

NST II Psychology

NST II Neuroscience (Module 5)

Brain Mechanisms of Memory and Cognition – 2

Motion processing; spatial cognition; parietal cortex

Rudolf Cardinal

Department of Experimental Psychology

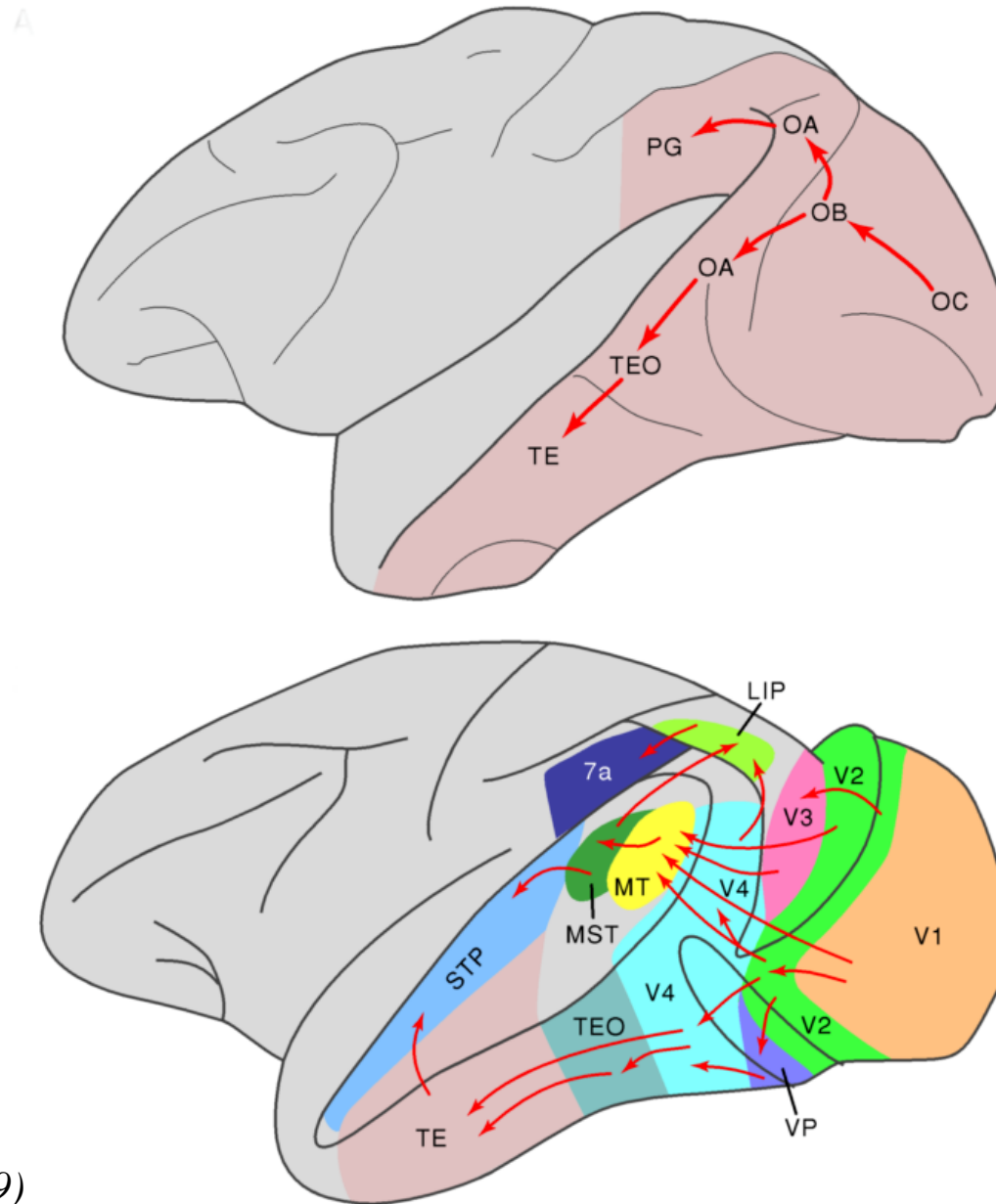
Monday 17, 24, 31 Jan; 7, 14, 28 Feb 2005; 10 am

Physiology Main Lecture Theatre

Slides will be at pobox.com/~rudolf/psychology

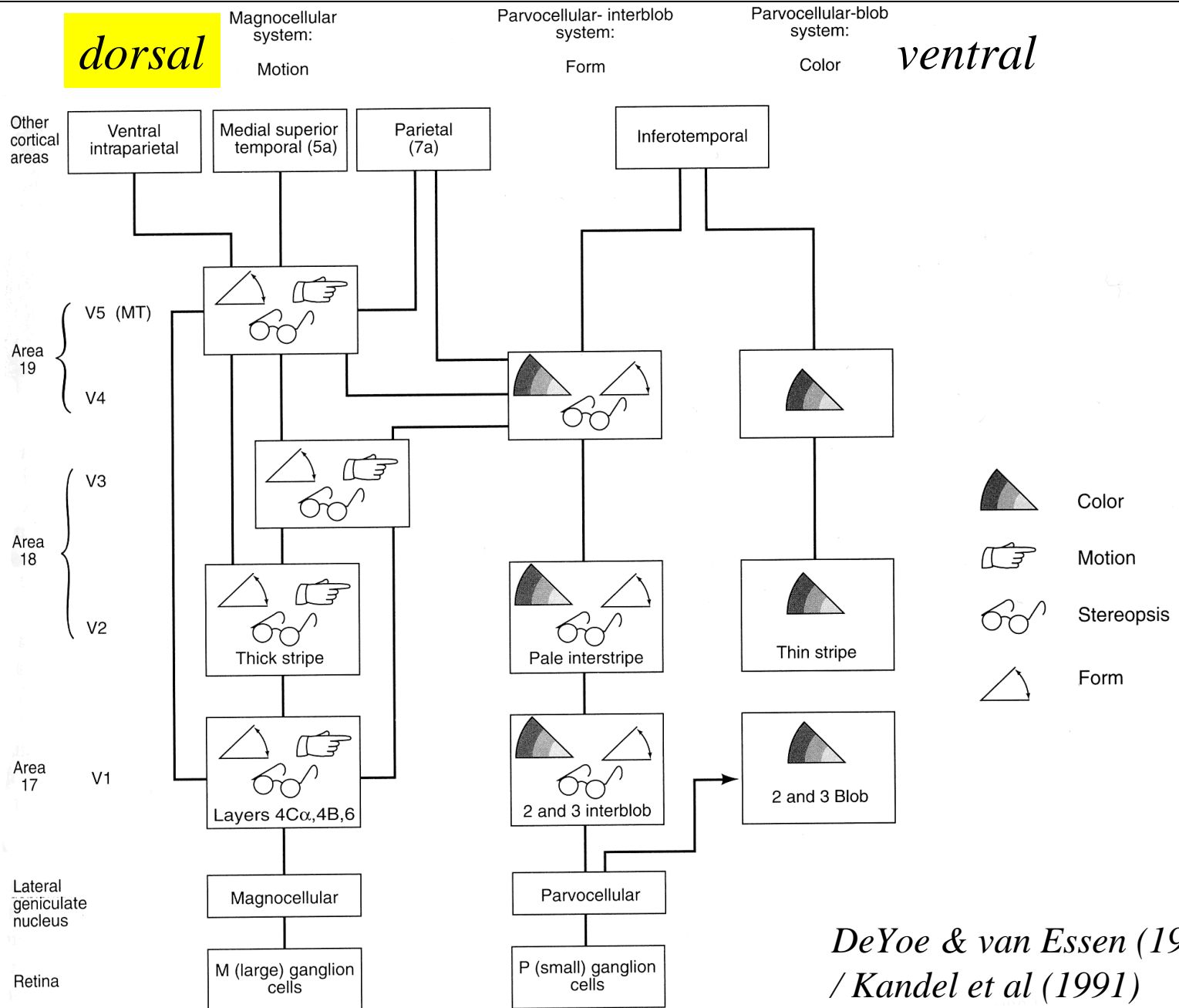


Two visual streams



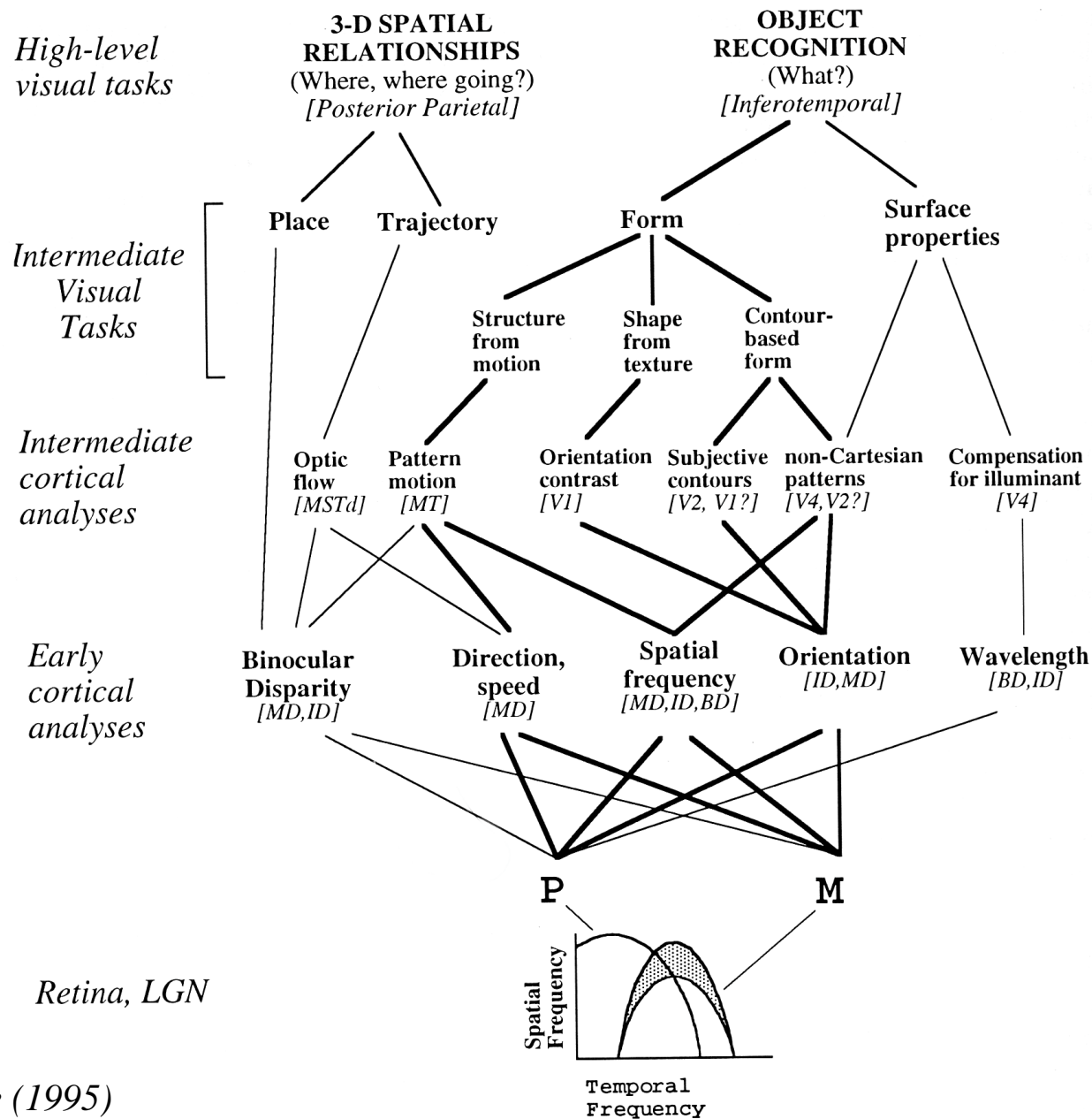
from Zigmond et al (1999)

Concurrent (parallel) processing begins at the retina



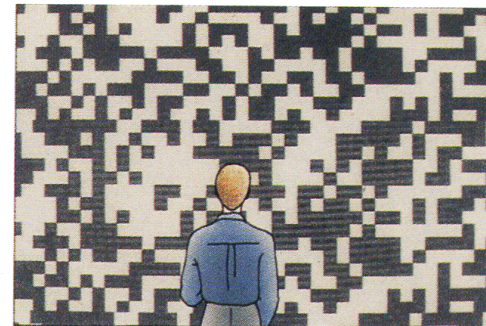
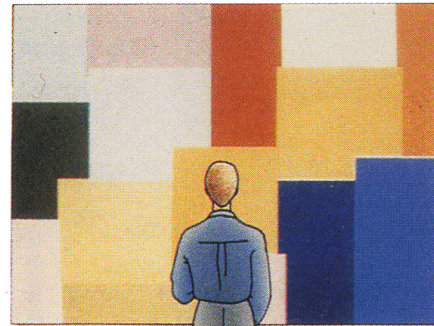
DeYoe & van Essen (1988)
/ Kandel et al (1991)

Information flow in the visual streams

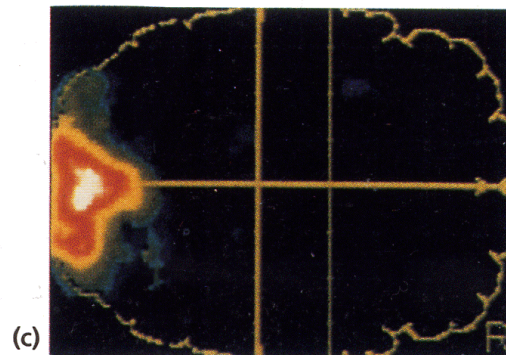
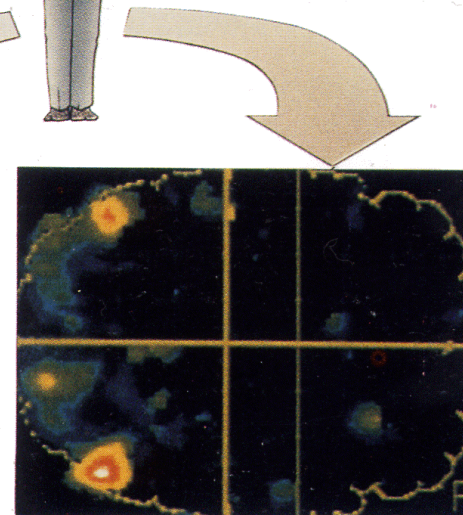
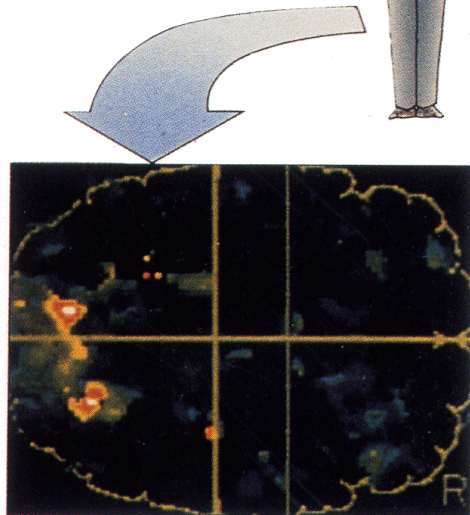


Colour (V4) and motion (V5)

colour (versus monochrome)



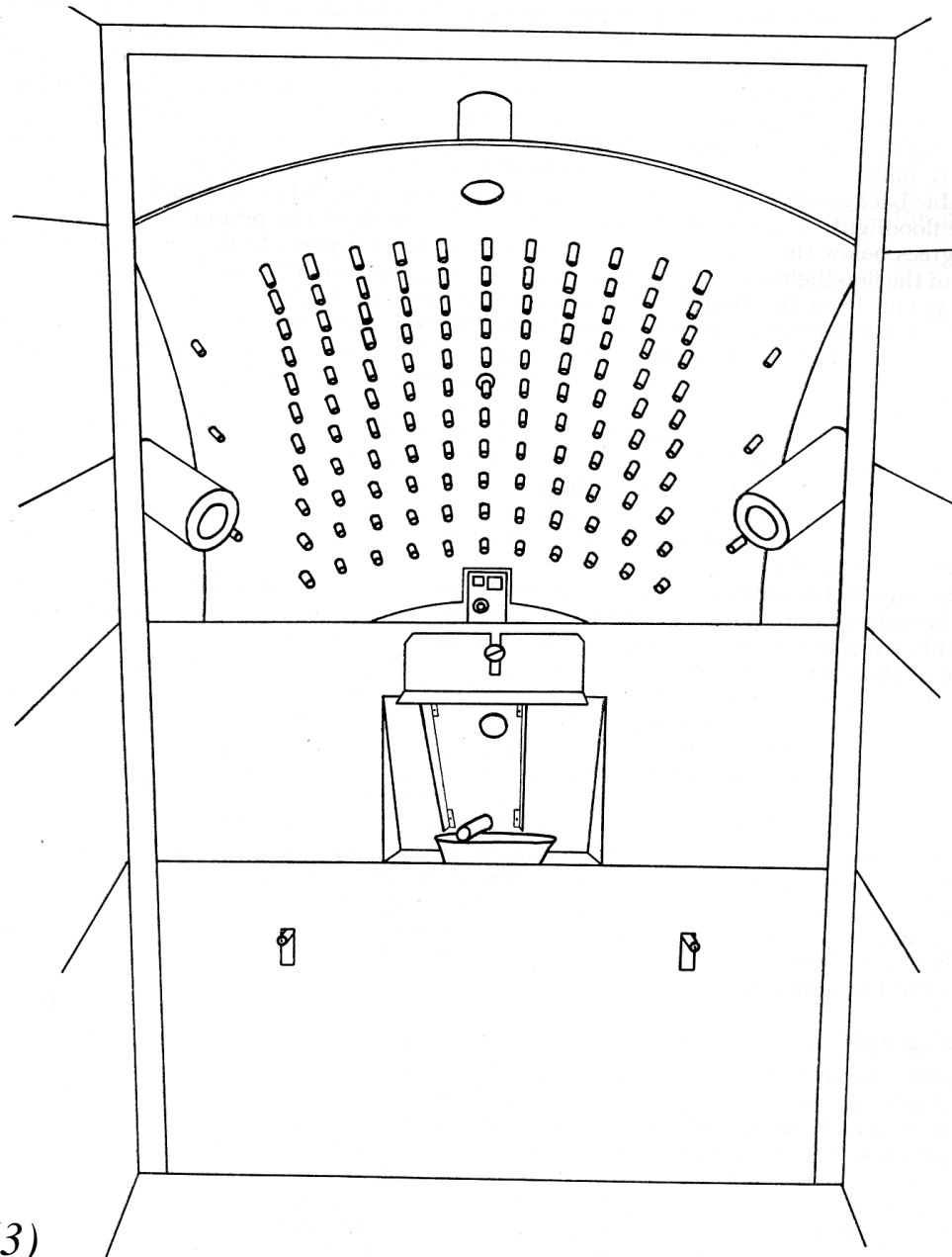
moving dot image (versus still)



*Blindsight:
residual visual function
after V1 lesions*

Blindsight: detection of visual stimuli without perception

Perimeter, for measuring visual fields in monkeys



Cowey & Weiskrantz (1963)

Blindsight: Helen

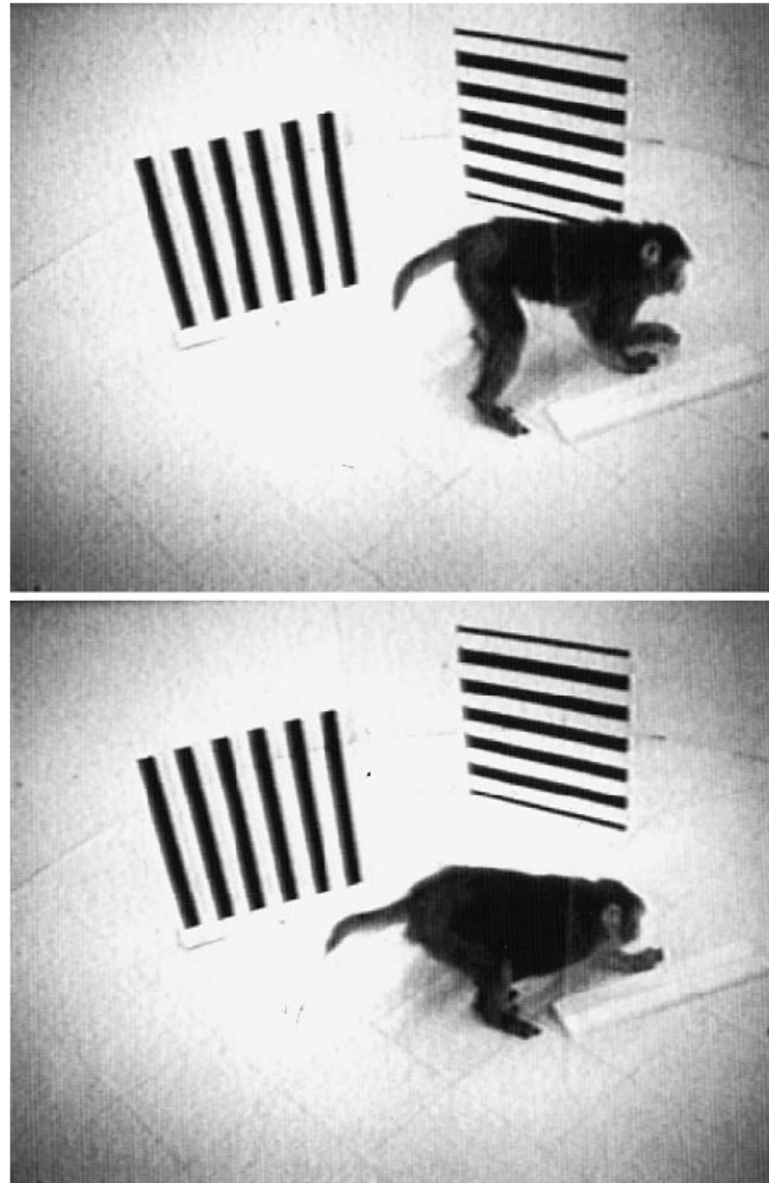
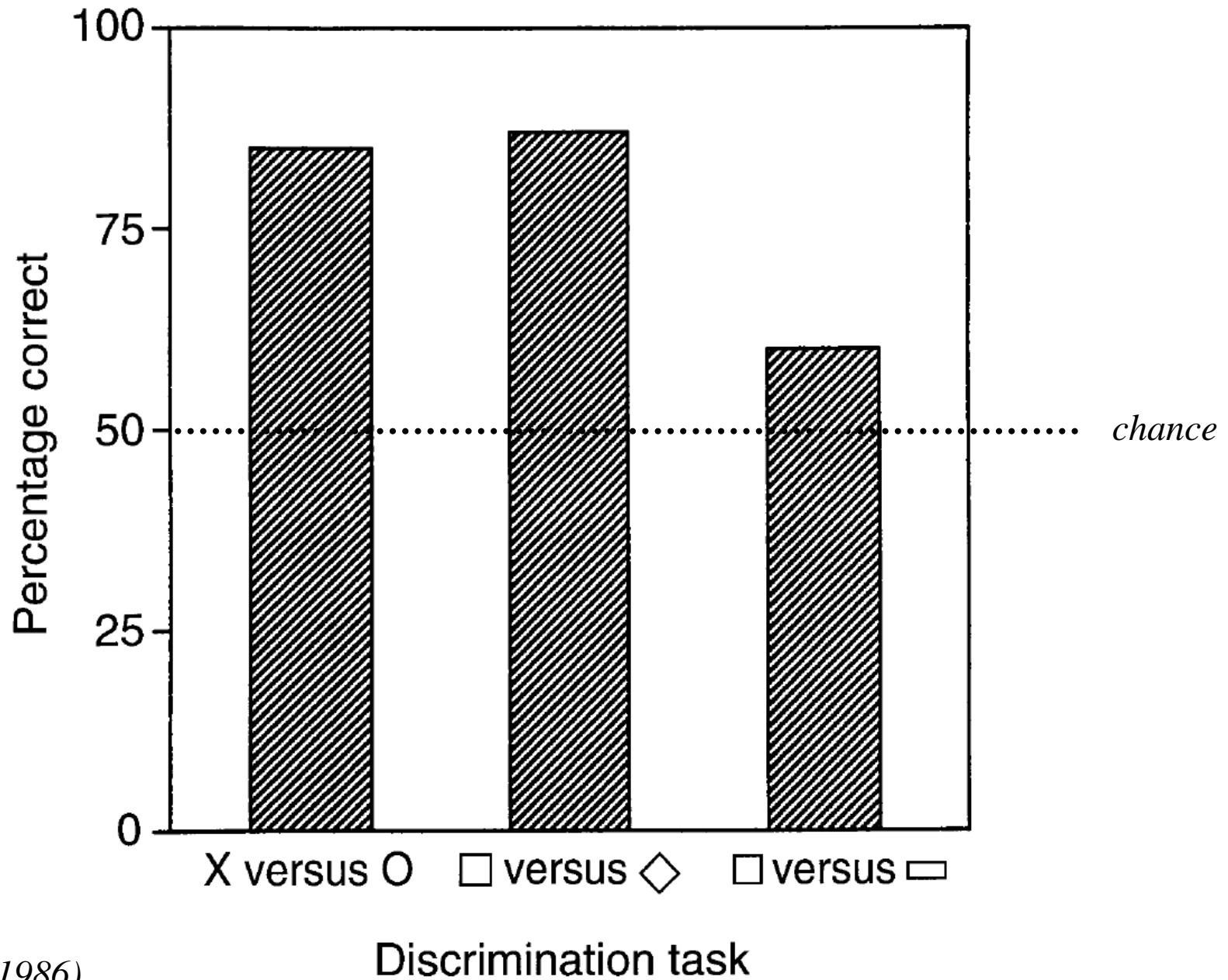


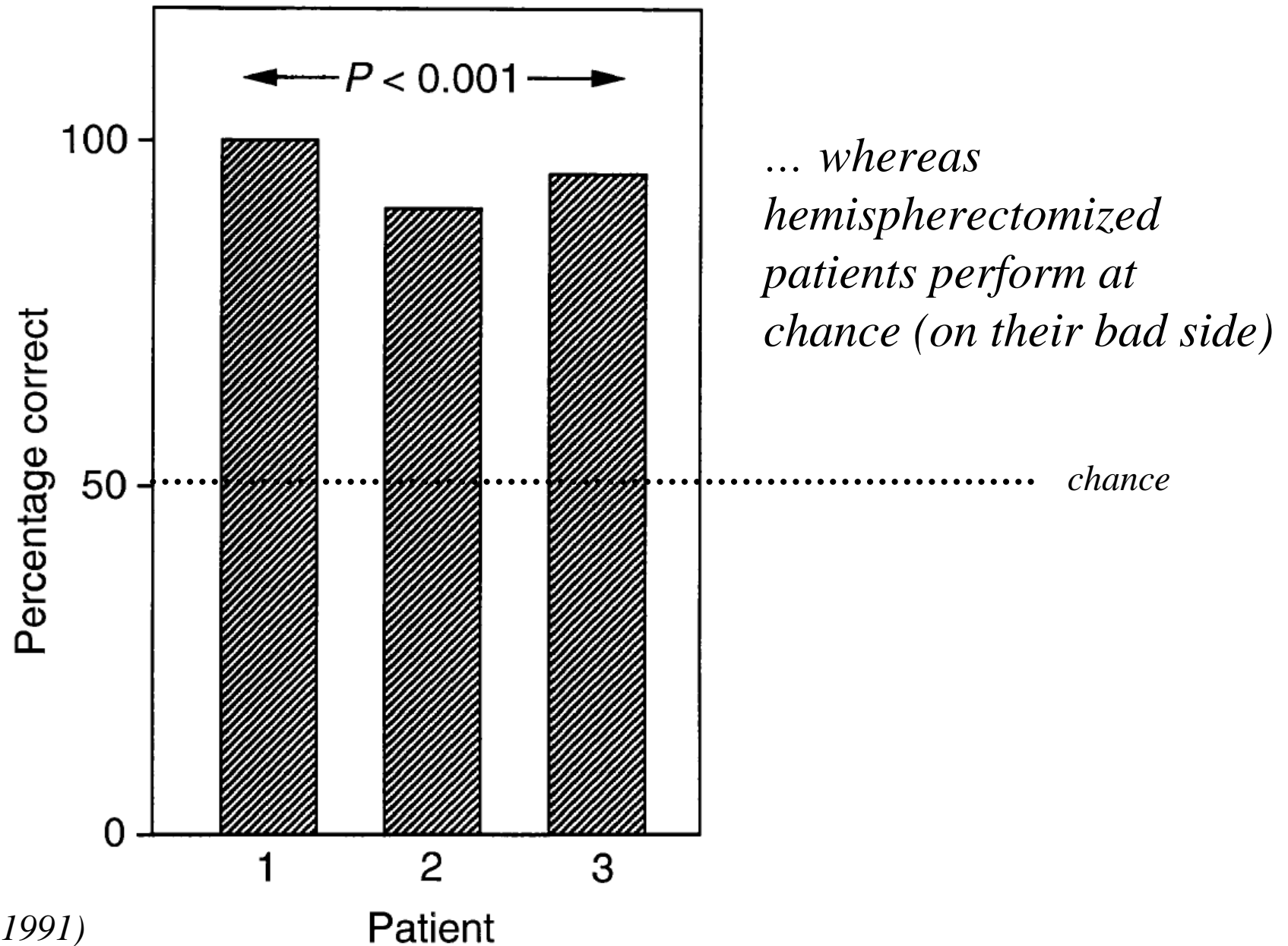
Fig. 15 The bilaterally destriated monkey Helen roamed freely among the objects in the test arena. She would, however, bump into the obstacle made of transparent perspex, as shown, revealing that her navigation was not based on non-visual cues. (Photographs taken from a film by N. Humphrey, and published with his kind permission.)

Blindsight: patient D.B. in a forced-choice discrimination



Weiskrantz (1986)

Blindsight: motion discrimination following V1 lesions



*Effects of parietal cortex lesions.
Bálint's syndrome; neglect*

Simultanagnosia

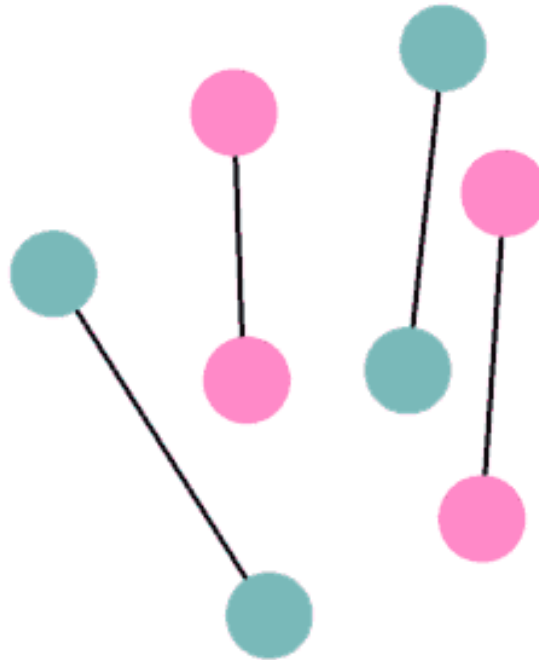
'Are there circles of two different colours?'

Random



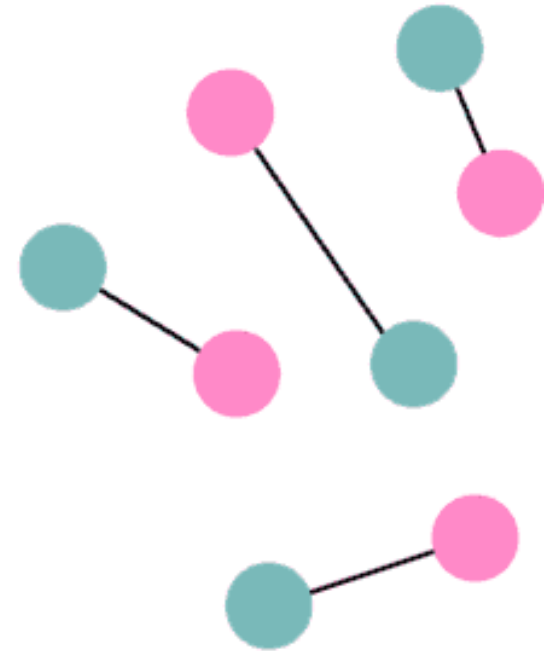
'No.'

Single



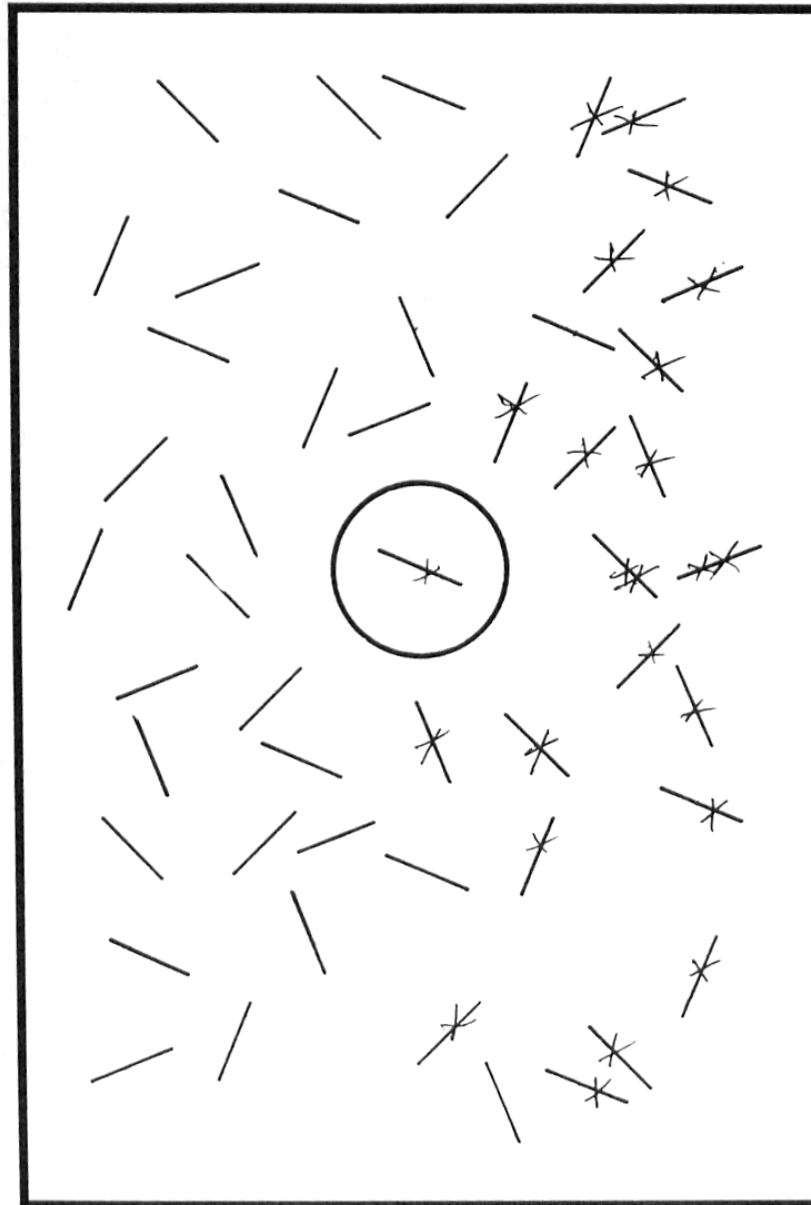
'No.'

Mixed



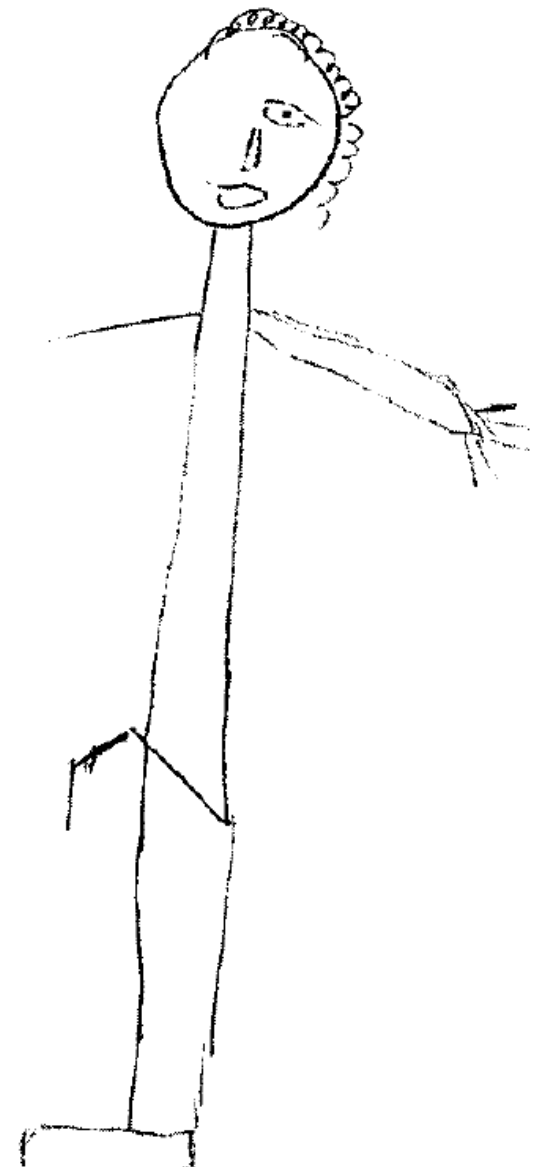
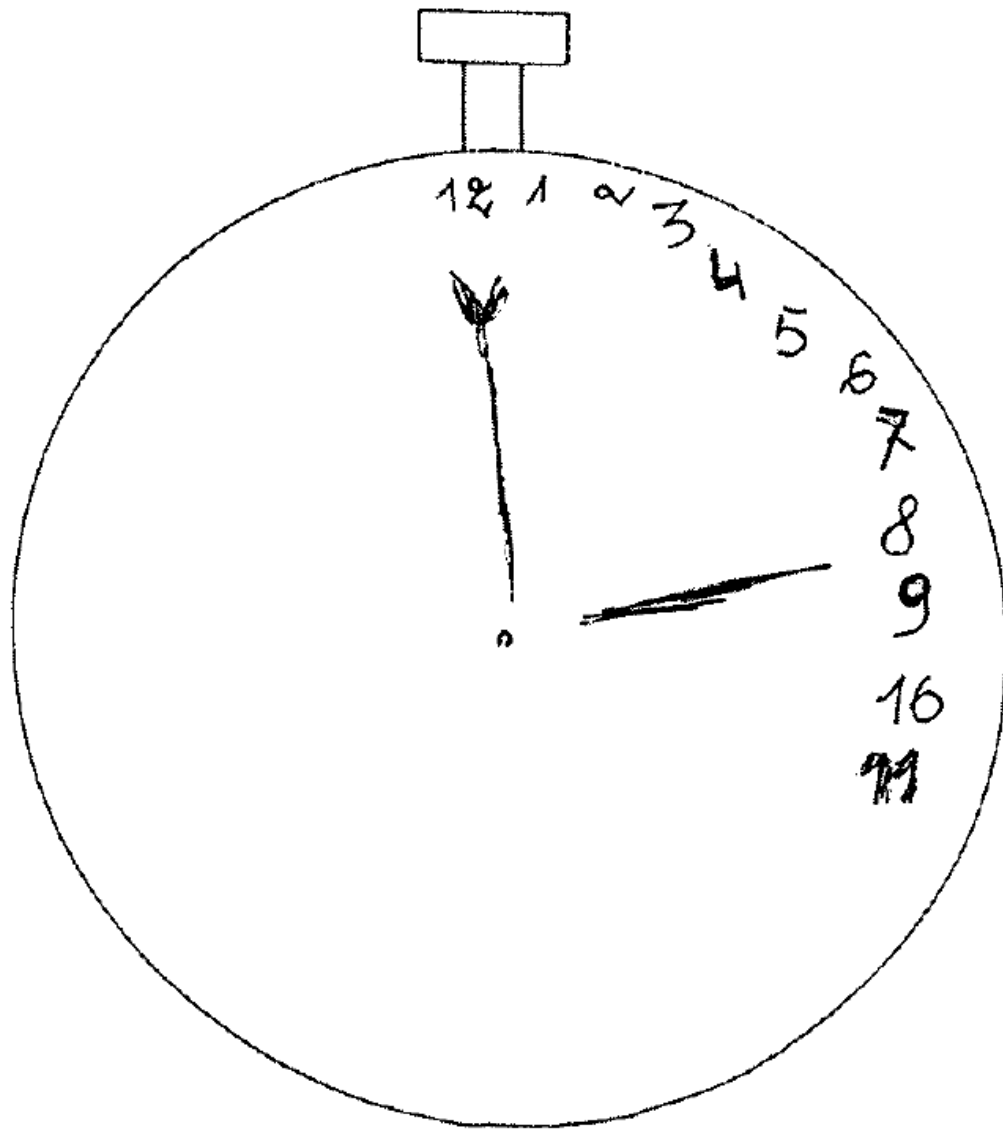
'Yes.'

Neglect: line cancellation task



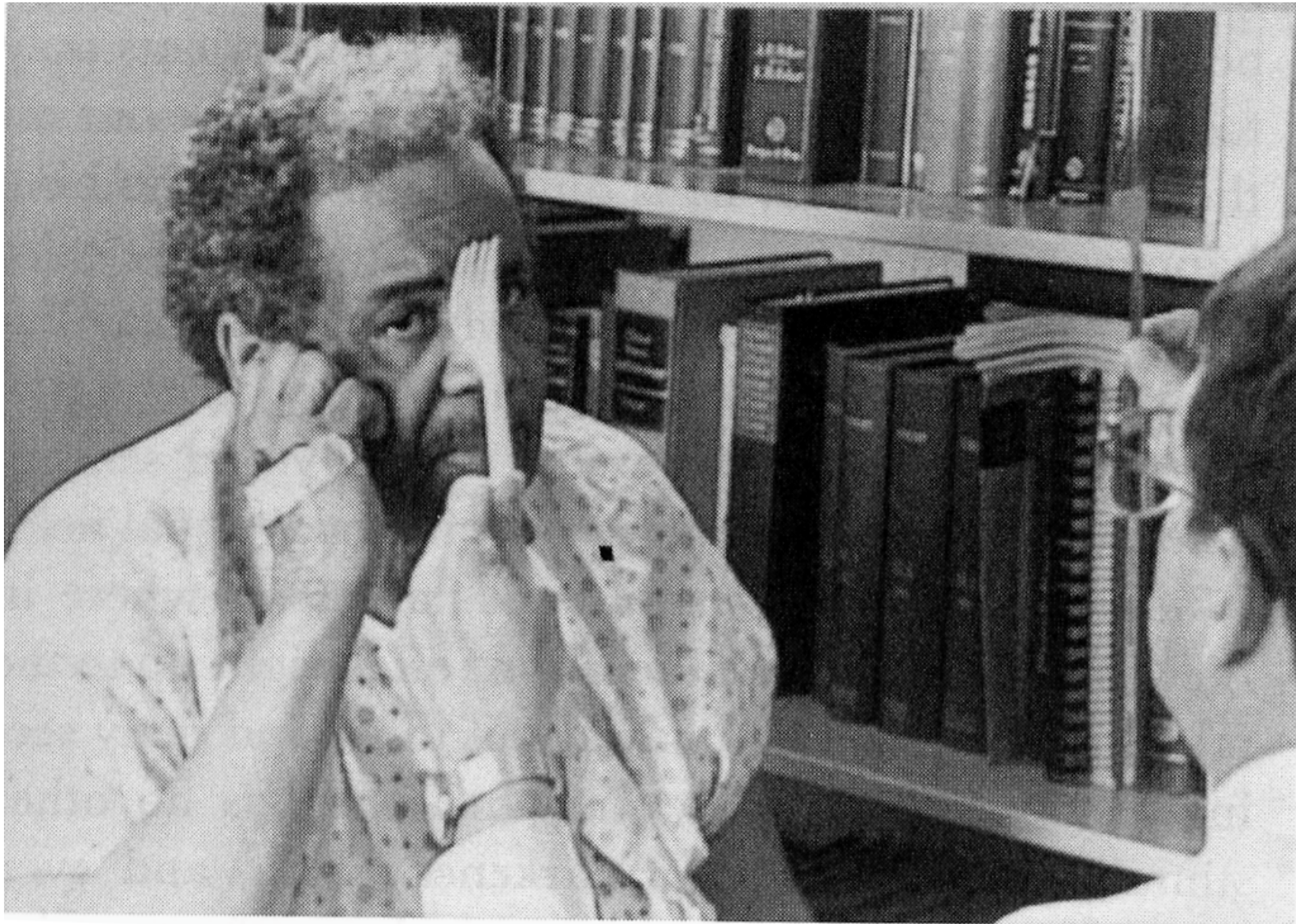
Kartsounis & Warrington, 1989

Neglect: drawings from memory



Beschin et al. (2000)

Sensory extinction following partial recovery from neglect



from Rafal & Robertson (1995)

Neglect is attentional: the Piazza del Duomo, Milan (1)



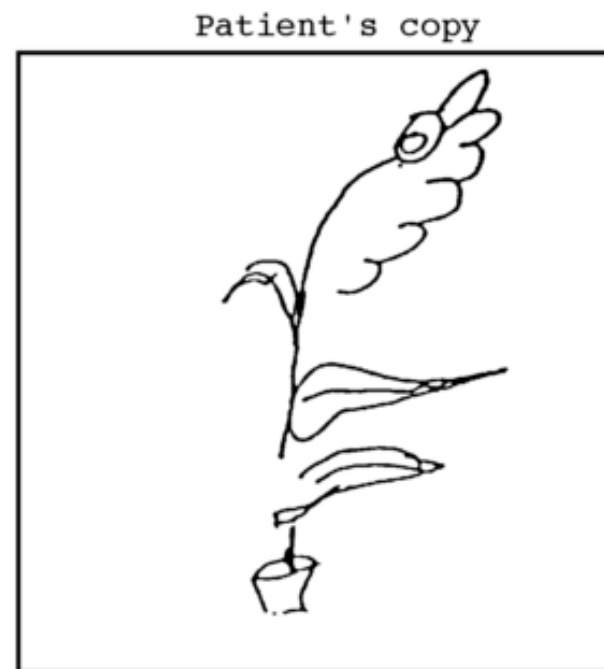
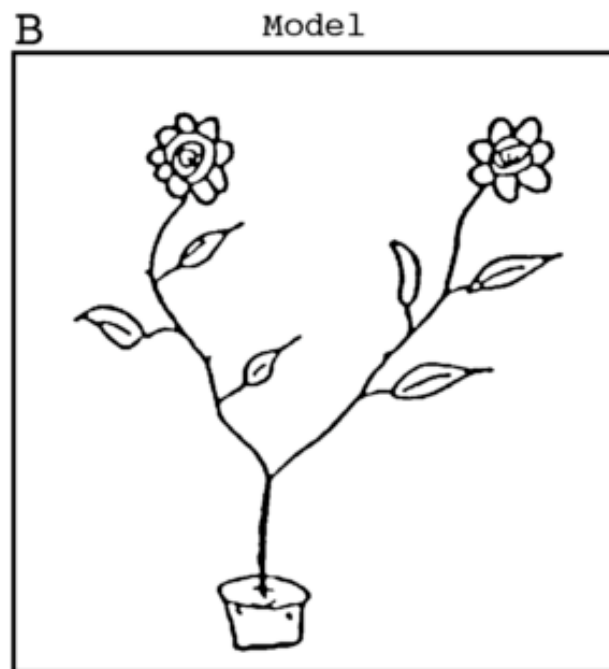
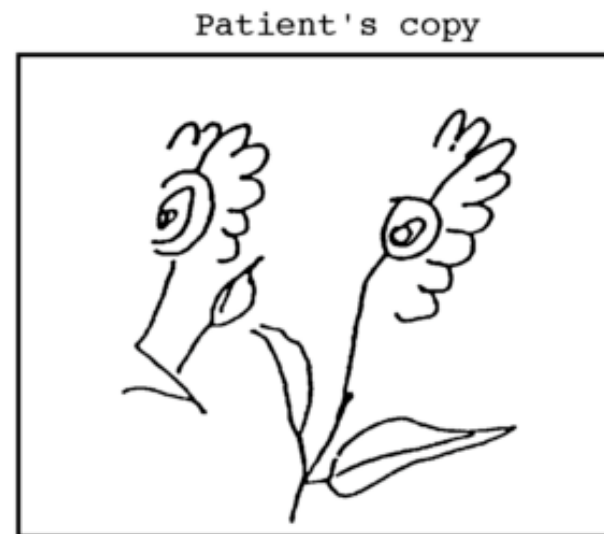
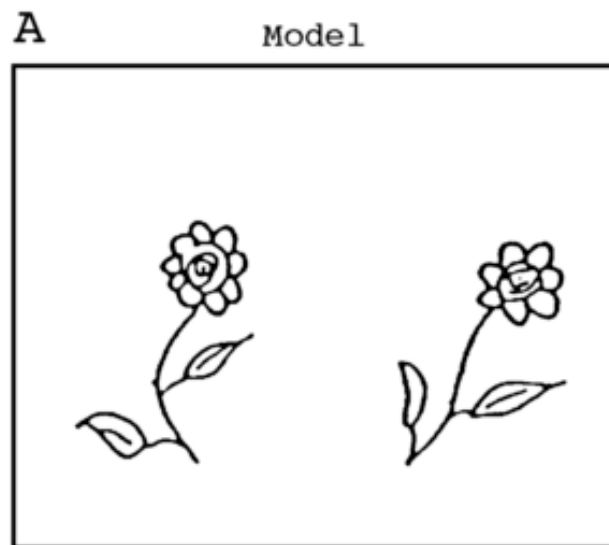
Bisiach & Luzzatti (1978)

Neglect is attentional: the Piazza del Duomo, Milan (2)

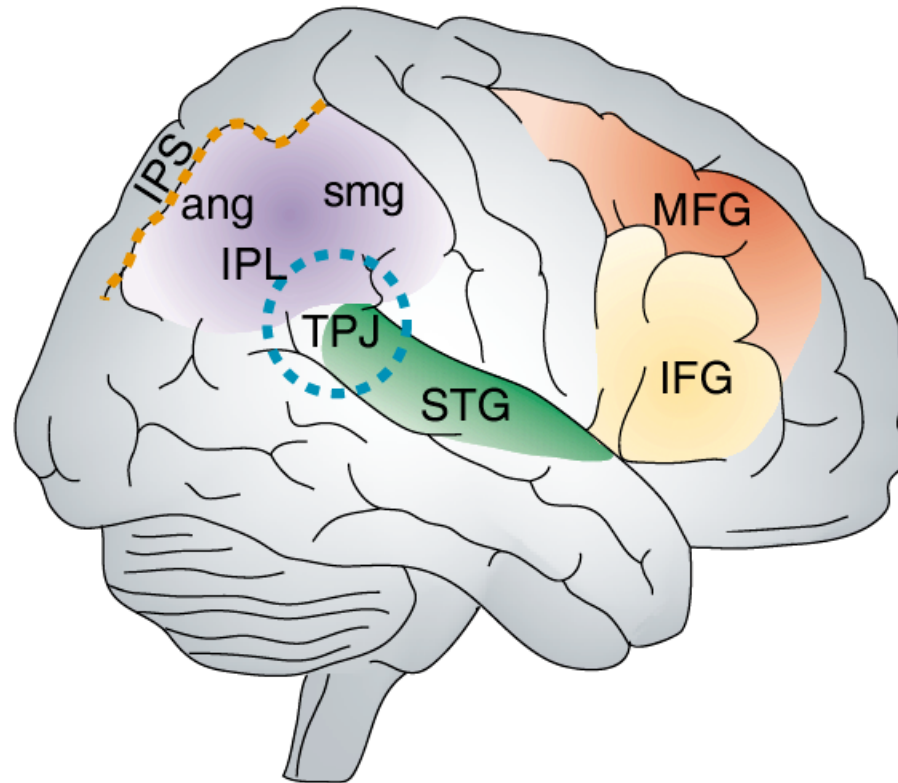


Bisiach & Luzzatti (1978)

Object-centred neglect



Cortical regions damaged in neglect



TPJ = temporo-parietal junction

IPL = inferior parietal lobule (ang = angular gyrus; smg = supramarginal gyrus)

IPS = intraparietal sulcus

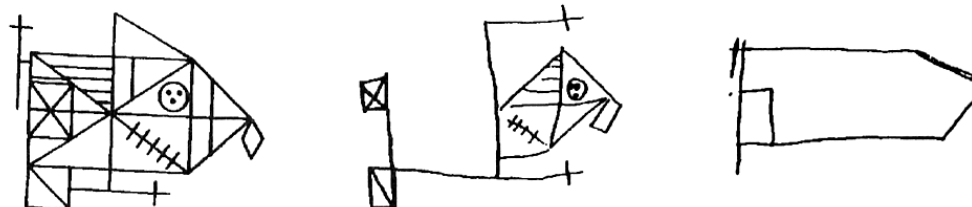
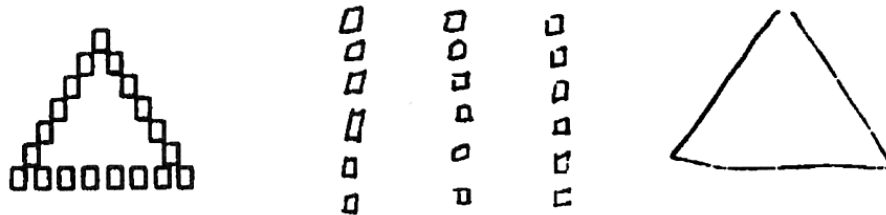
STG = superior temporal gyrus

MFG = middle frontal gyrus

IFG = inferior frontal gyrus

Left/right asymmetry of function in the TPJ

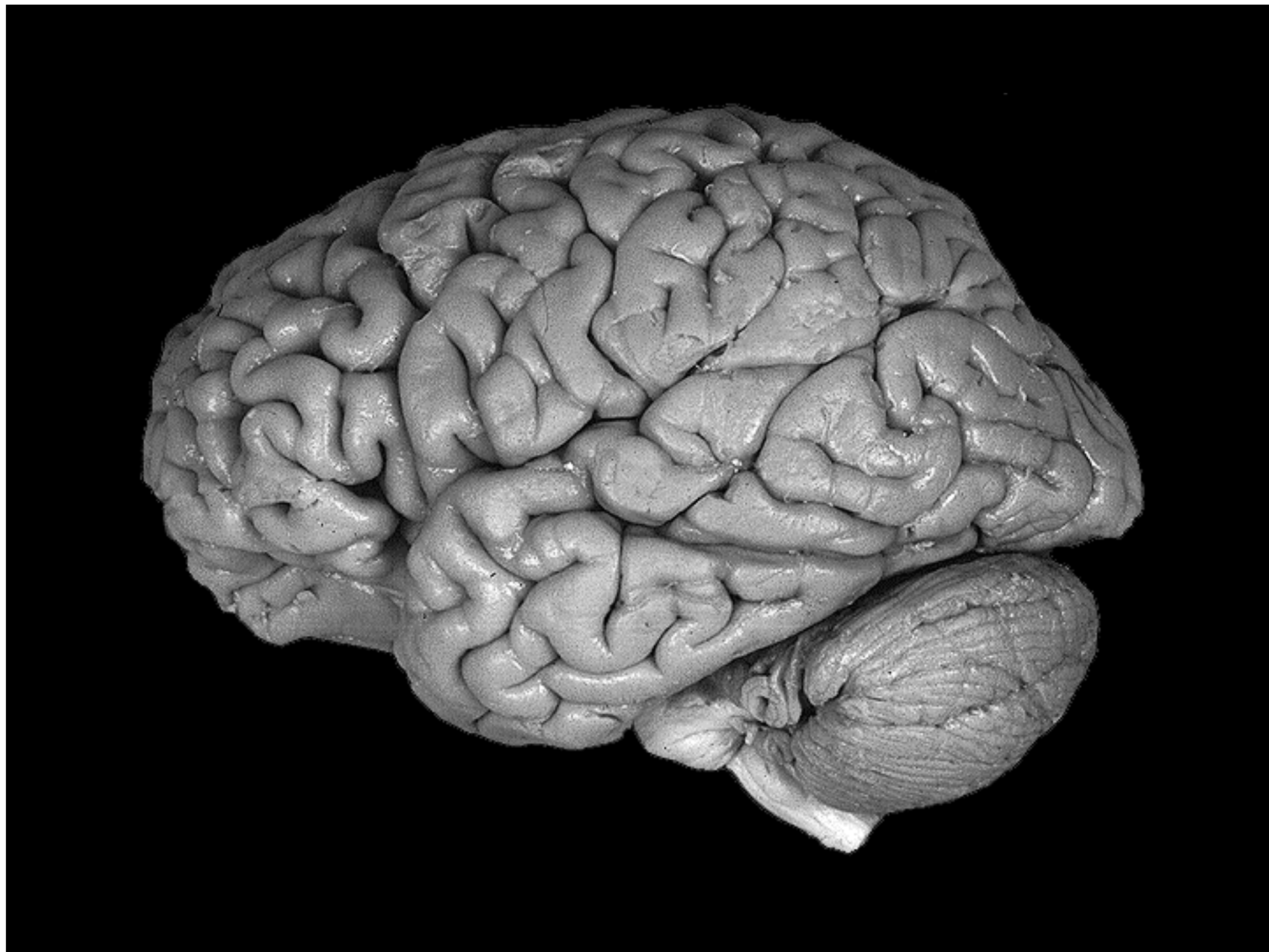
Stimulus Right Damage Left Damage



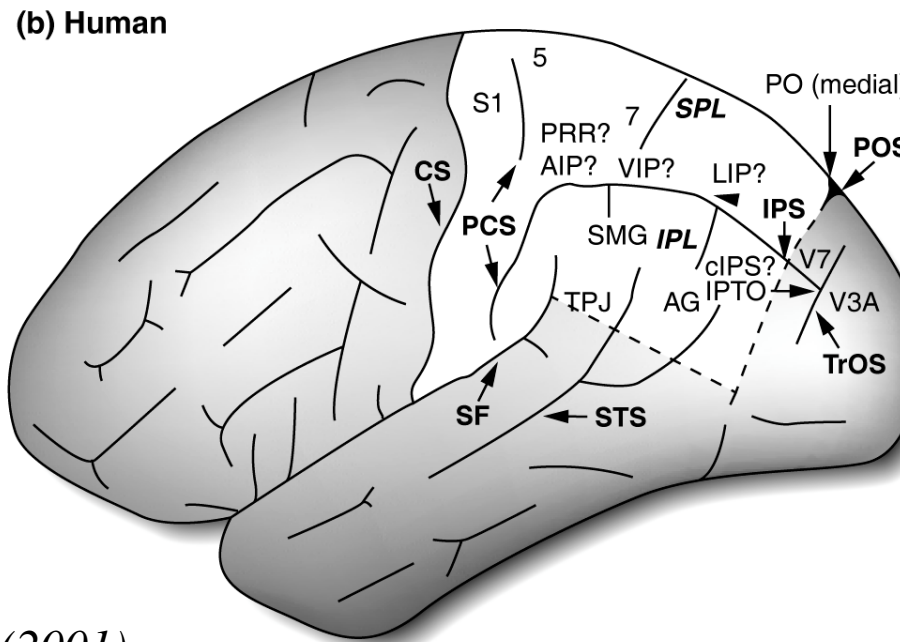
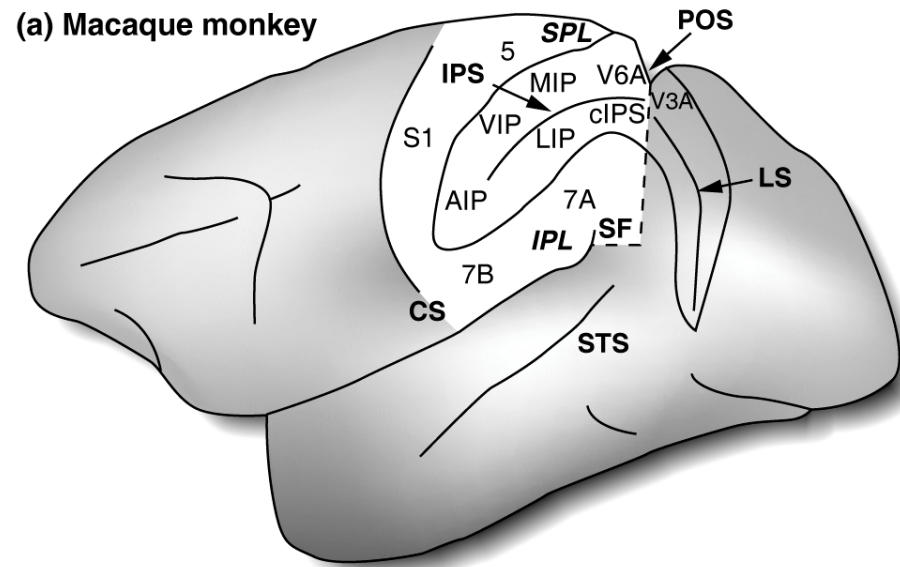
Rey-Osterreith figure

FIGURE 44.9 Examples of drawings of a stimulus by patients with left or right hemisphere damage. (Adapted from Robertson and Lamb, 1991.)

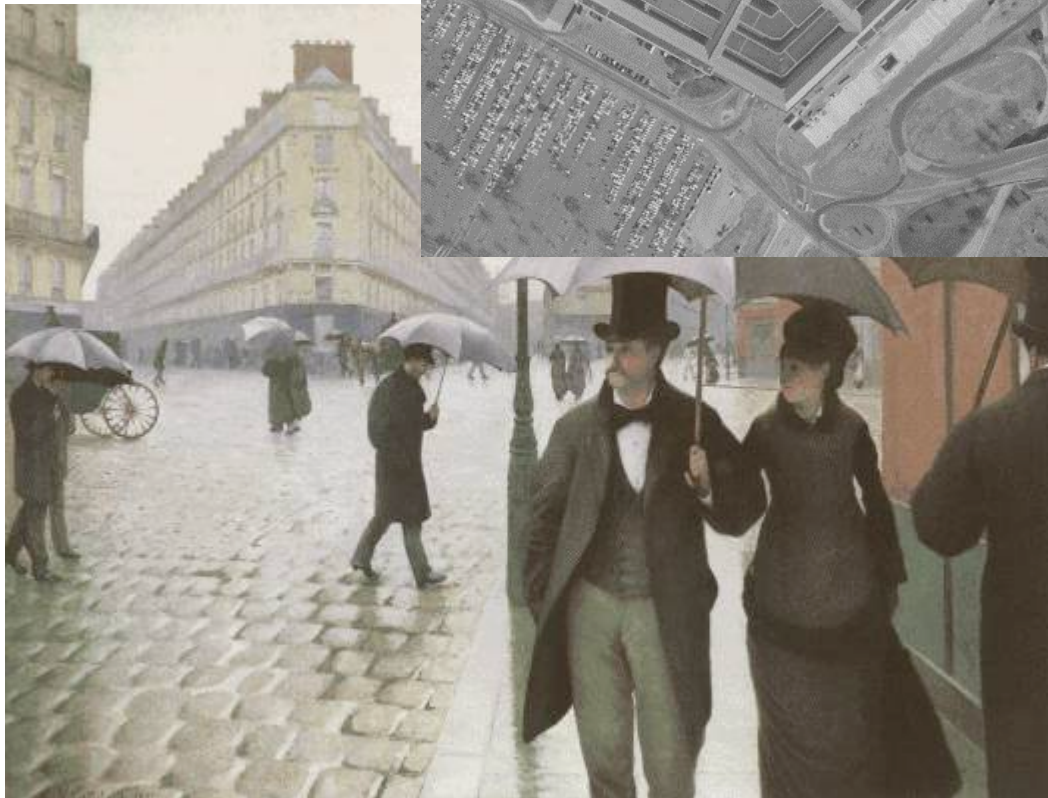
*Parietal cortex:
anatomy and electrophysiology*



Parietal cortex (with the intraparietal sulcus 'unfolded')



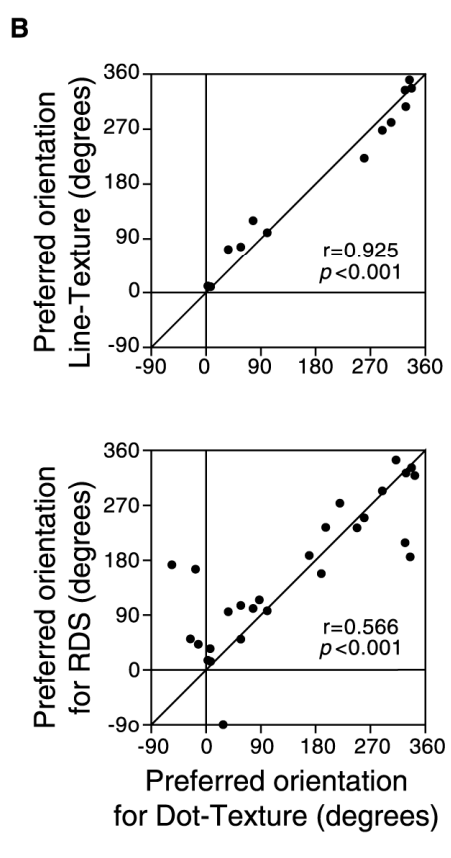
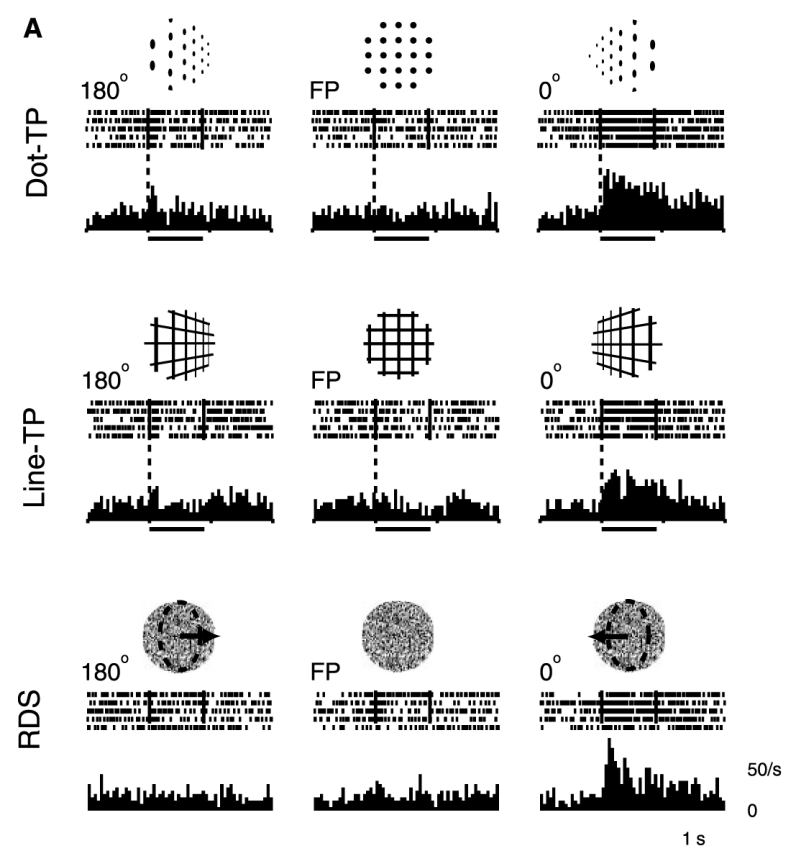
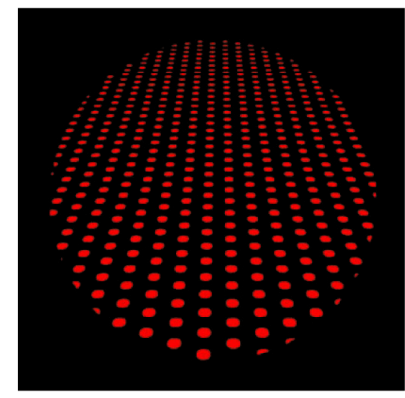
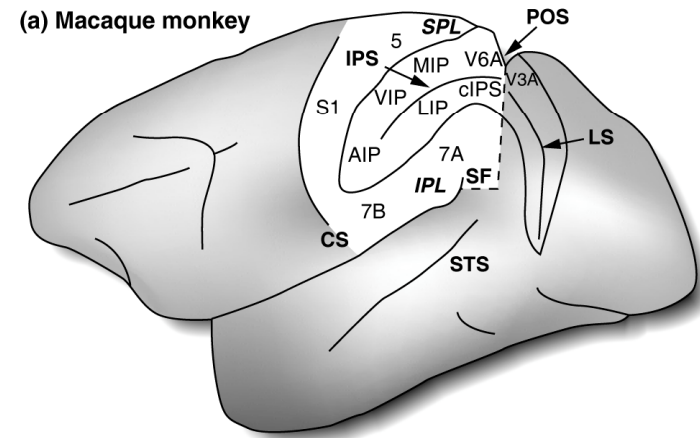
A 3D world from a 2D retinal image



There are multiple monocular cues for depth, such as texture gradient, in addition to stereopsis (binocular disparity and convergence information).

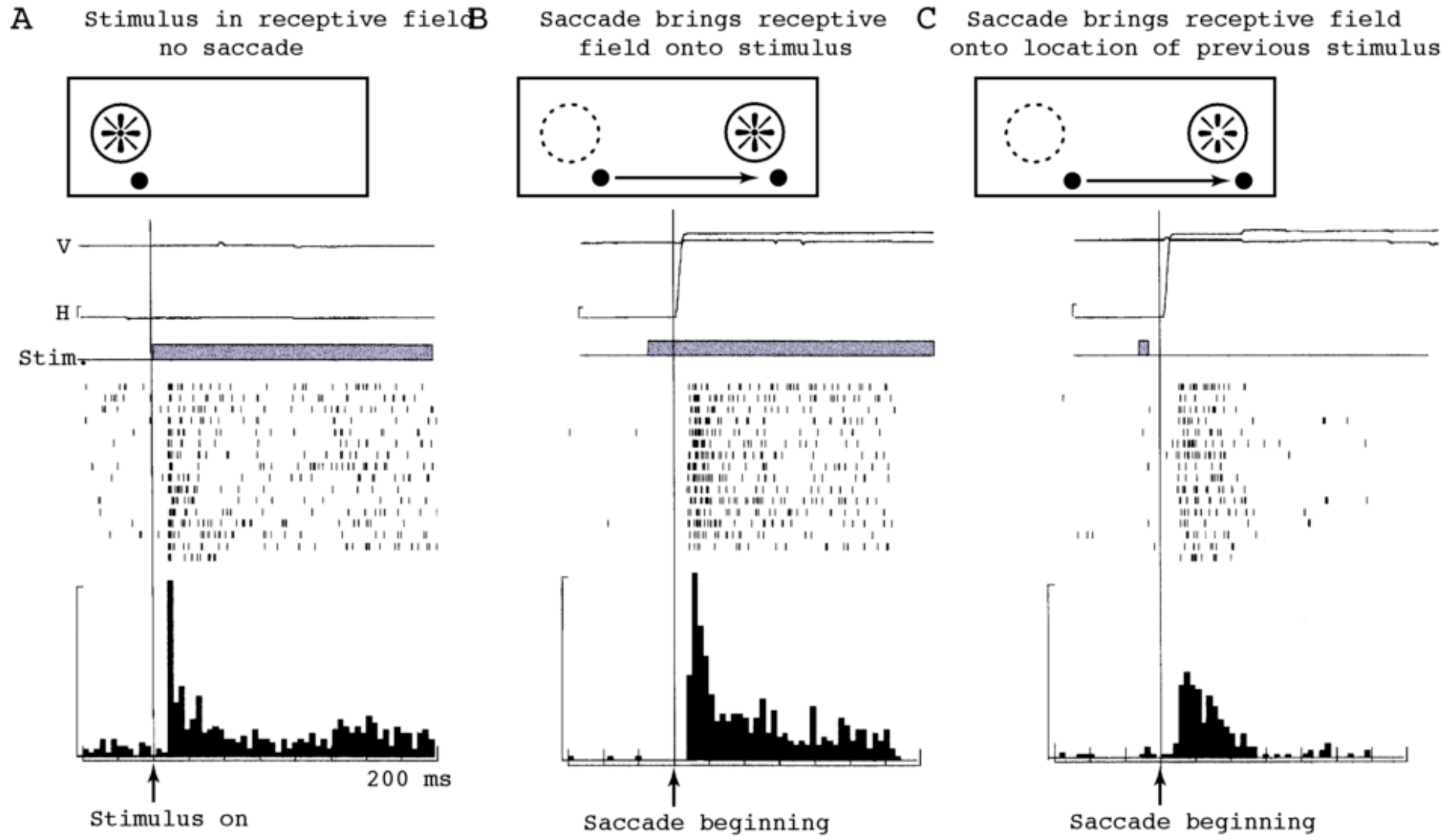
(Above: stereo pair of satellite images. Left: 'Rue de Paris, temps de pluie' by Gustave Caillebotte, 1877.)

Caudal intraparietal sulcus (cIPS) and 3D spatial processing

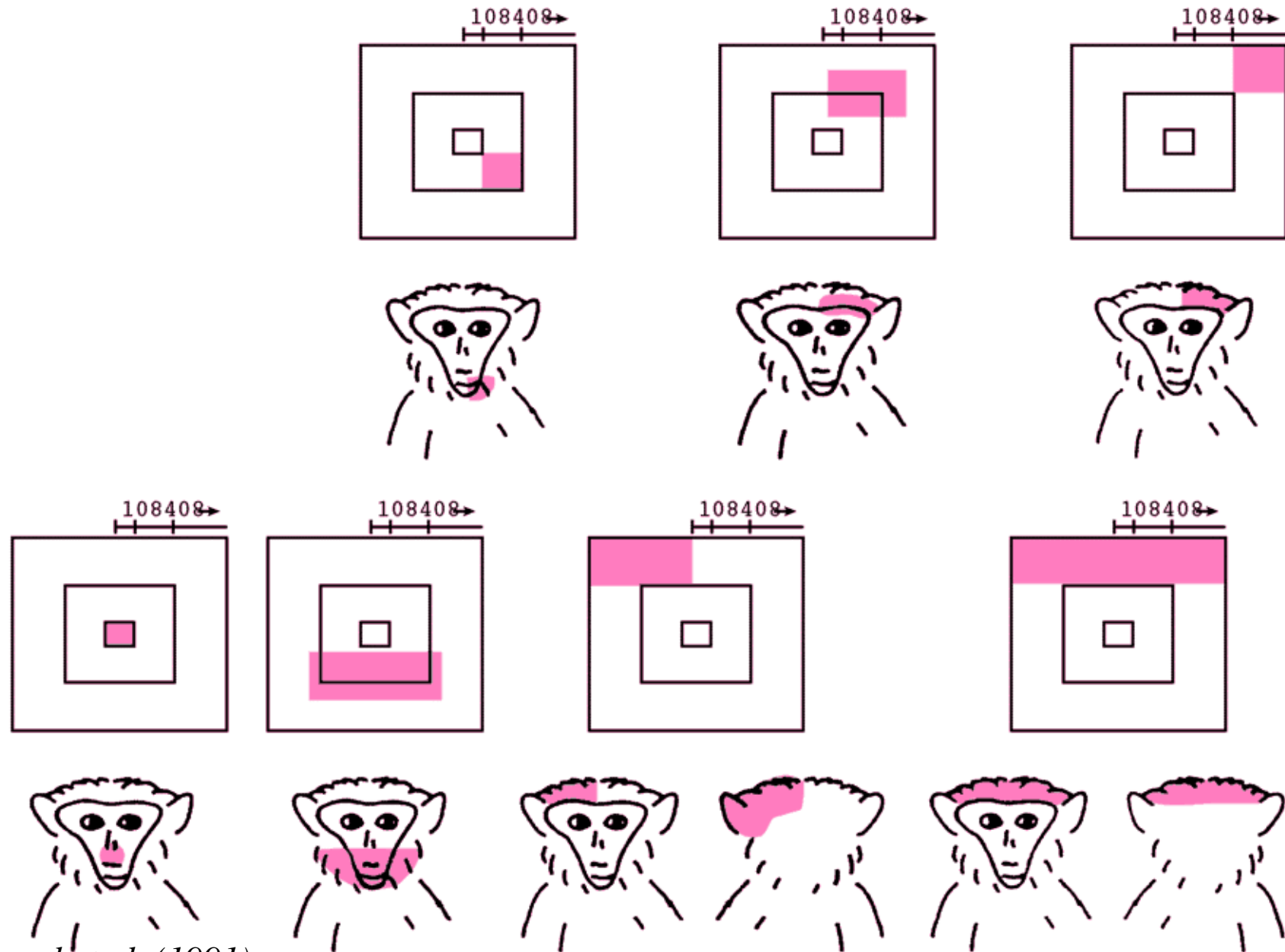


Tsutsui et al. (2002)
Science 298: 409

LIP neuronal responses: updated based on planned motor acts

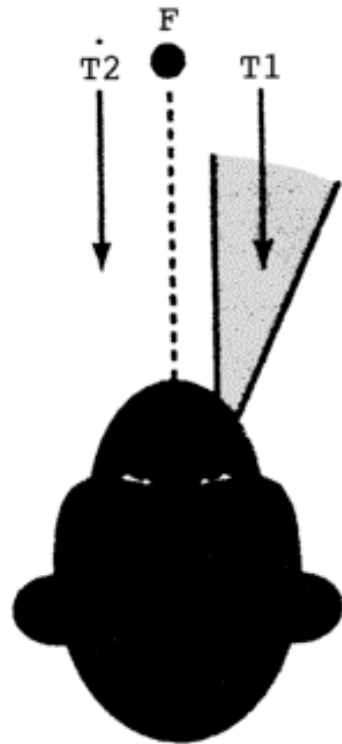


VIP neuronal responses: polymodal, 'head-centred'

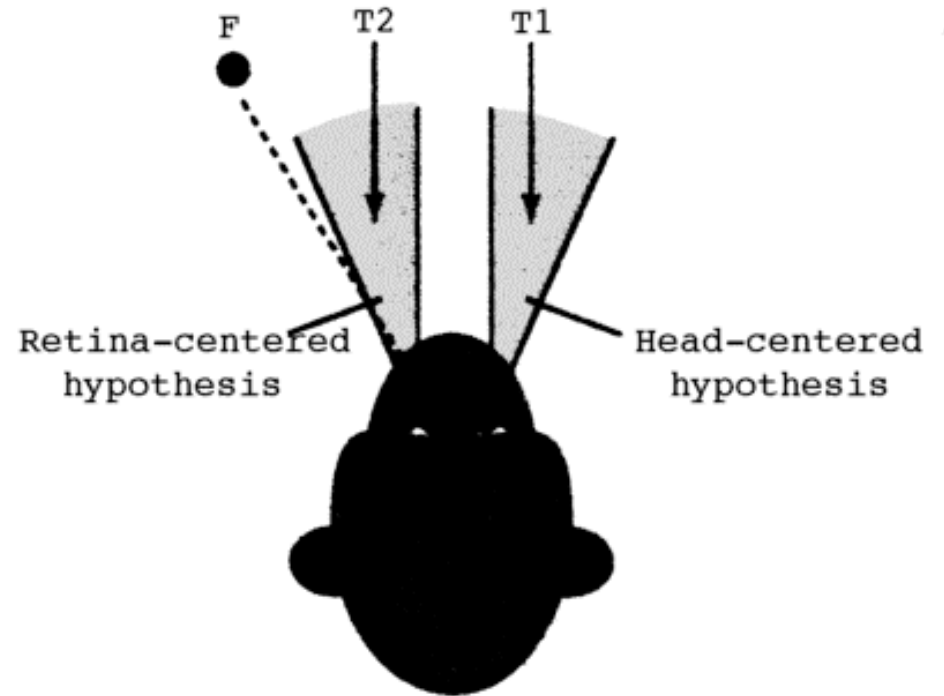


Duhamel et al. (1991)

'Head-centred' receptive fields in VIP



*monkey looking
straight ahead (at F);
grey = receptive field*



*monkey looking
30° to left (at F)*

Electrophysiology - 7a, 7b, AIP: visuomotor control

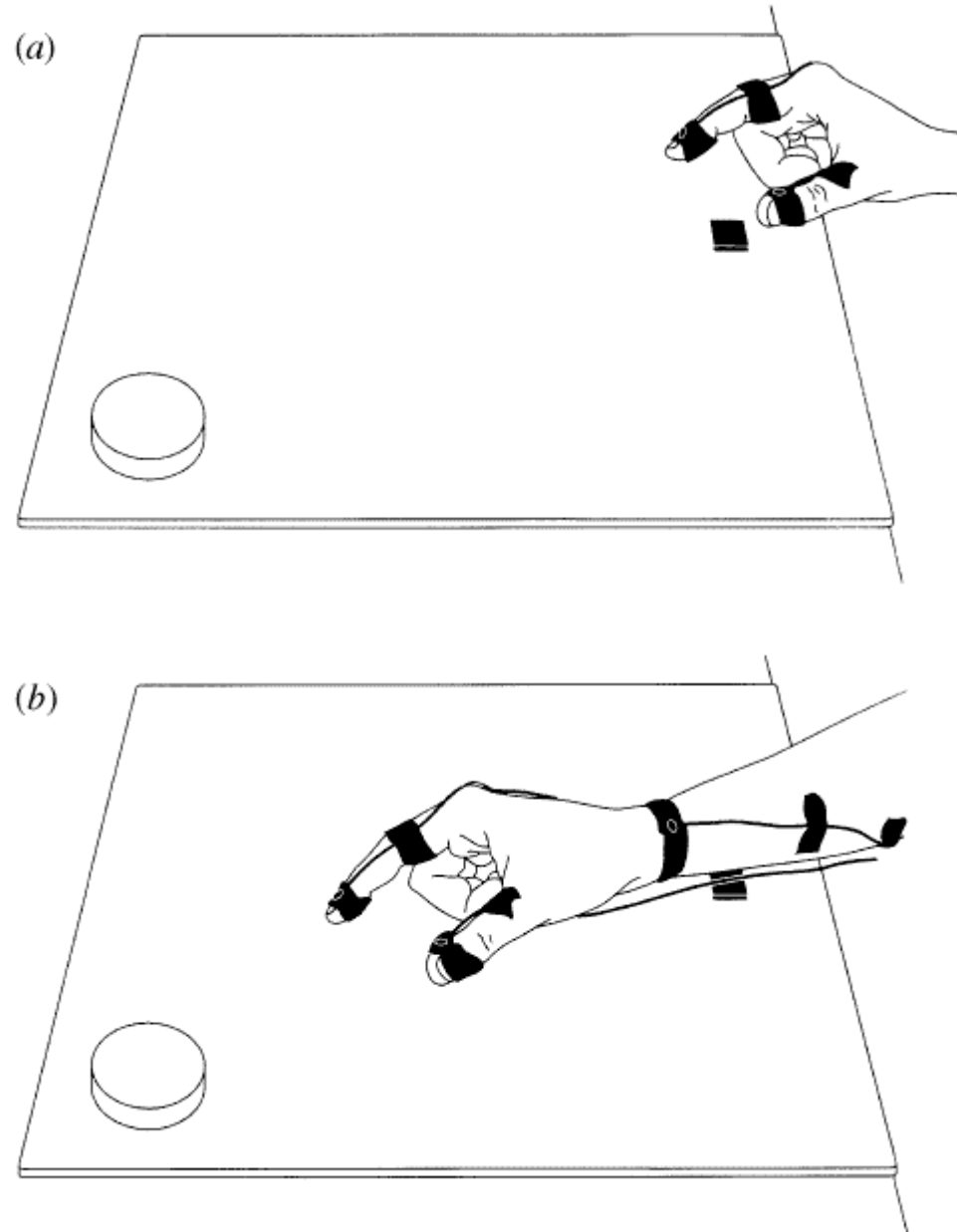
- **7a:** Similar to LIP. Visual receptive fields; also respond to position of eyes in orbits; thus may e.g. respond best to stimulus in RF when eye in a certain position.
- **7a:** Activity related to saccades, visual pursuit, and also movement of arm towards a target (N.B. relevance to optic ataxia) and manipulation of an object. *Visuomotor.*
- **7b:** Response to somatosensory as well as visual input.
- **AIP:** involved in visual guidance of precise hand movements. *Visuomotor.* Receives info about 3D properties of objects from other parietal regions. Active during all phases of grasping activity.

Electrophysiology - 5: somatomotor control ('active touch')?

- **5:** Predominantly somatosensory and proprioceptive input (N.B. is adjacent to primary somatosensory cortex). Responds e.g. to active touching, but not to passive visual or cutaneous stimulation.

*The dorsal stream:
visuomotor control*

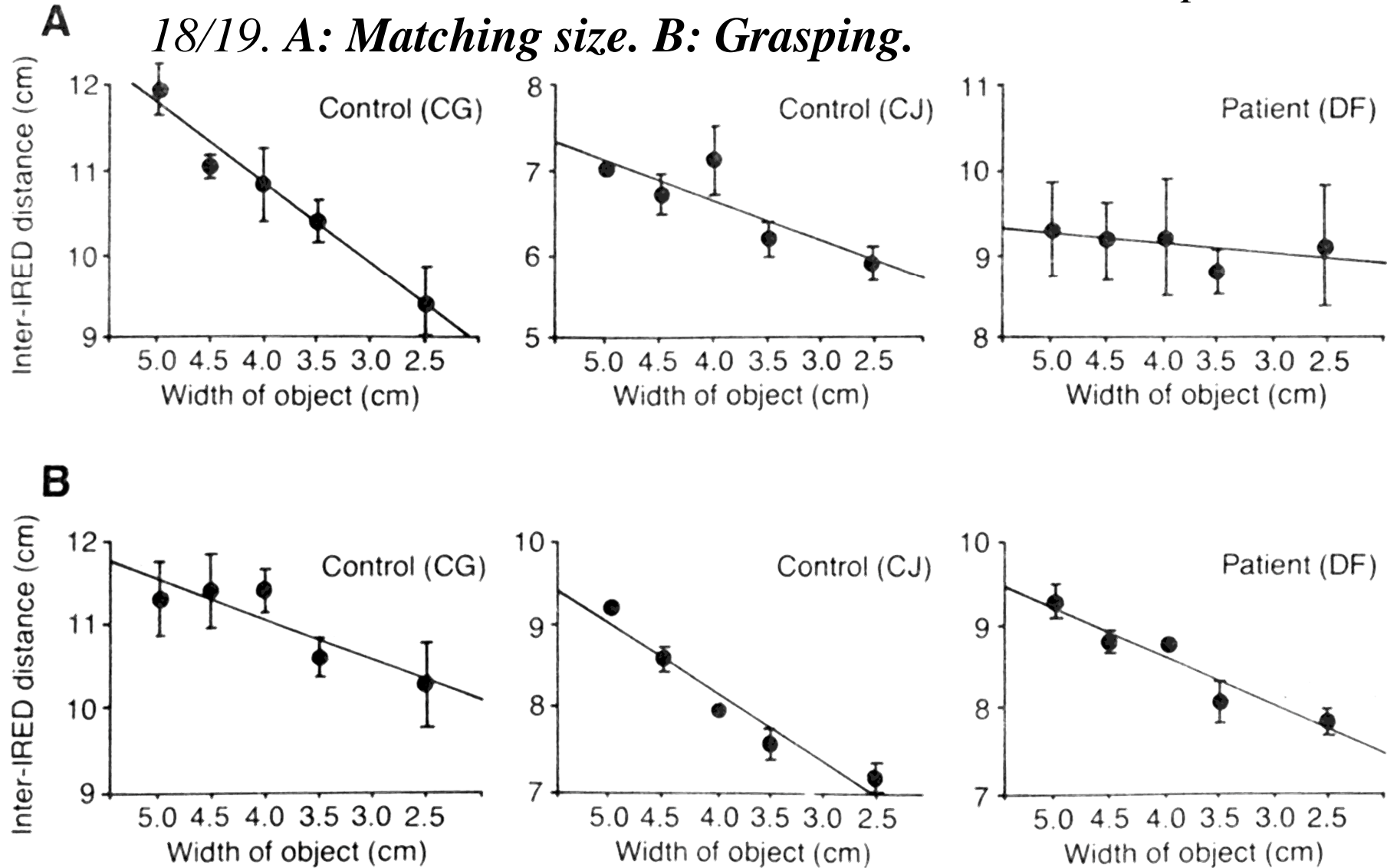
Perception of object size *versus* grasping



Milner (1998)

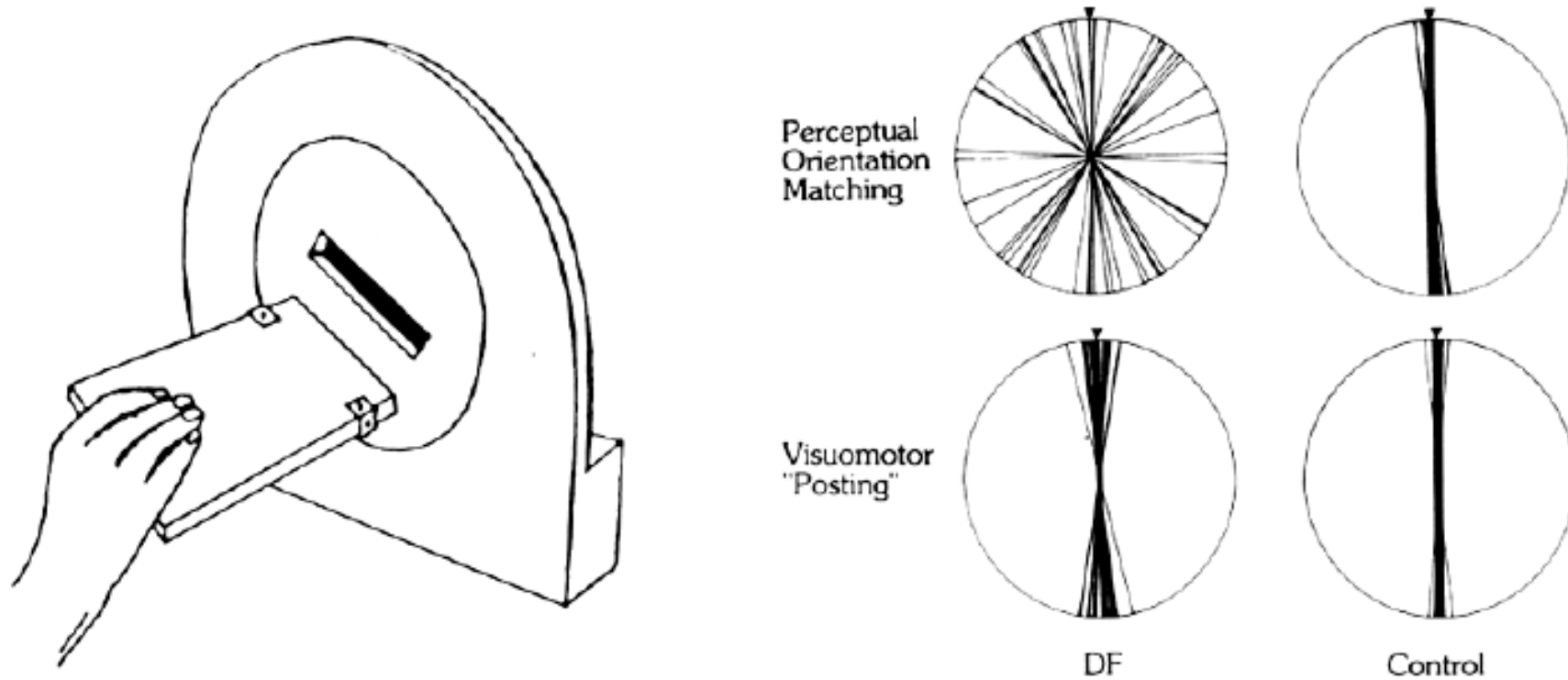
Impaired perception of object size, but normal actions

Patient D.F.; ventral stream lesion due to anoxia; esp. areas 18/19. A: Matching size. B: Grasping.

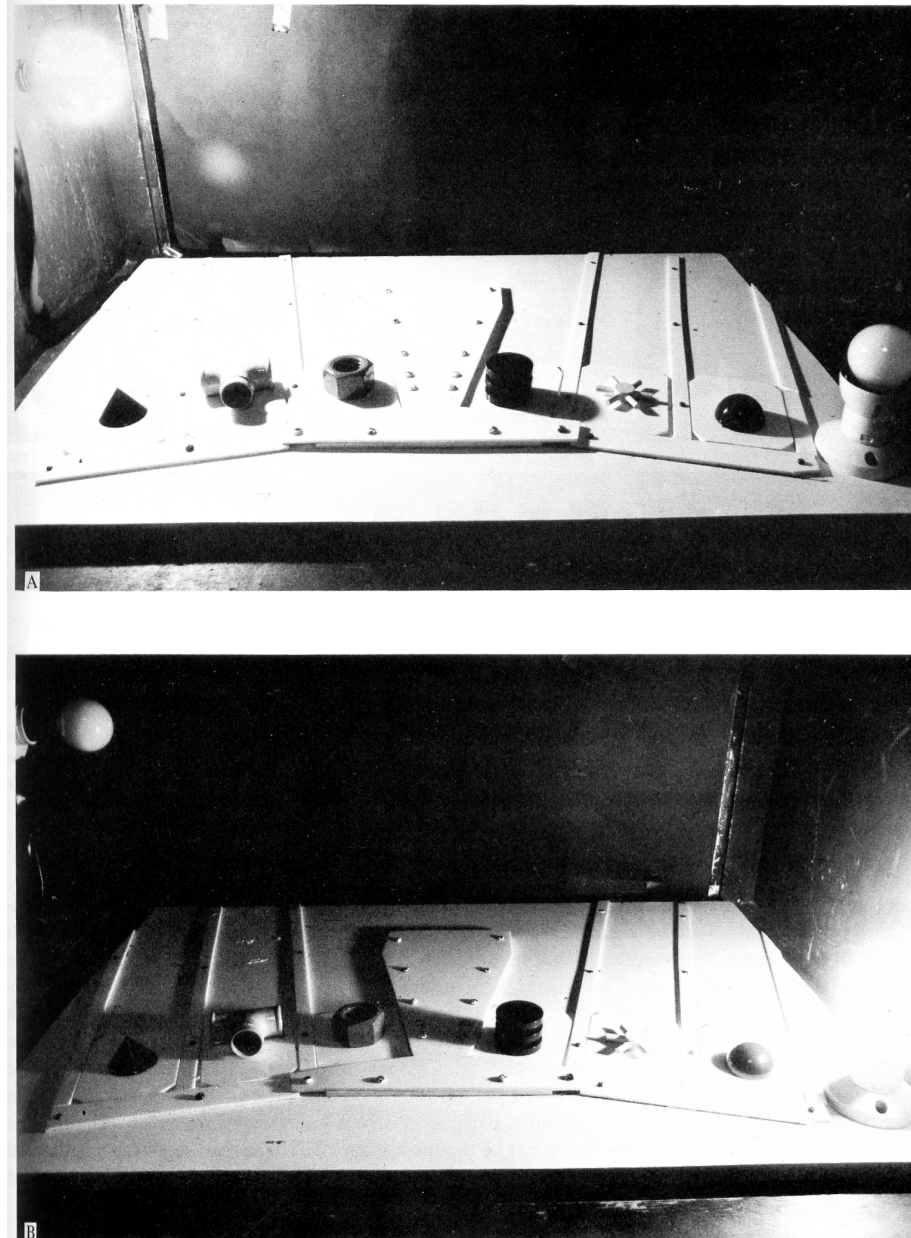


Impaired perception of orientation, but normal actions

Patient D.F.; ventral stream lesion (due to anoxia secondary to carbon monoxide poisoning); esp. areas 18/19

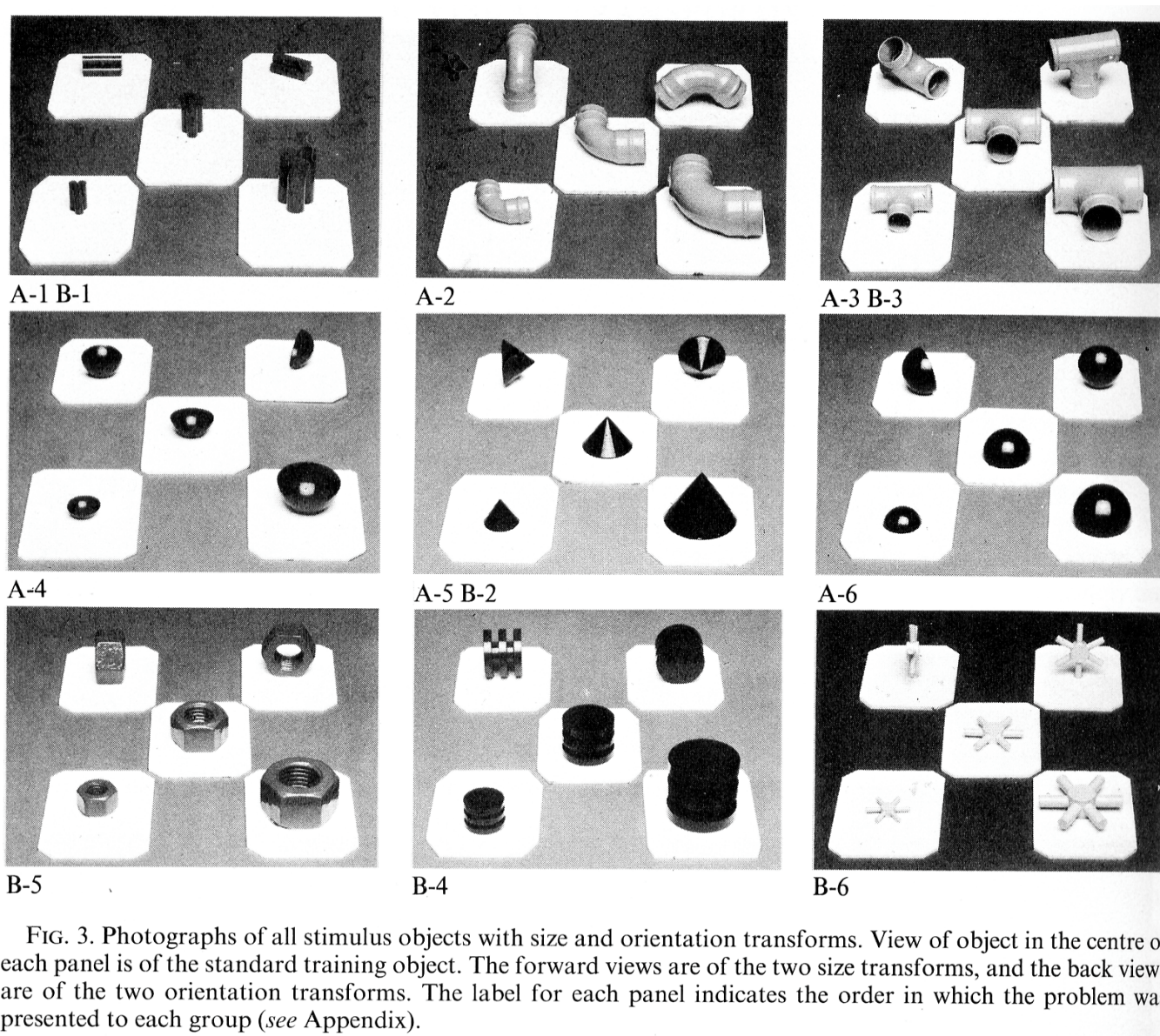


Object constancy in the ventral stream (1 - shadow)



Weiskrantz & Saunders (1984) - impaired by TE (inferotemporal) lesions, not parietal lesions

Object constancy in the ventral stream (2 - size, orientation)



Weiskrantz & Saunders (1984) - impaired by TE (inferotemporal) lesions, not parietal lesions

Summary

- **Ventral stream is *object-centred*.** Object detection largely irrespective of position, sometimes independent of viewpoint, etc. Required for visual awareness?
- **Dorsal stream is *visuomotor*.** High spatial precision for guidance of action. Unconscious?
- The **posterior parietal cortex maintains multiple maps of space** with which it can control actions; some approximate allocentric maps (independent of eye/body position to a degree).
- The **posterior parietal cortex has *attentional* functions**, separate from its visuomotor functions. To be continued...

