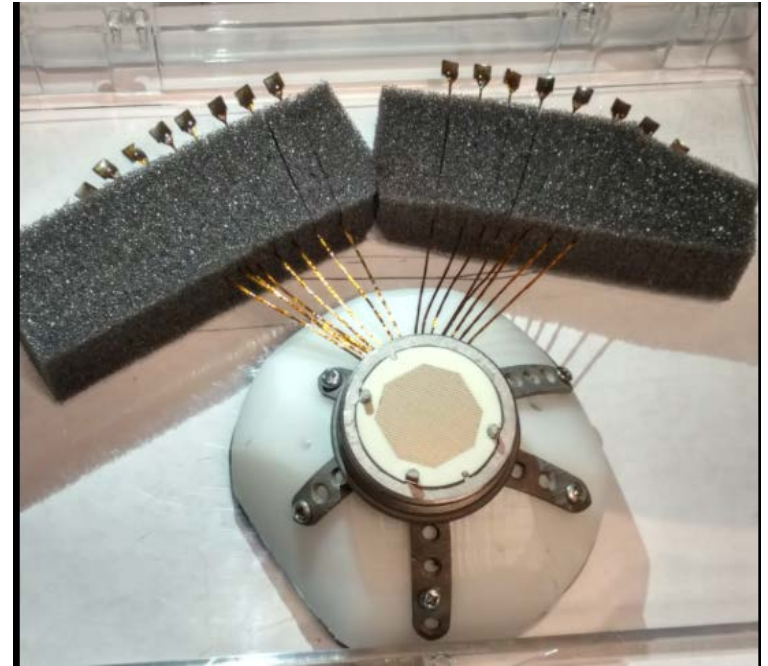
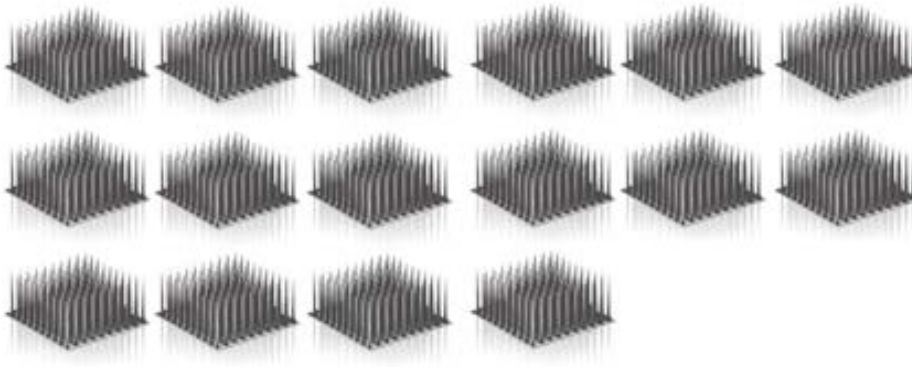


Visual cortex prosthesis for the blind





16 x 64 = 1024



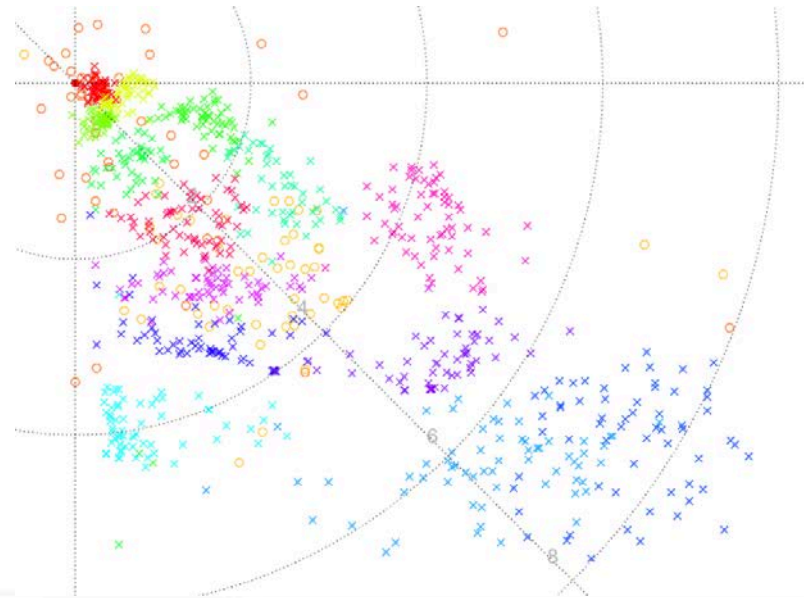
Xing Chen



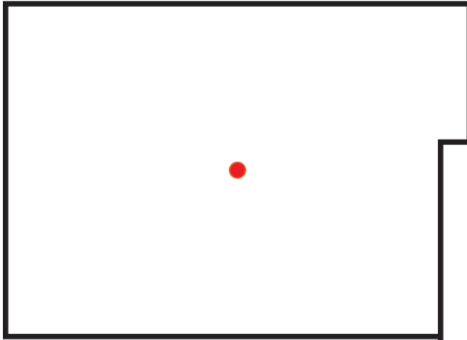
Feng Wang



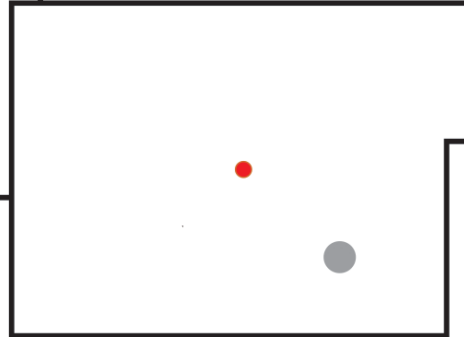
Rick Schuurman



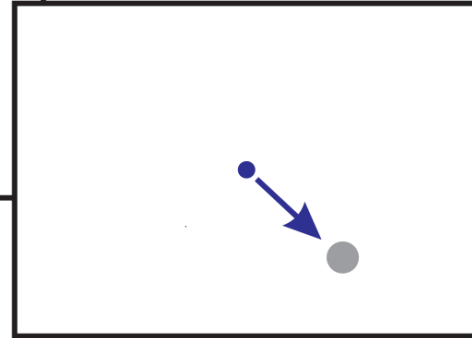
Fixate



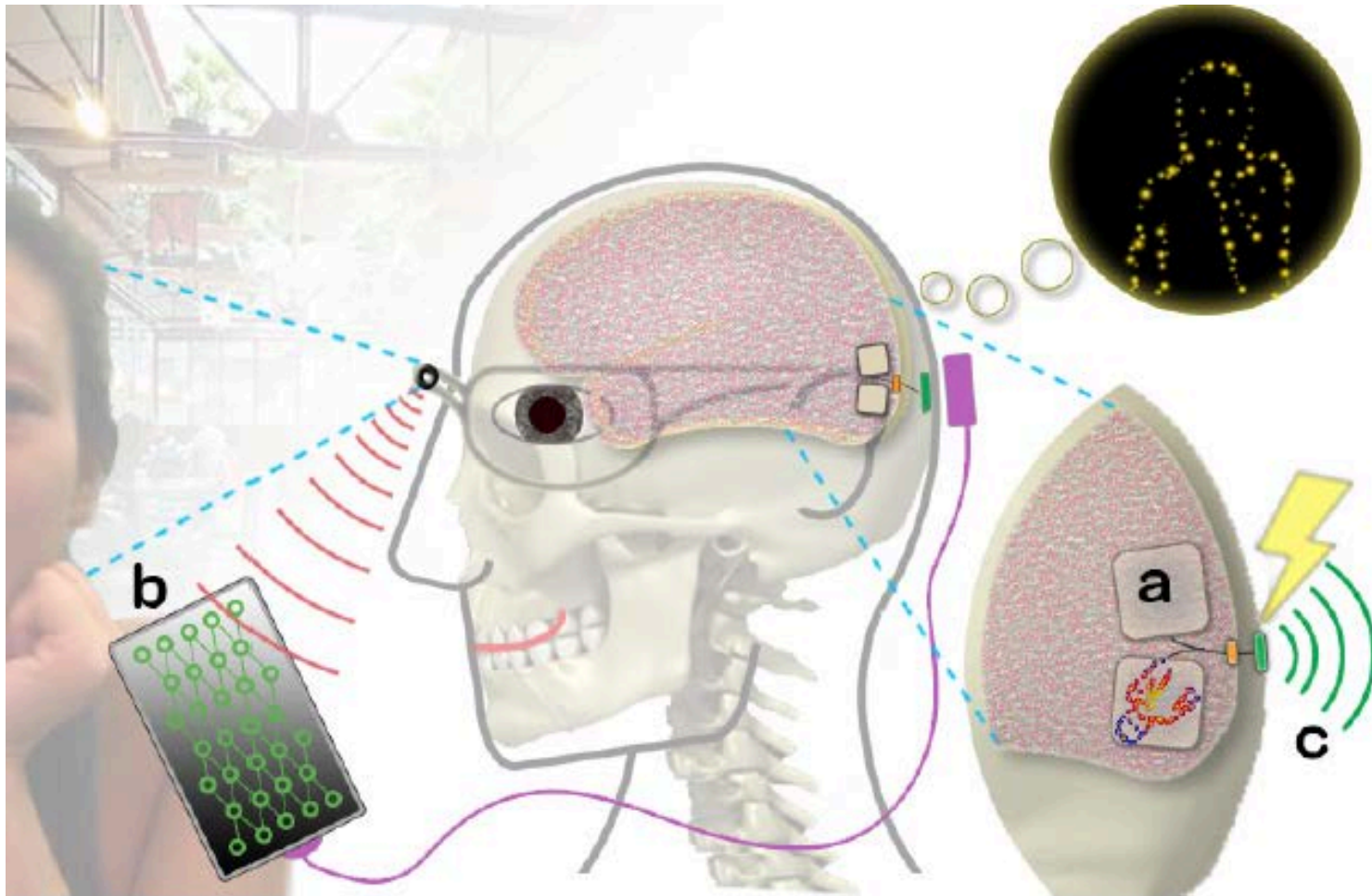
Stimulus



Eye movement



Visual cortex prosthesis for the blind





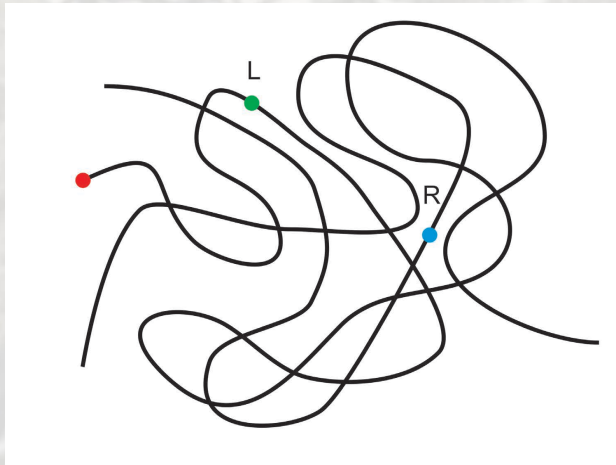
Mark Bentum
Rob Mestrom
Adedayo Omisakin
Tom van Nunen



NeuroTech-NL

Introduction: visual cortex -- feedforward and feedback processing

Contour grouping



Prosthesis



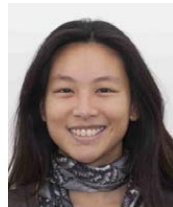
Victor Lamme
Henk Spekreijse
Arezoo Pooresmaeili



Matt Self
Hans Baaijen
Jessy Possel
Judith Peters
Rainer Goebel



Xing Chen
Feng Wang
Chris Klink



Thank you

