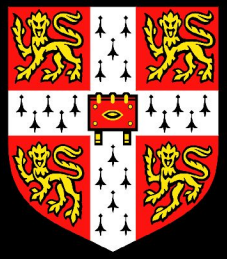
NST II Psychology
NST II Neuroscience (Module 5)

Brain Mechanisms of Memory and Cognition – 2

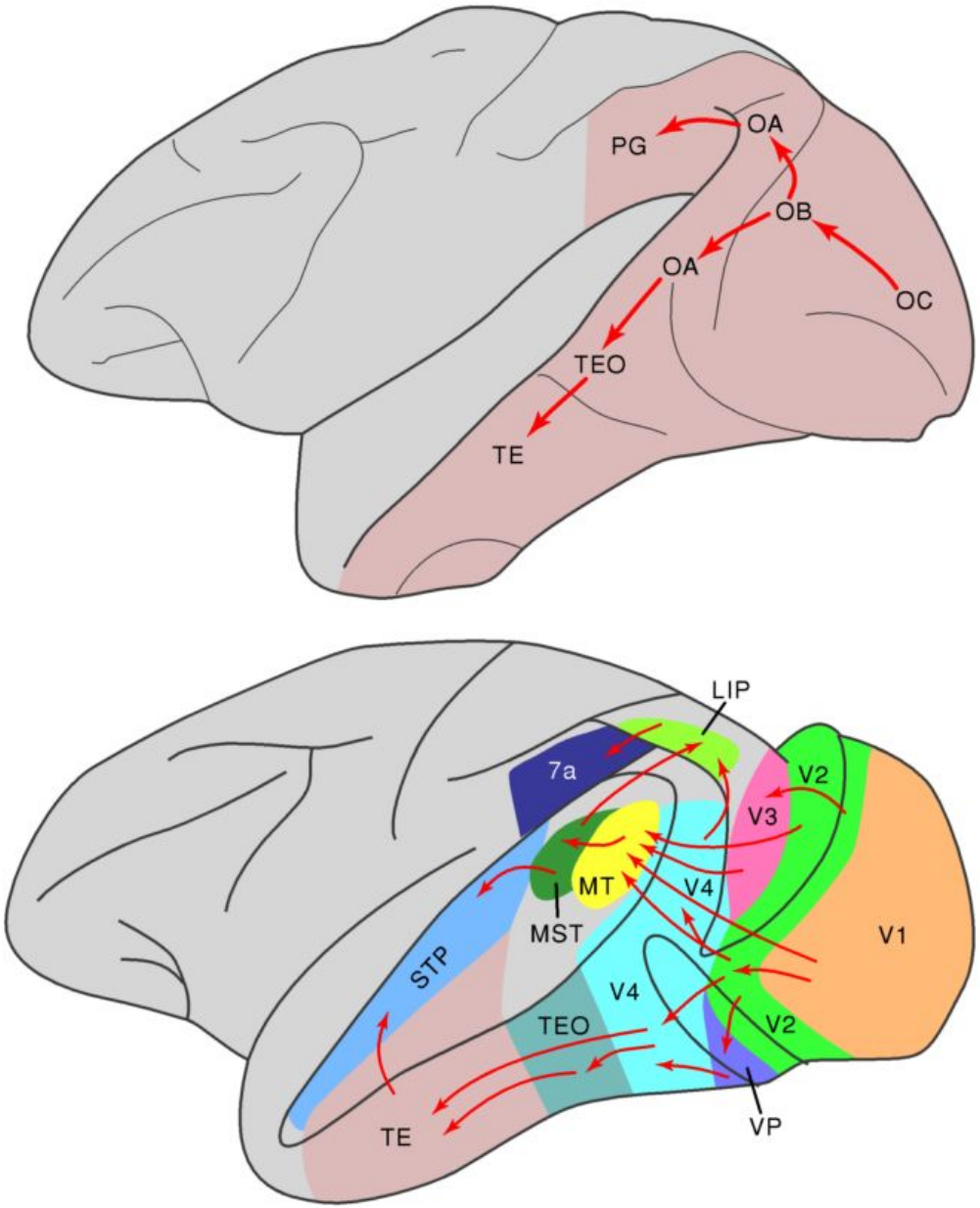
Motion processing; spatial cognition; parietal cortex

Rudolf Cardinal
Department of Experimental Psychology

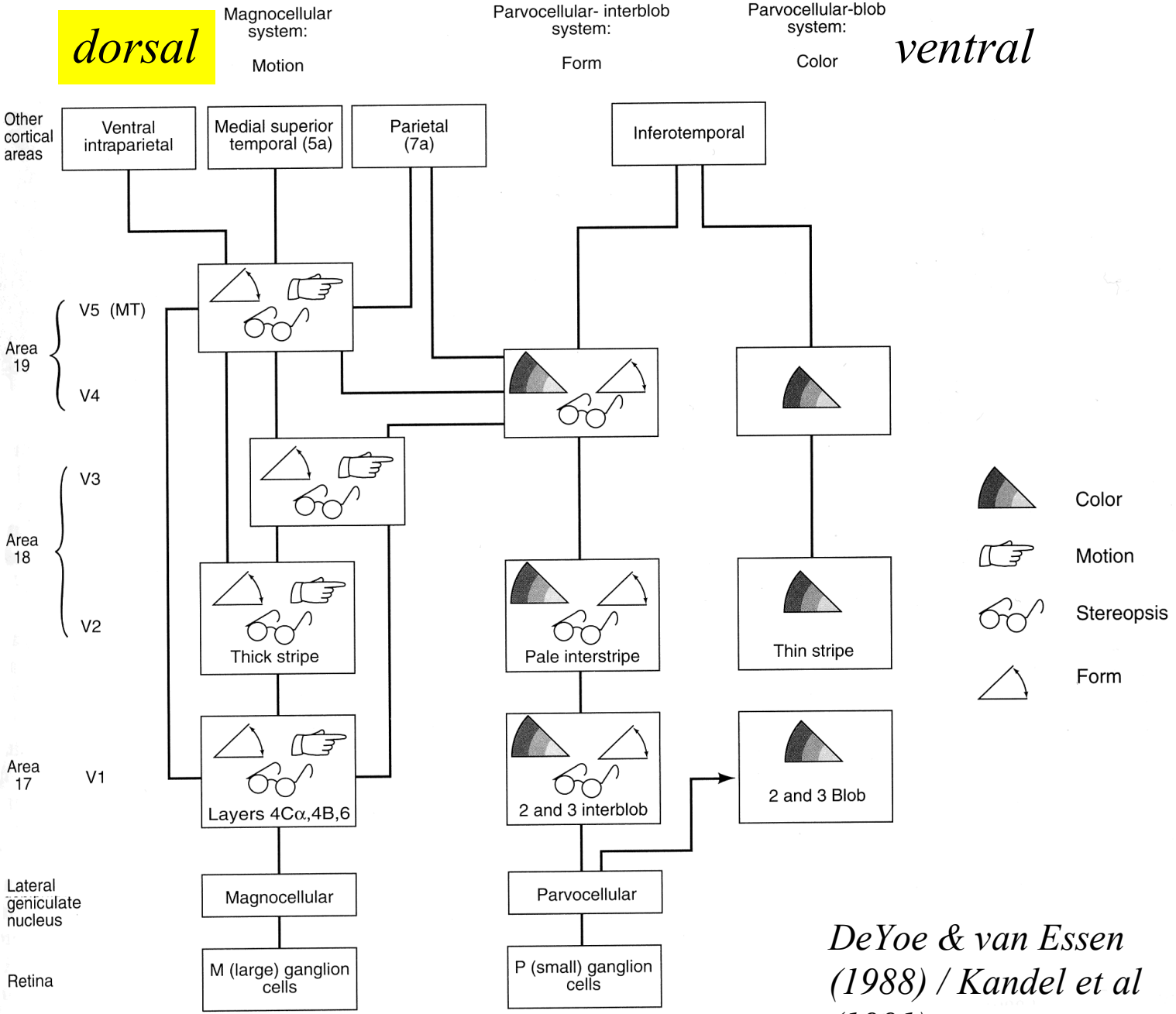


Monday 13, 20, 27 Jan; 3, 10, 24 Feb 2003; 10 am
Physiology Main Lecture Theatre

Two visual streams

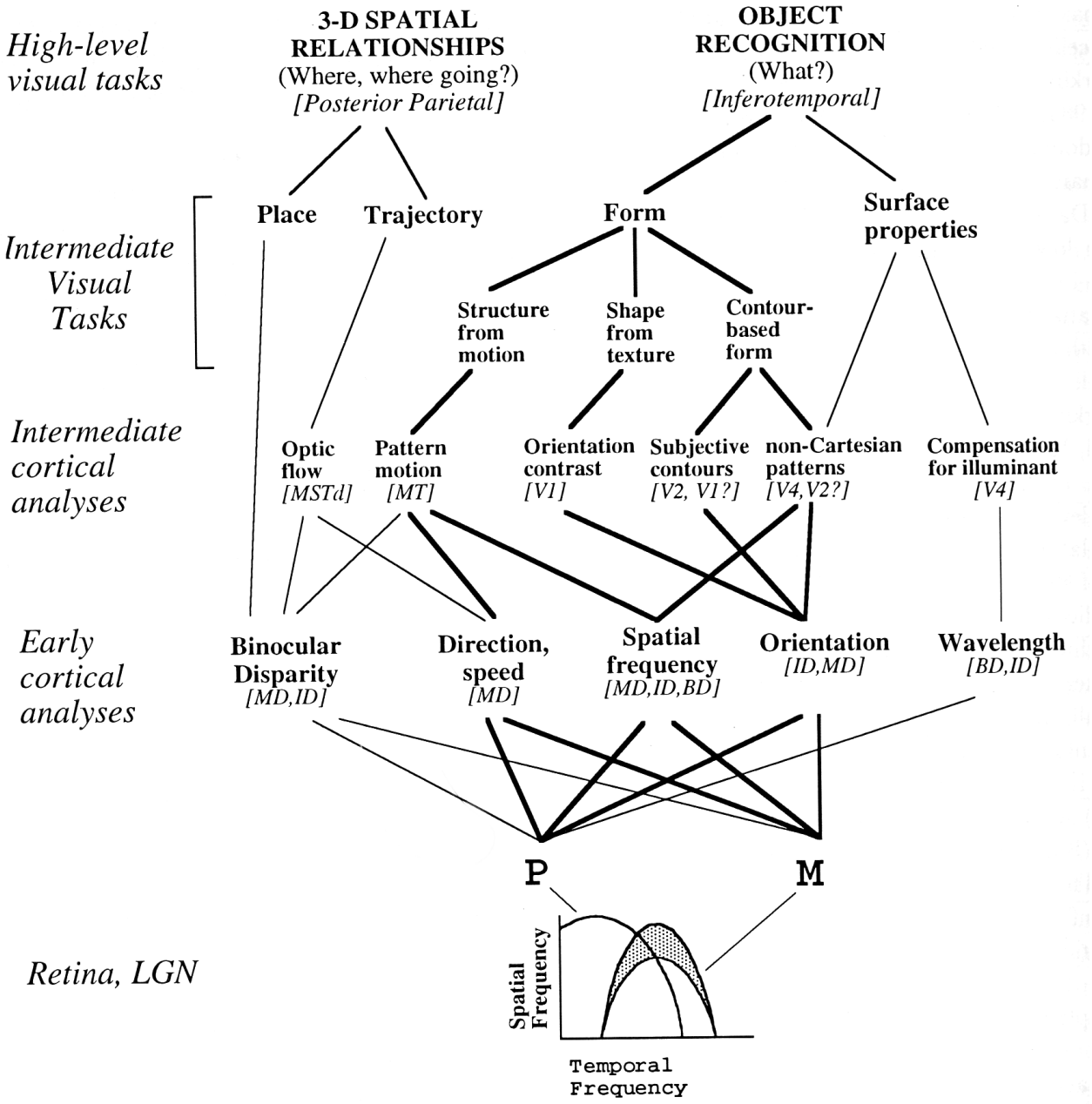


Concurrent (parallel) processing begins at the retina



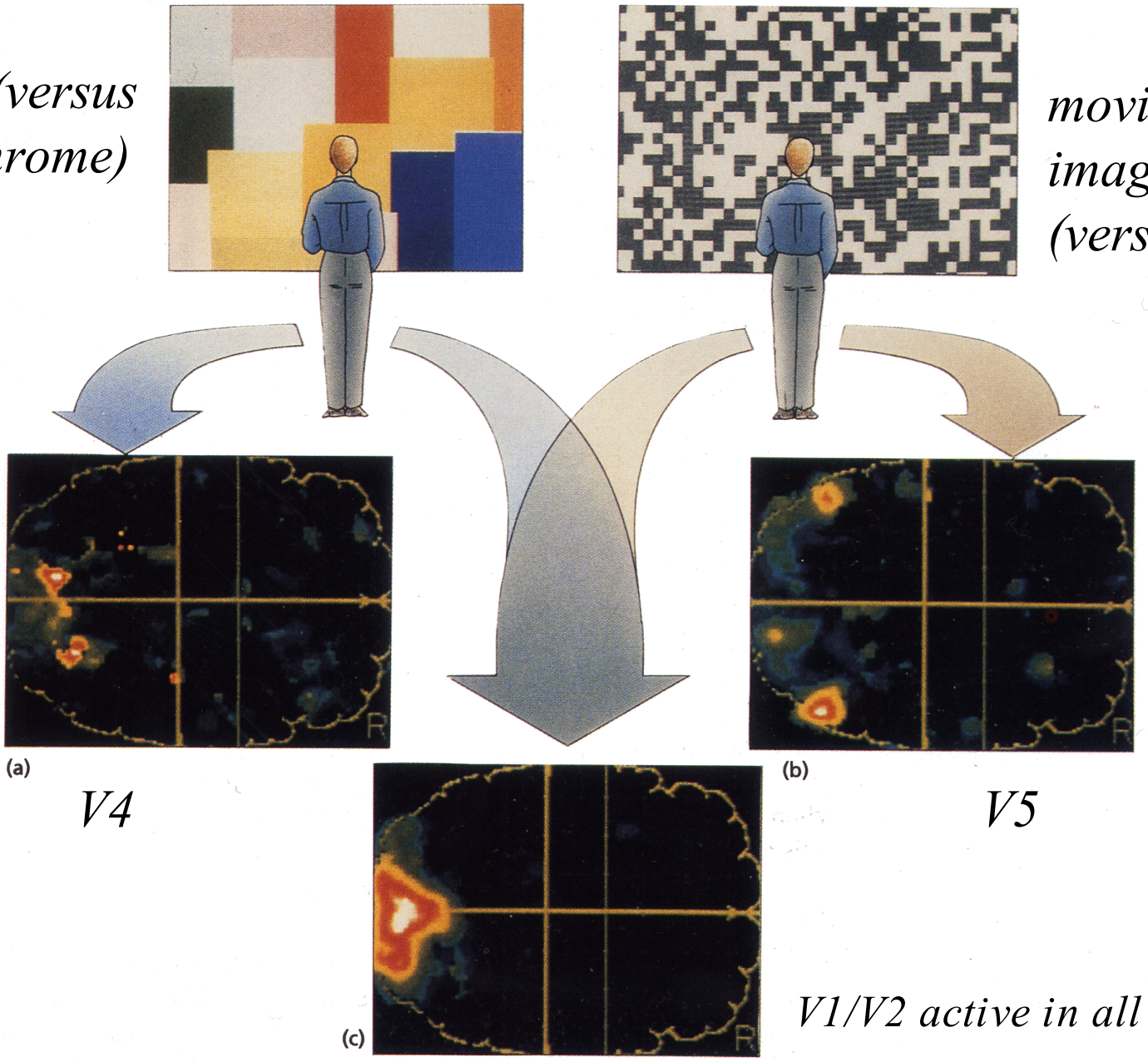
DeYoe & van Essen (1988) / Kandel et al

Information flow in the visual streams



Colour (V4) and motion (V5)

colour (versus monochrome)



moving dot image (versus still)

V4

V5

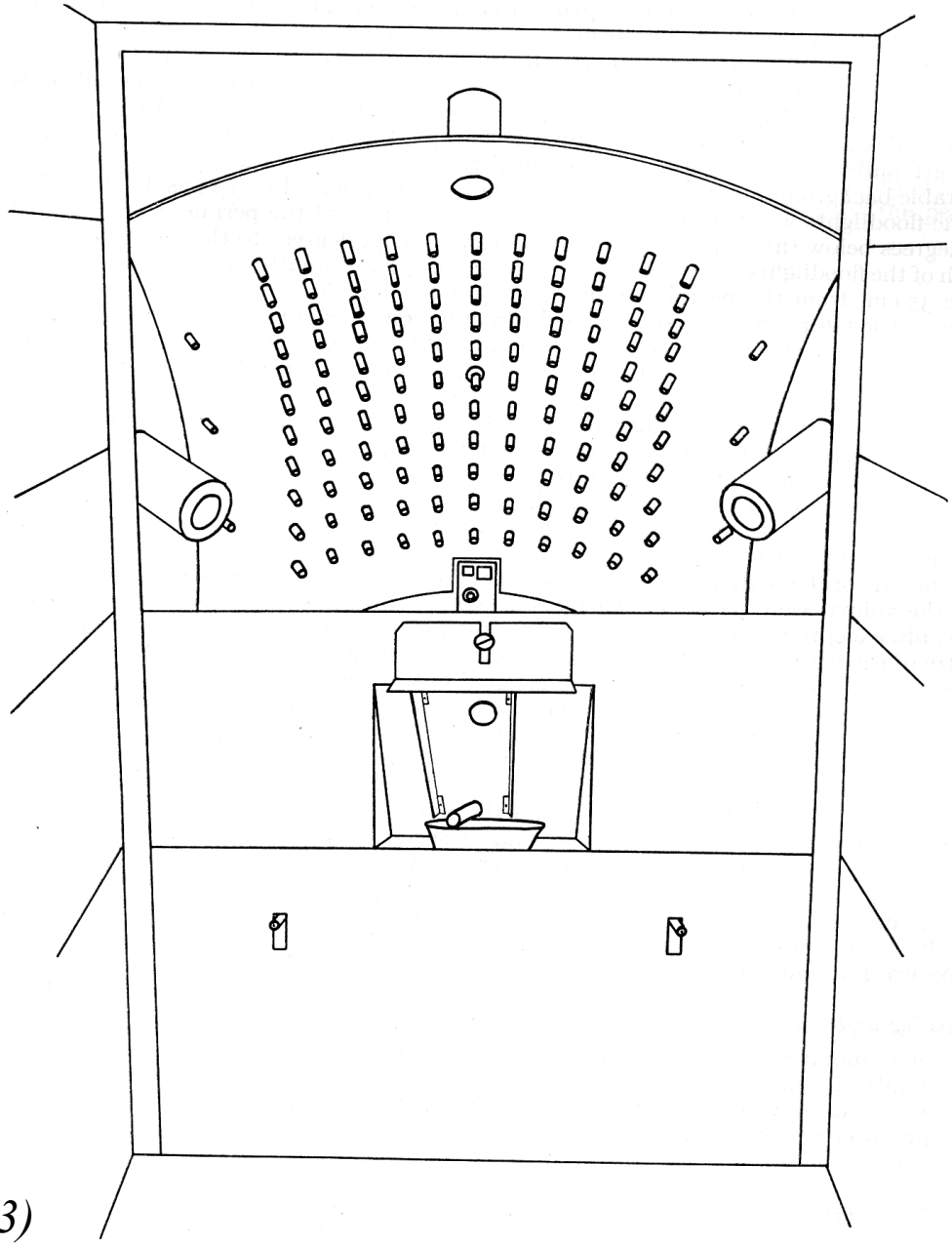
V1/V2 active in all conditions

Zeki (1993)

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

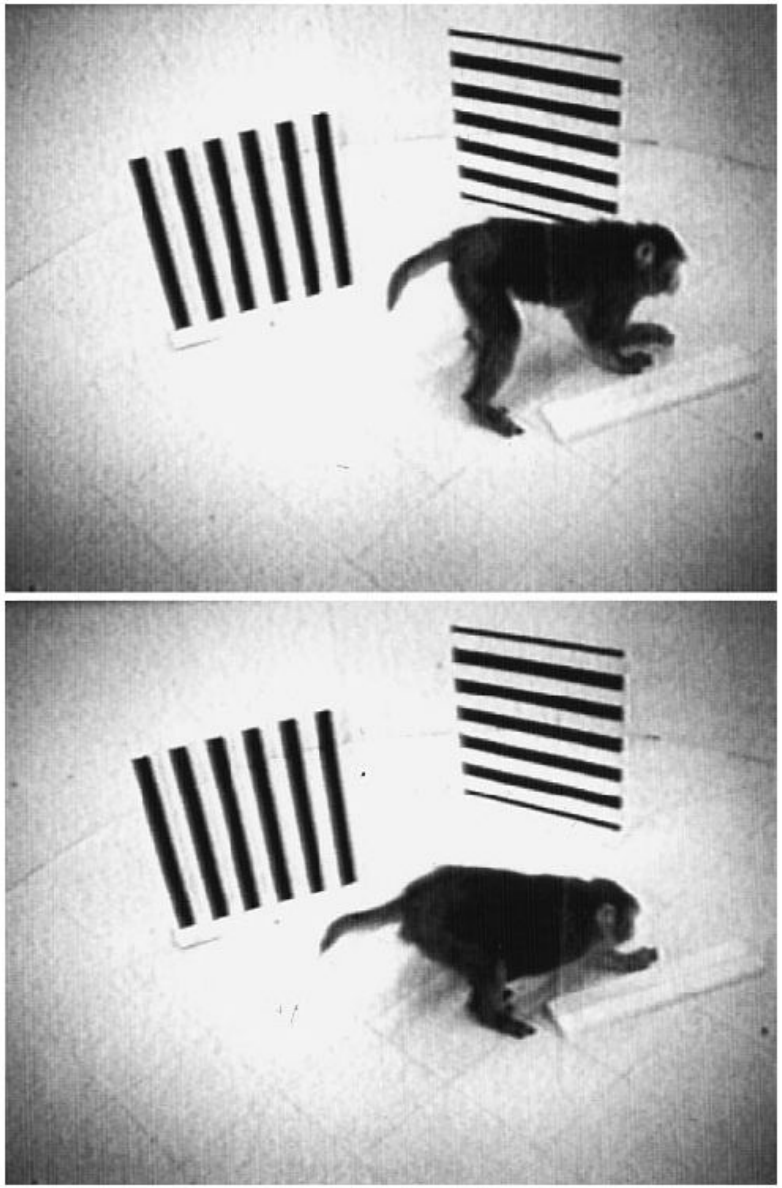
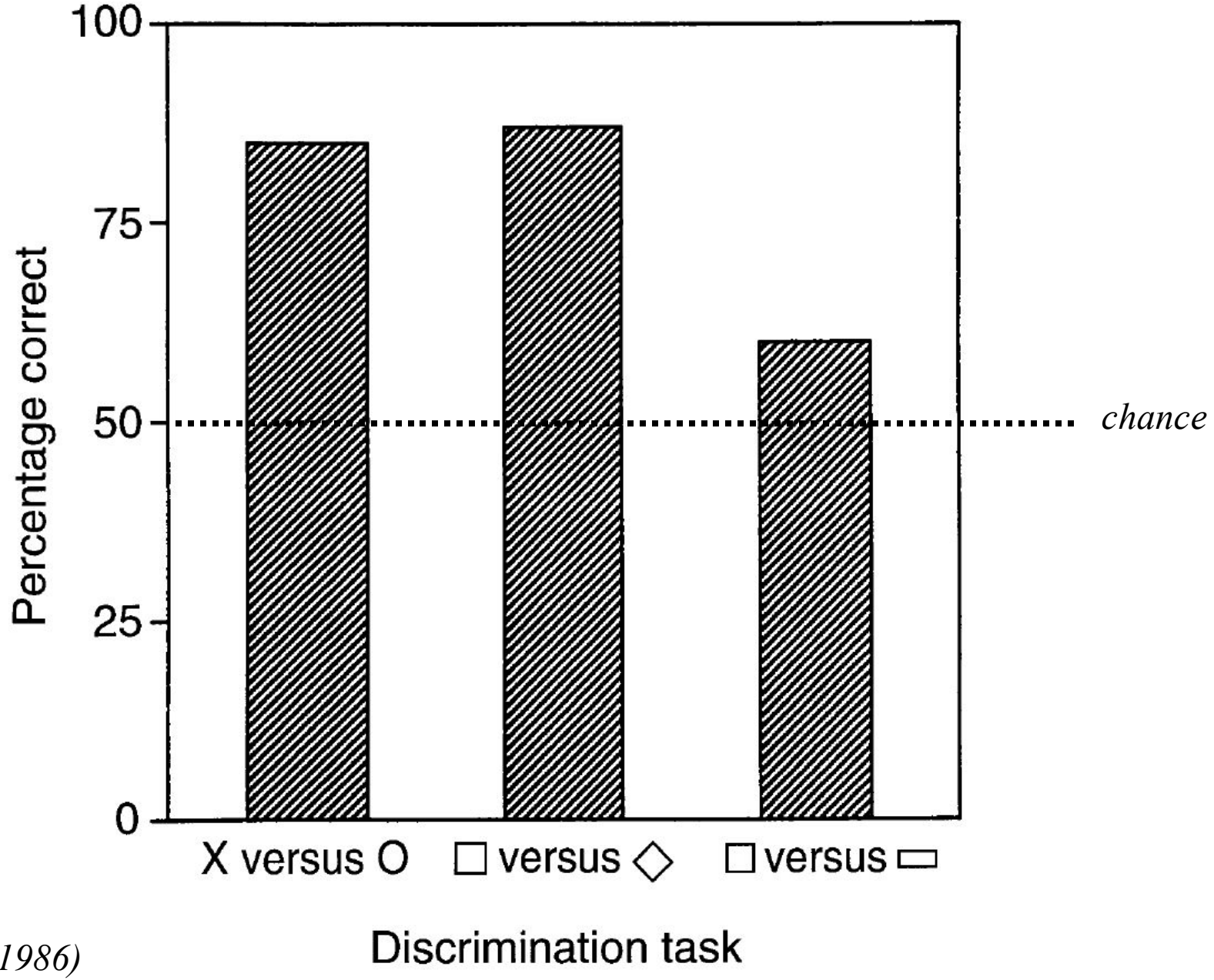


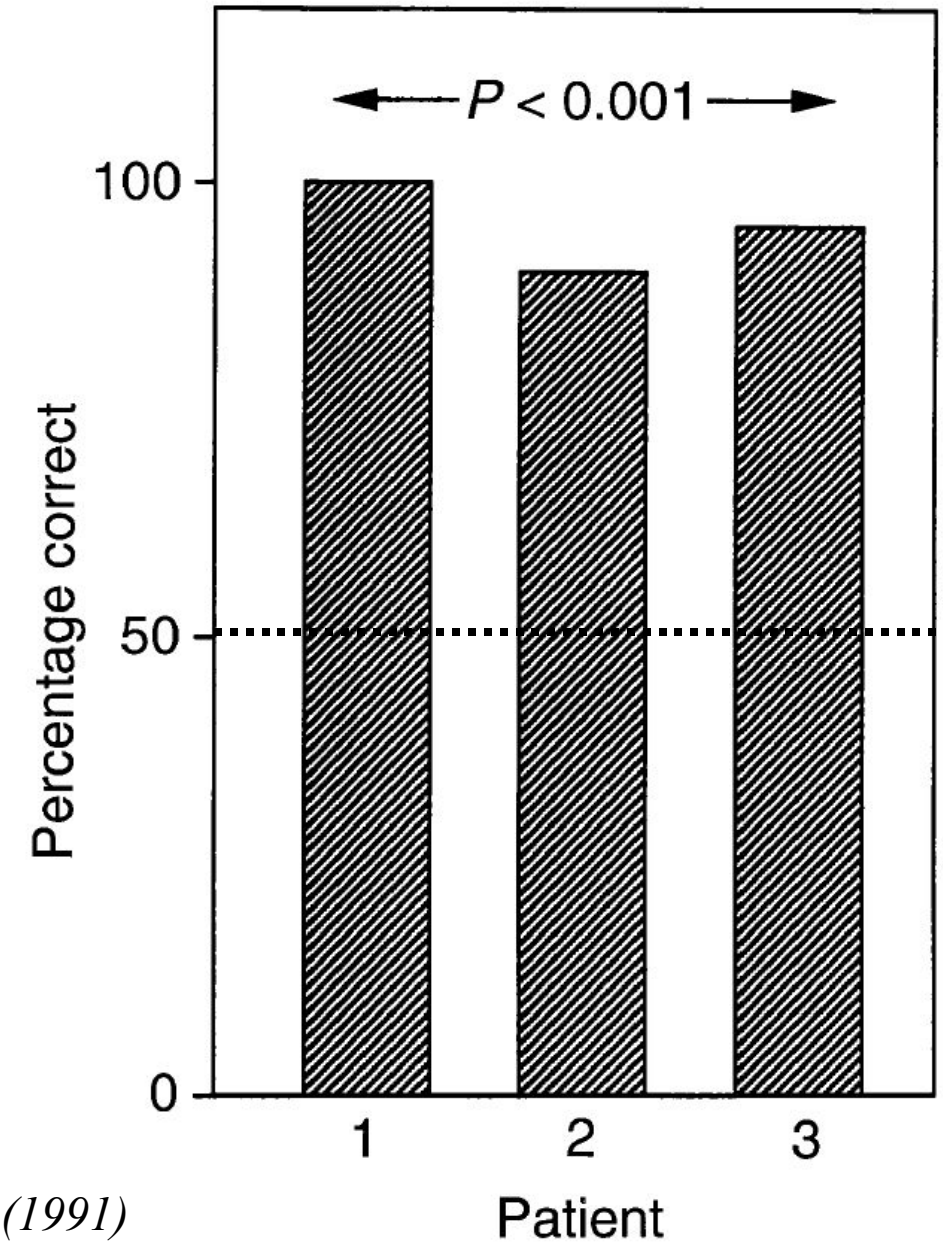
Fig. 15 The bilaterally destriated monkey Helen roamed freely among the objects in the test arena. She would, however, bump into the obstacle made of transparent perspex, as shown, revealing that her navigation was not based on non-visual cues. (Photographs taken from a film by N. Humphrey, and published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

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



Weiskrantz (1986)

Blindsight: motion discrimination following V1 lesions



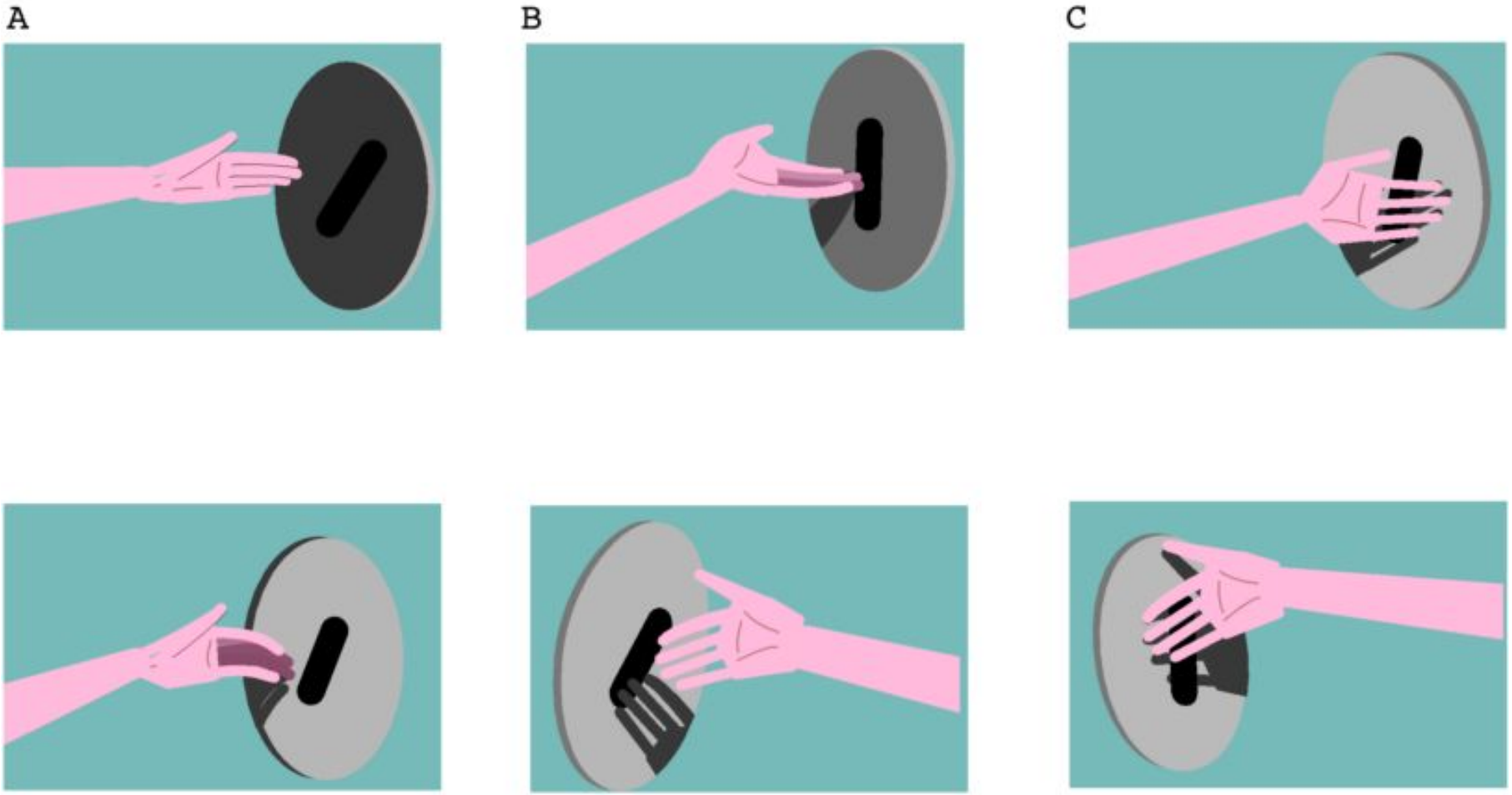
... whereas hemispherectomized patients perform at chance (on their bad side)

chance

Perenin (1991)

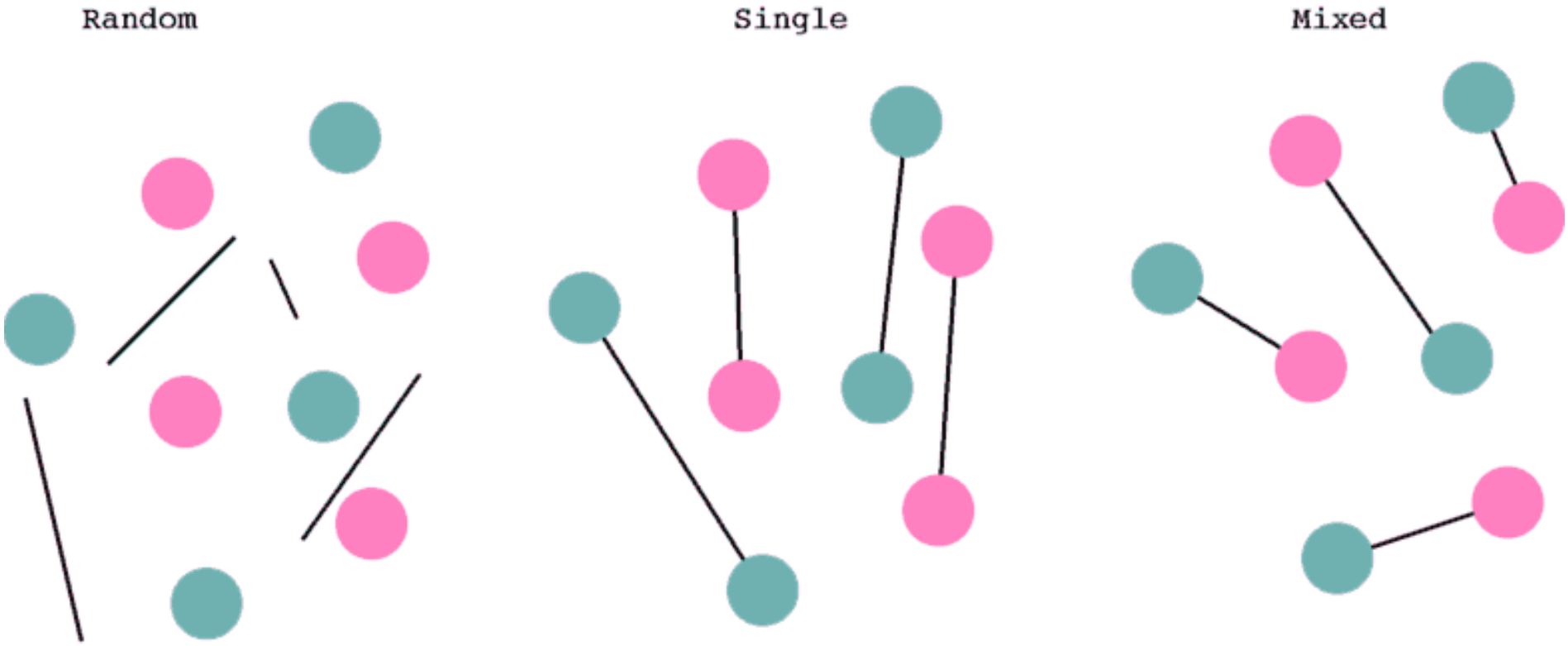
Effects of parietal cortex lesions.
Bálint's syndrome; neglect

Optic ataxia: impaired visual guidance of movement



Simultanagnosia

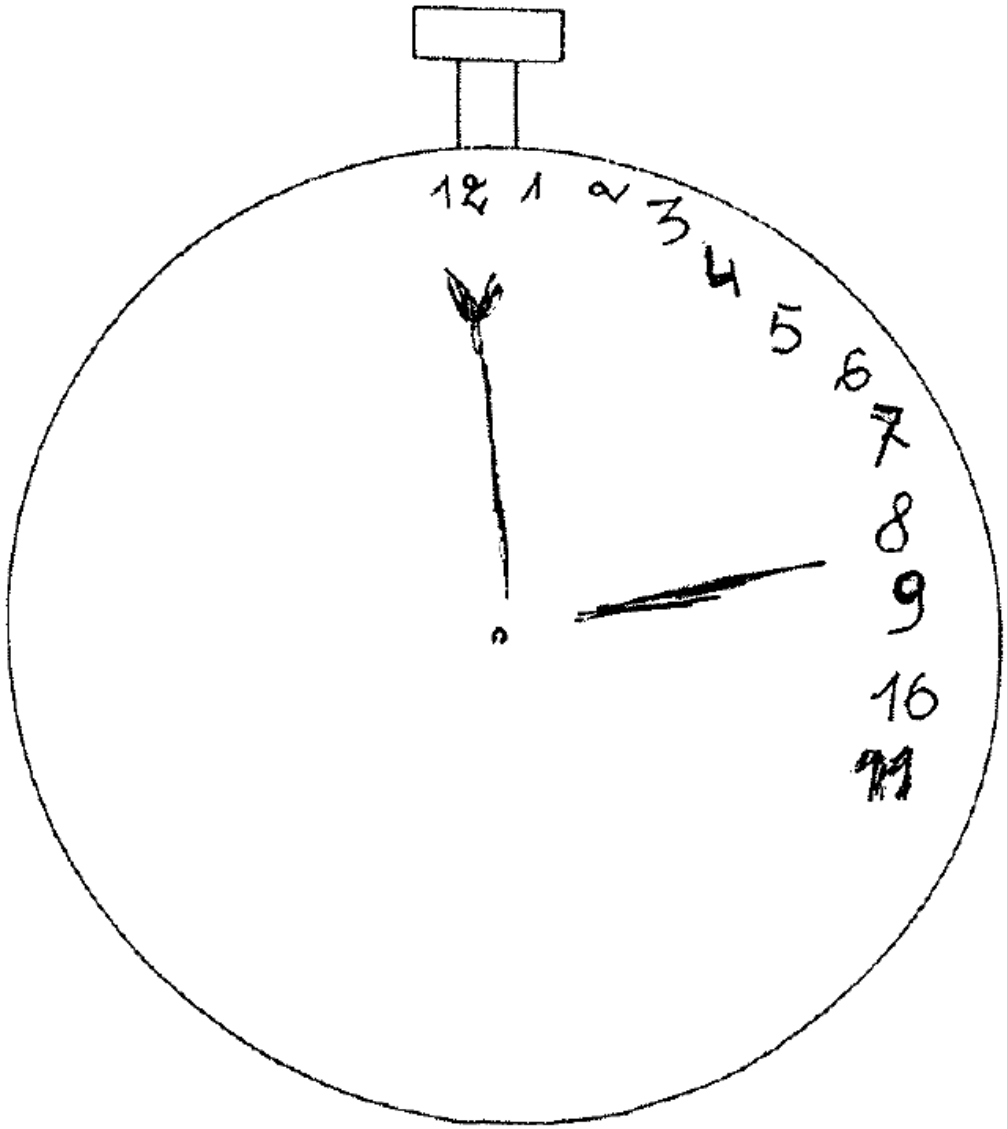
'Are there circles of two different colours?'

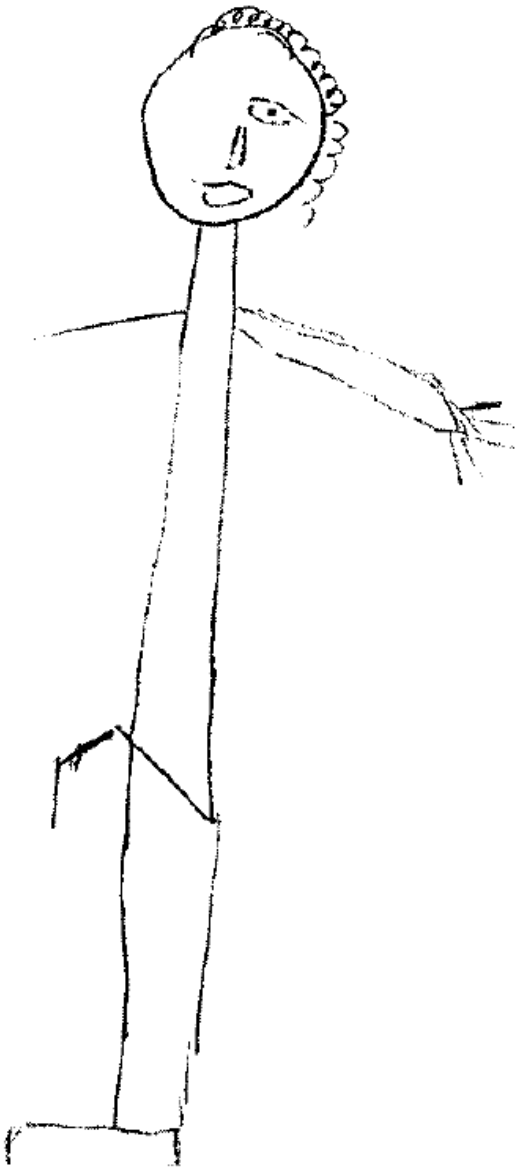


'No.' *'No.'* *'Yes.'*

Humphreys & Riddoch (1993)

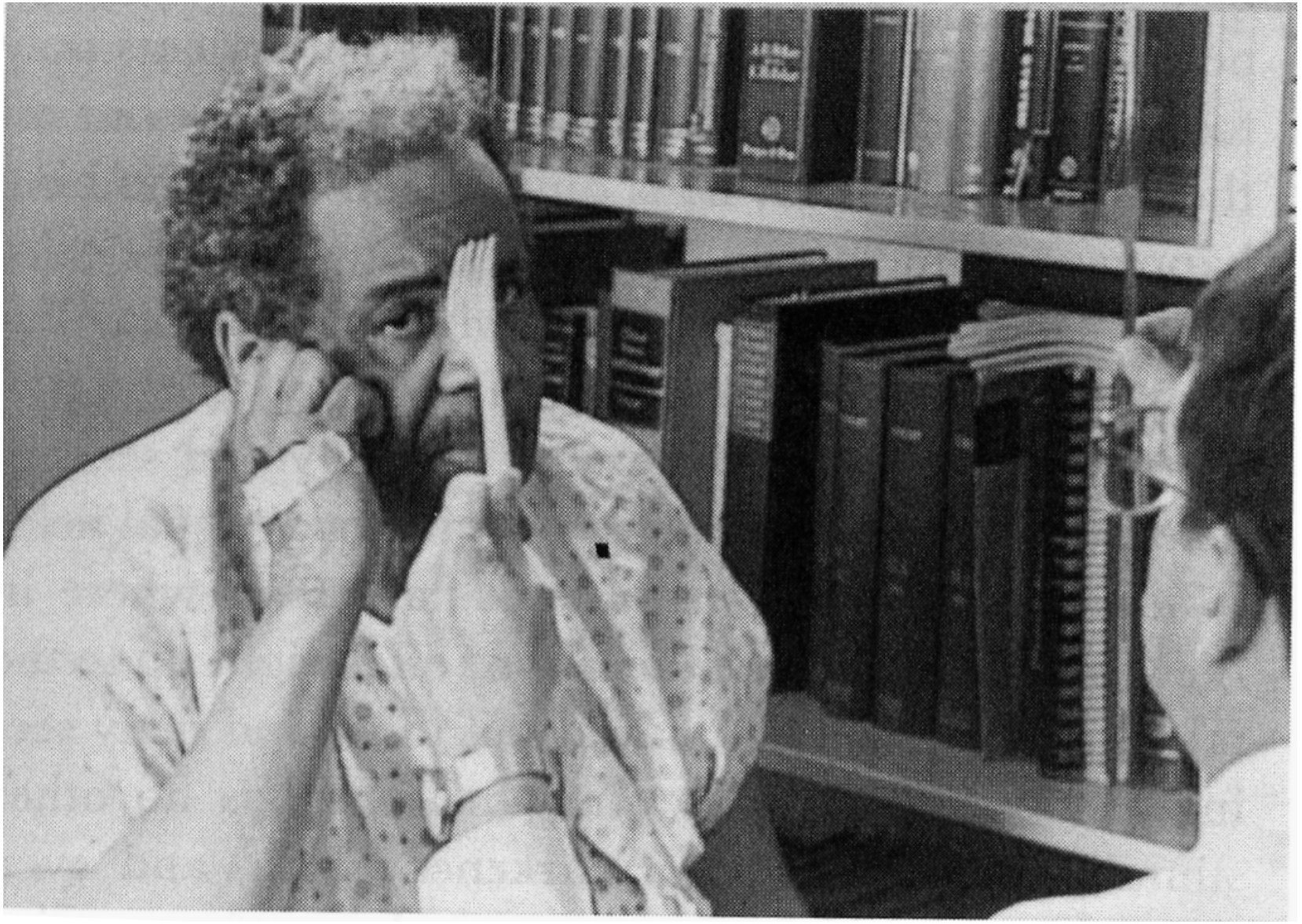
Neglect: drawings from memory





Beschin et al. (2000)

Sensory extinction following partial recovery from neglect



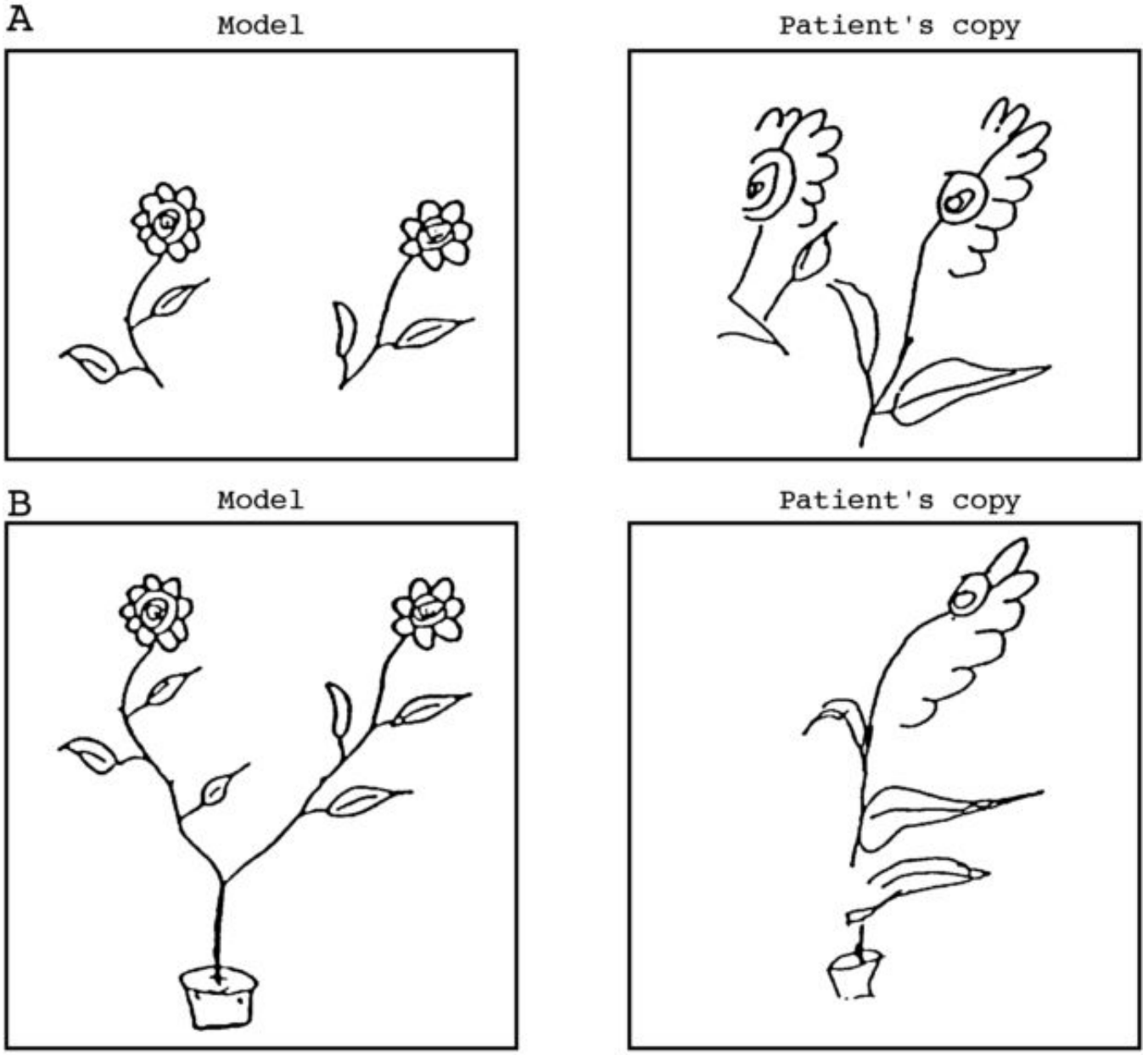
Neglect is attentional: the Piazza del Duomo, Milan (1)

Bisiach & Luzzatti (1978)

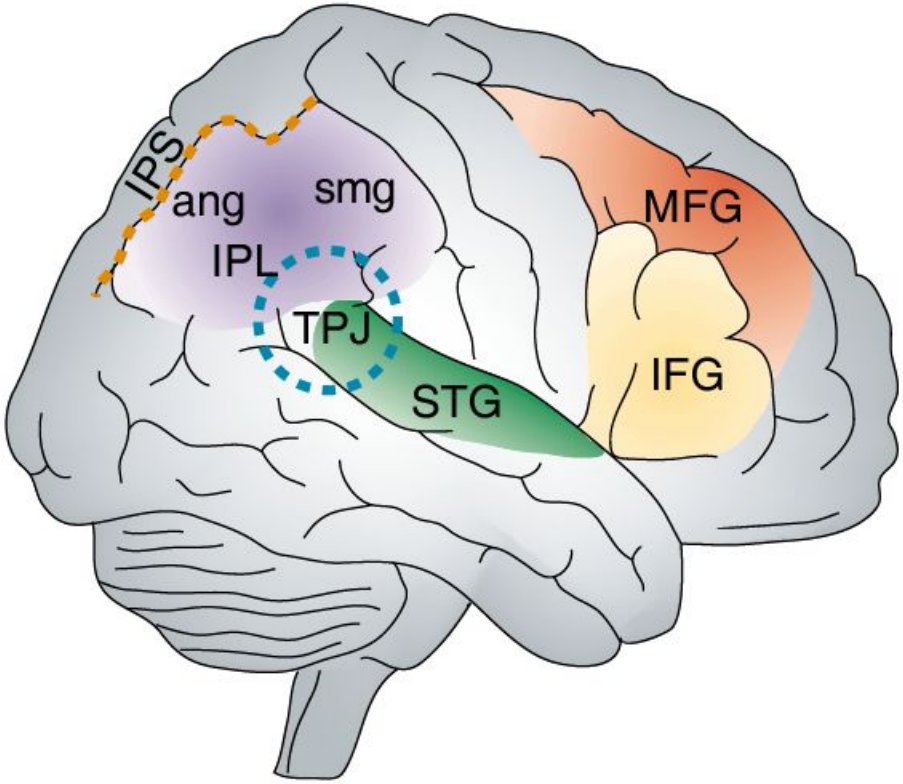
Neglect is attentional: the Piazza del Duomo, Milan (2)

Bisiach & Luzzatti (1978)

Object-centred neglect



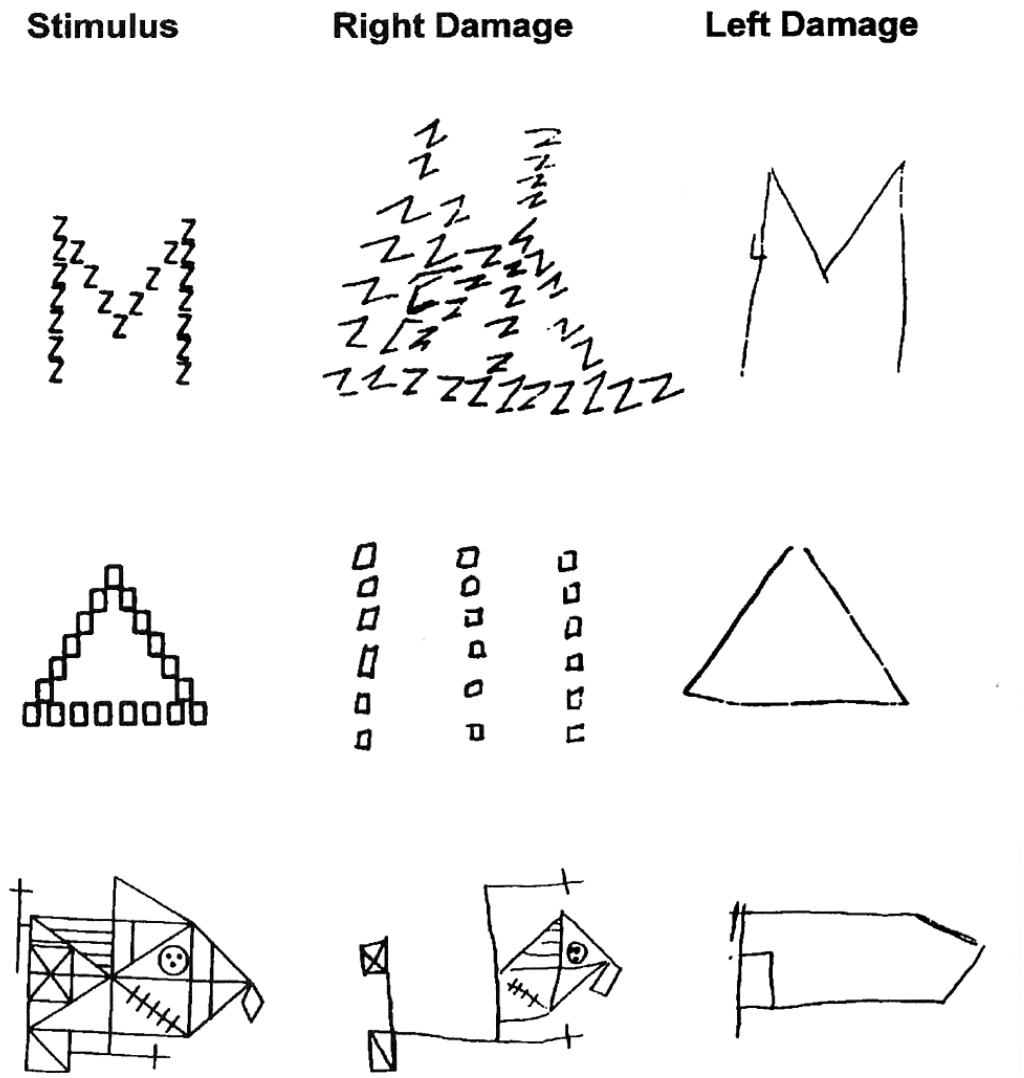
Cortical regions damaged in neglect



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

Husain & Rorden (2003) Nature Rev Neuro 4: 26

Left/right asymmetry of function in the TPJ

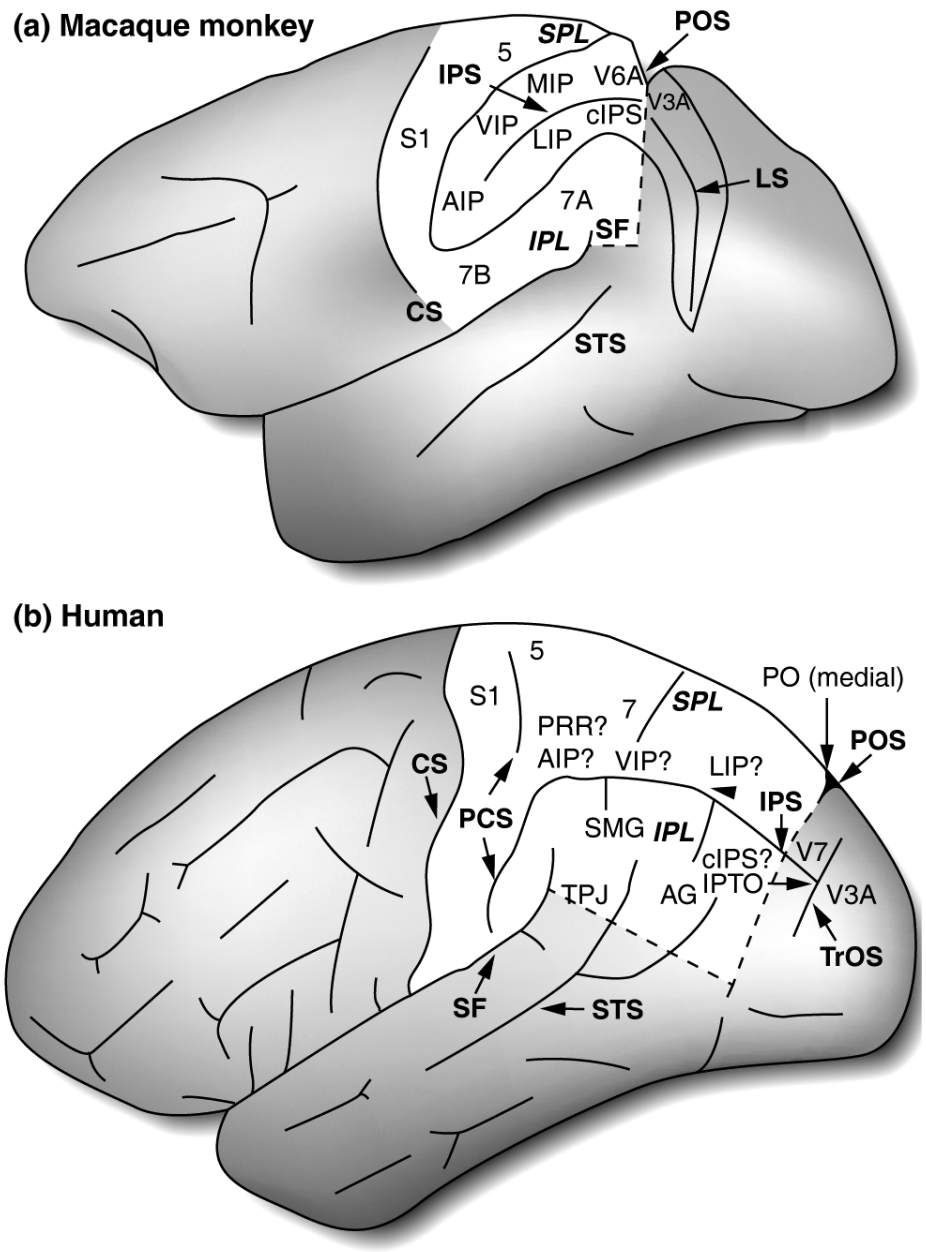


Rey-Osterreith figure

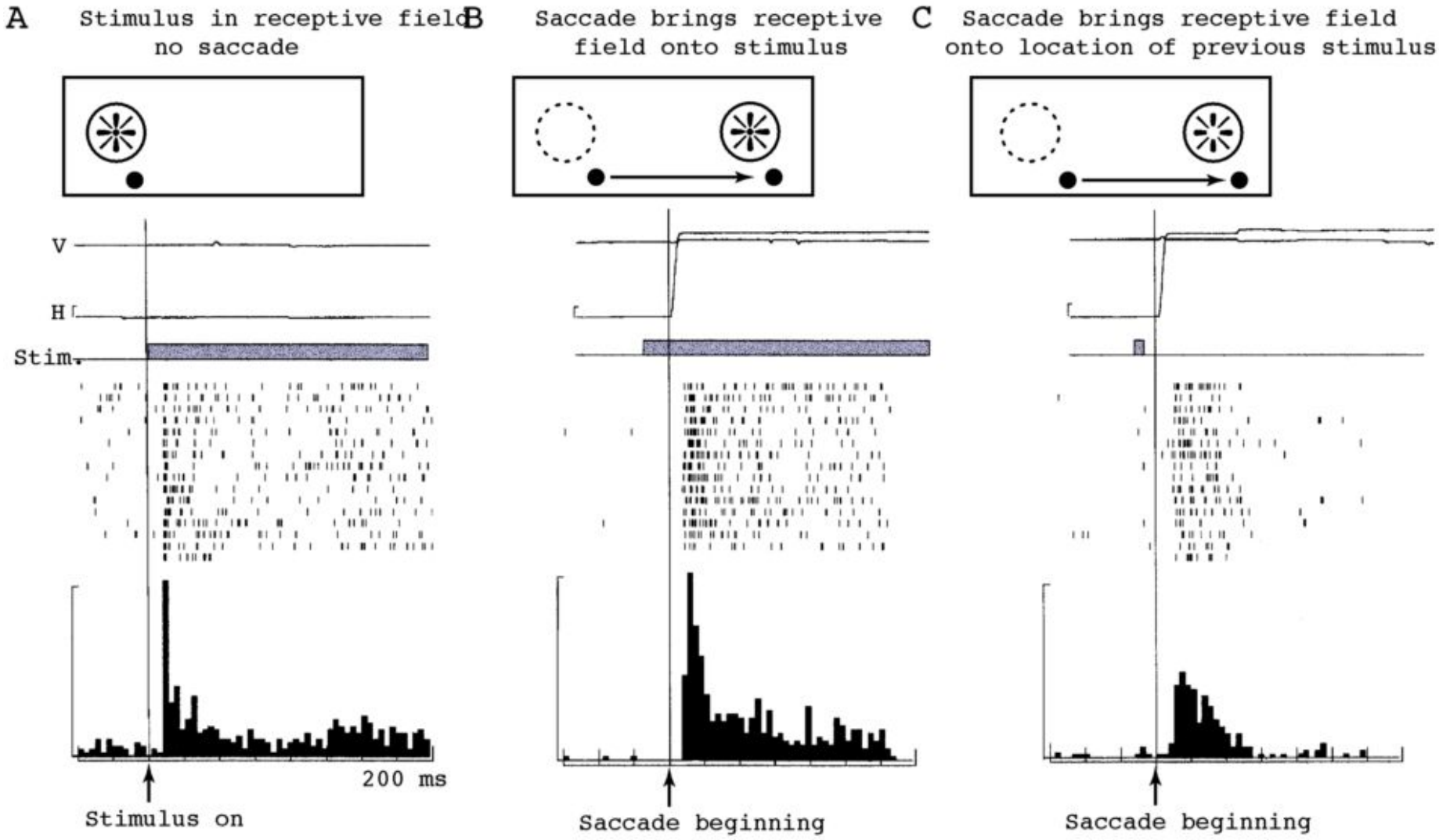
FIGURE 44.9 Examples of drawings of a stimulus by patients with left or right hemisphere damage. (Adapted from Robertson and Lamb, 1991.)

Parietal cortex: anatomy and electrophysiology

Parietal cortex (with the intraparietal sulcus 'unfolded')

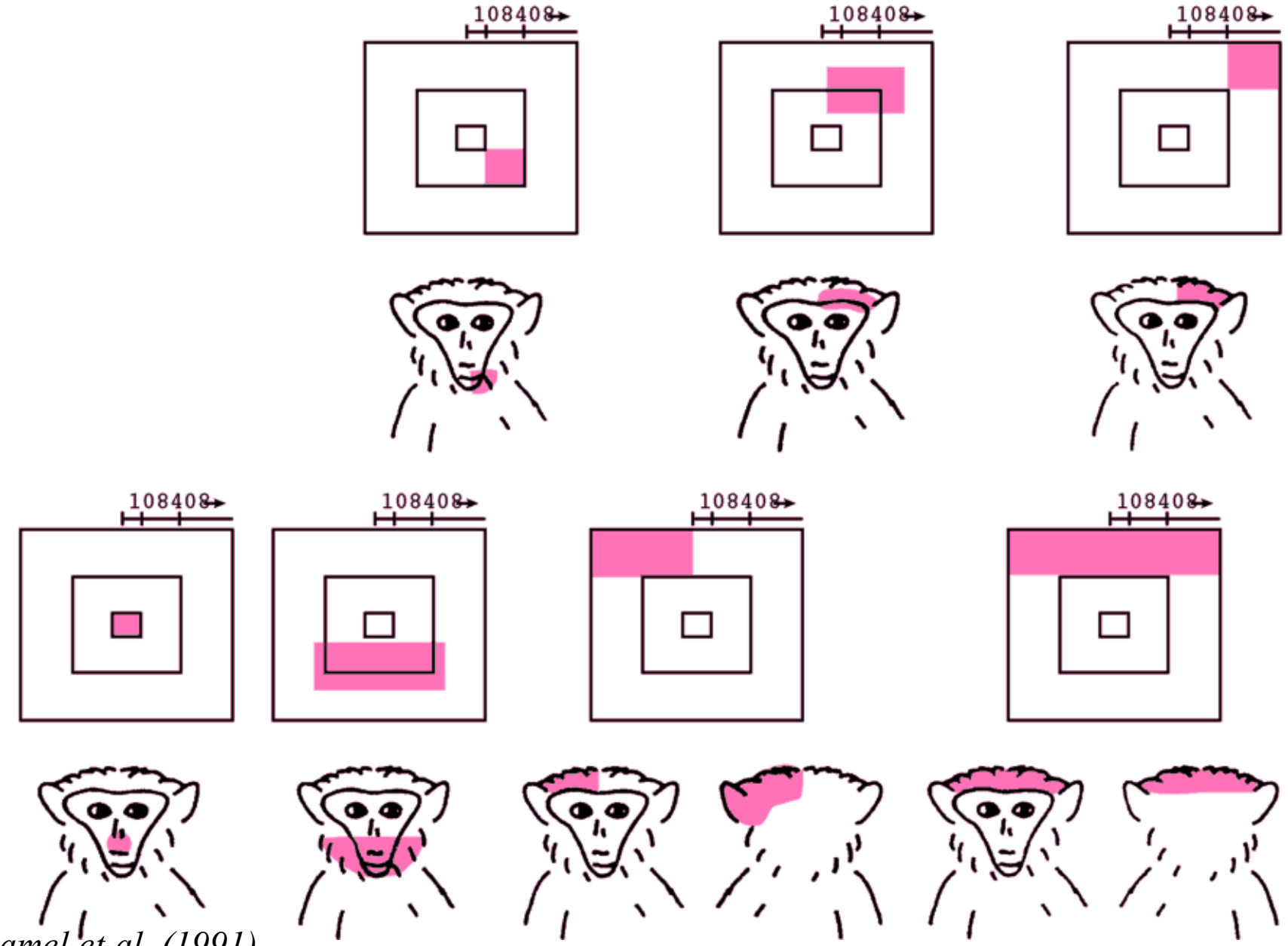


LIP neuronal responses



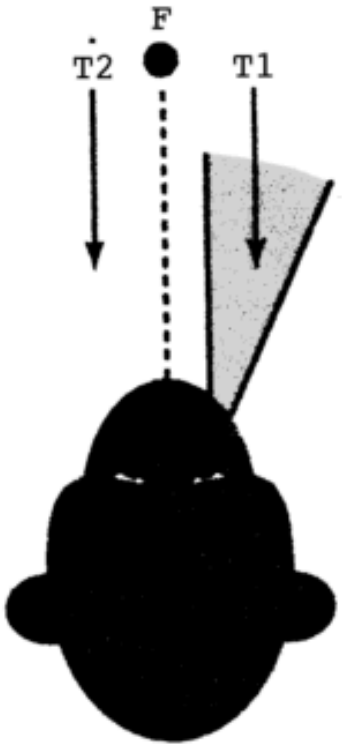
Duhamel et al. (1992) Science 255: 90

VIP neuronal responses: polymodal, ‘head-centred’

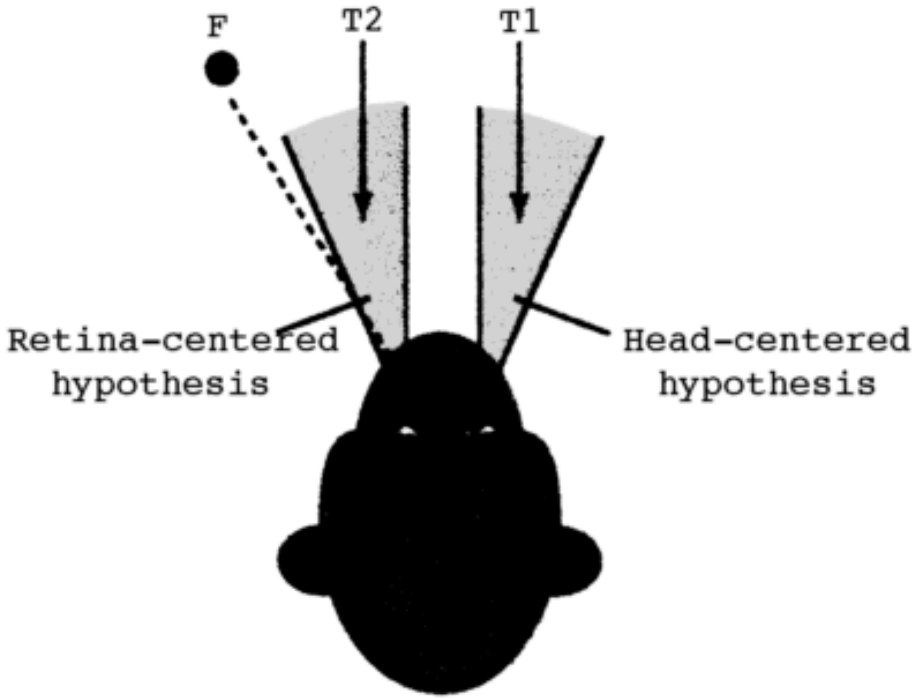


Duhamel et al. (1991)

‘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

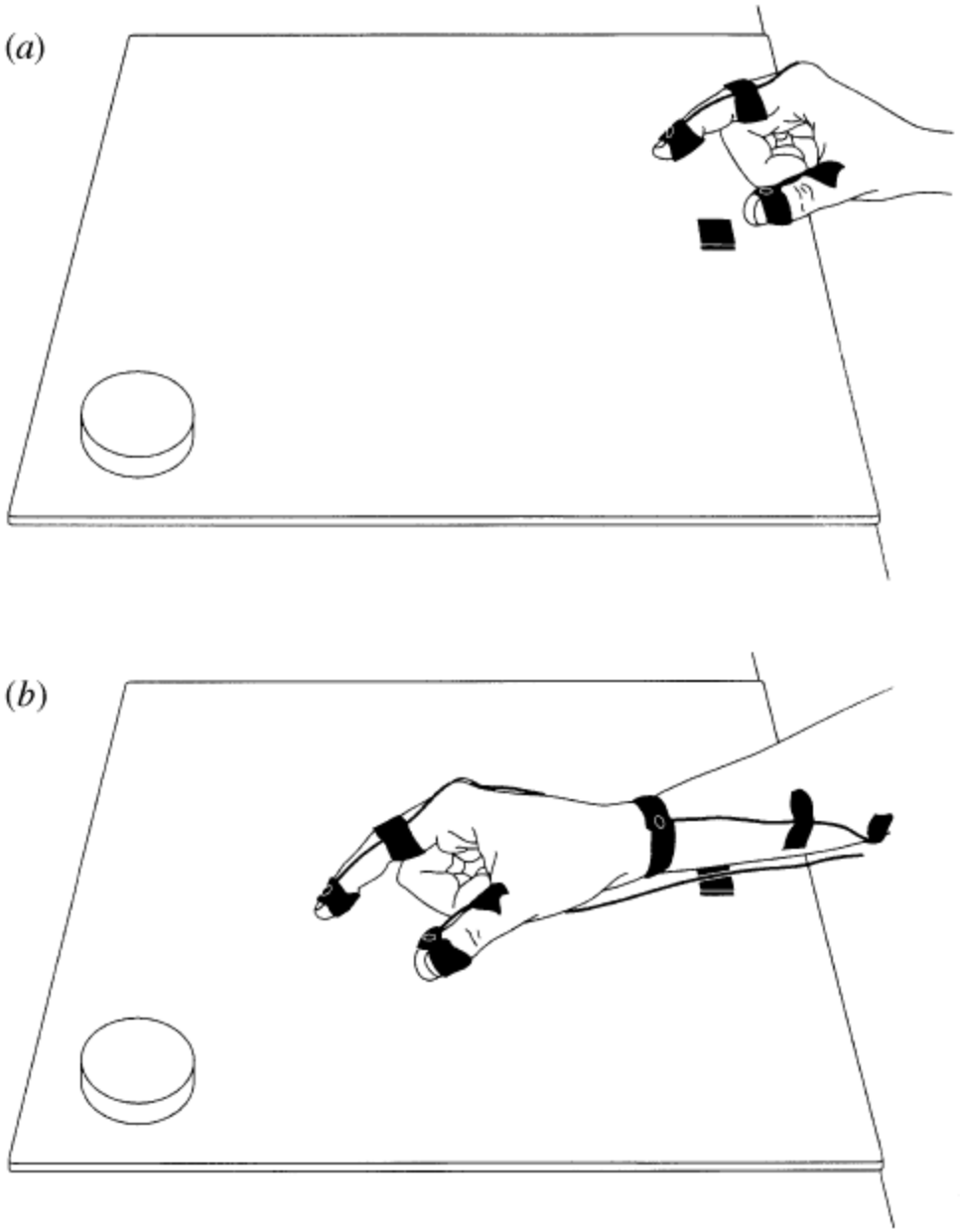
- **7a:** Similar to LIP. Visual receptive fields; also respond to position of eyes in orbits; thus may e.g. respond best to stimulus in RF when eye in a certain position.
- **7a:** Activity related to saccades, visual pursuit, and also movement of arm towards a target (N.B. relevance to optic ataxia) 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

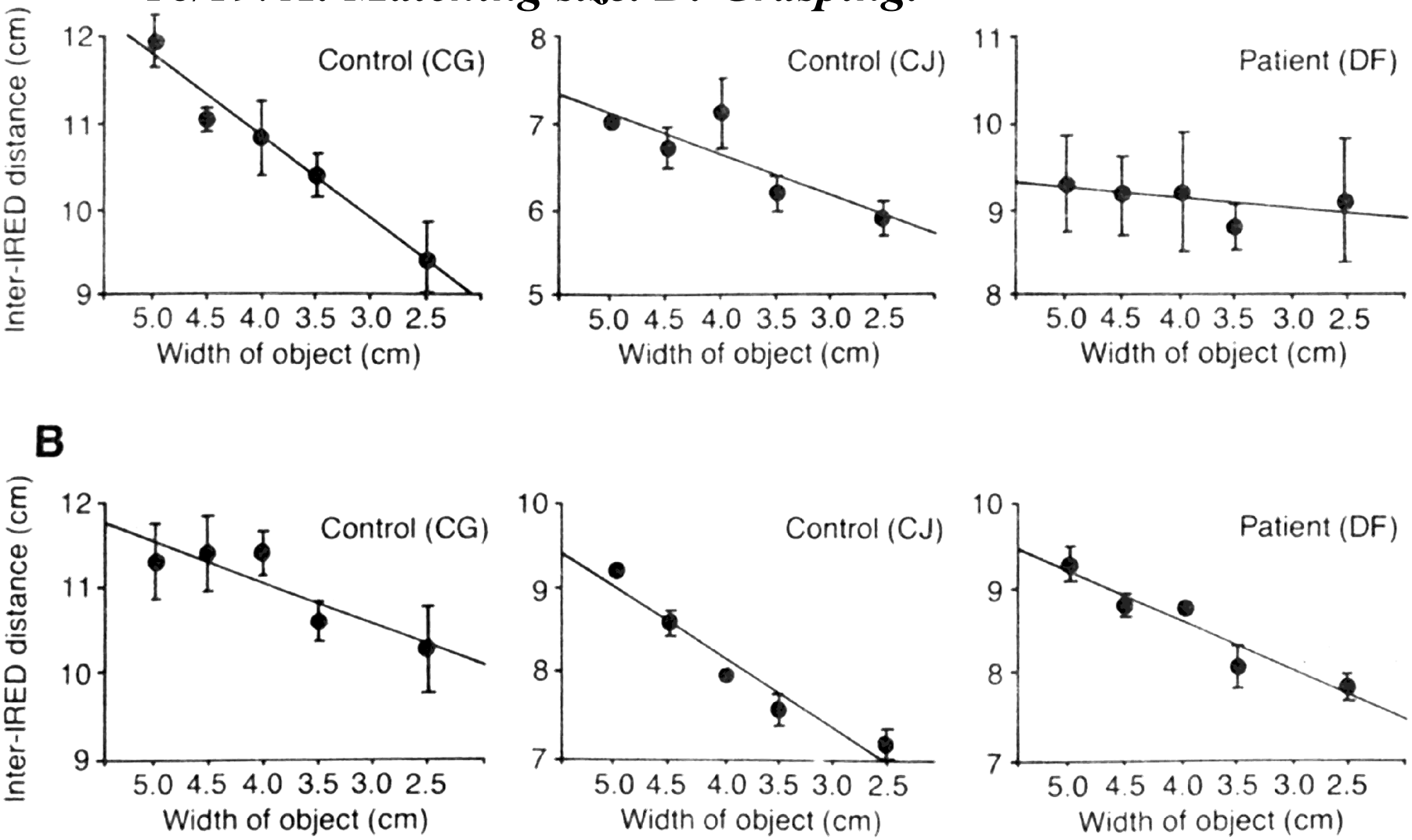
Perception of object size *versus* grasping



Milner (1998)

Impaired perception of object size, but normal actions

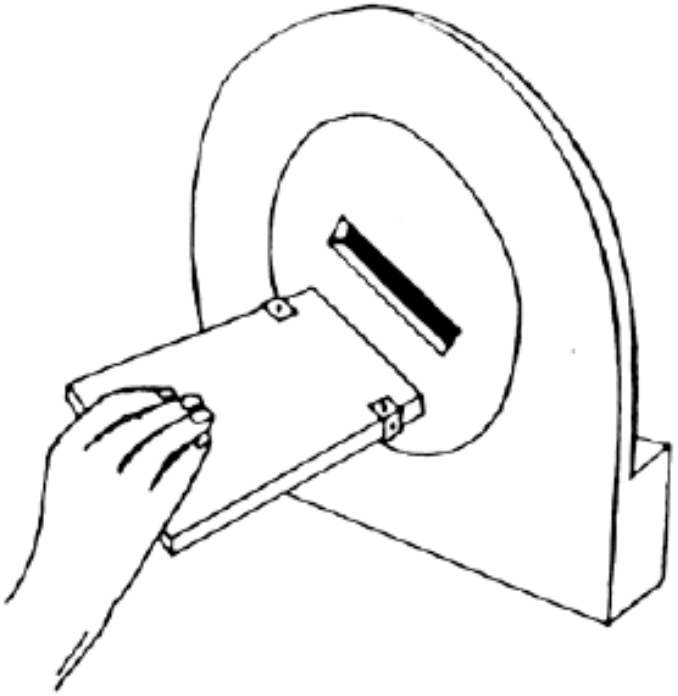
Patient D.F.; ventral stream lesion due to anoxia; esp. areas 18/19. ***A: Matching size. B: Grasping.***

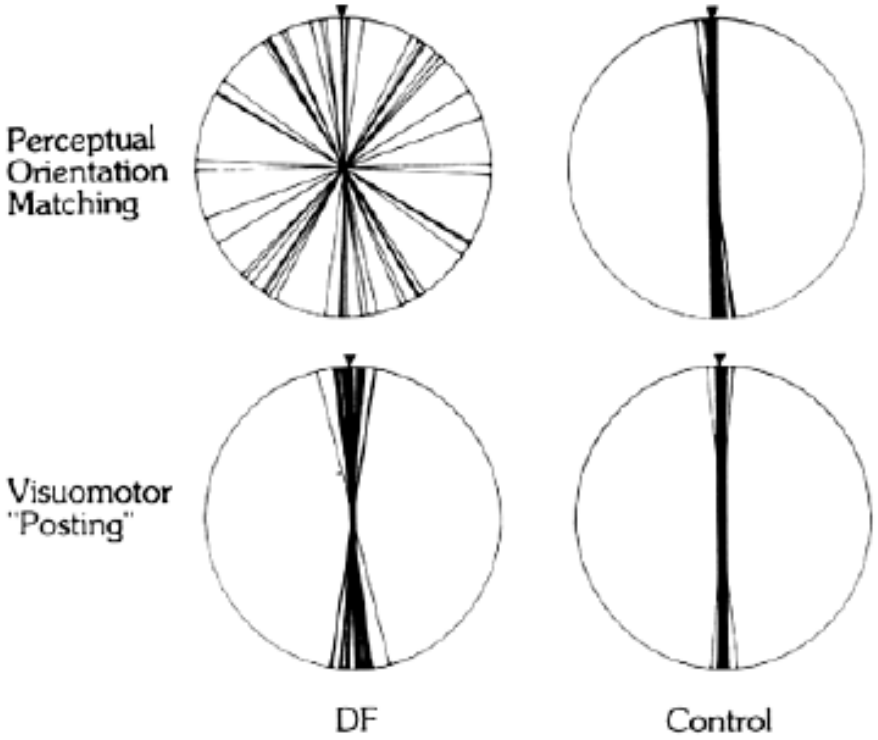


Goodale et al. (1991) Nature 349: 154

Impaired perception of orientation, but normal actions

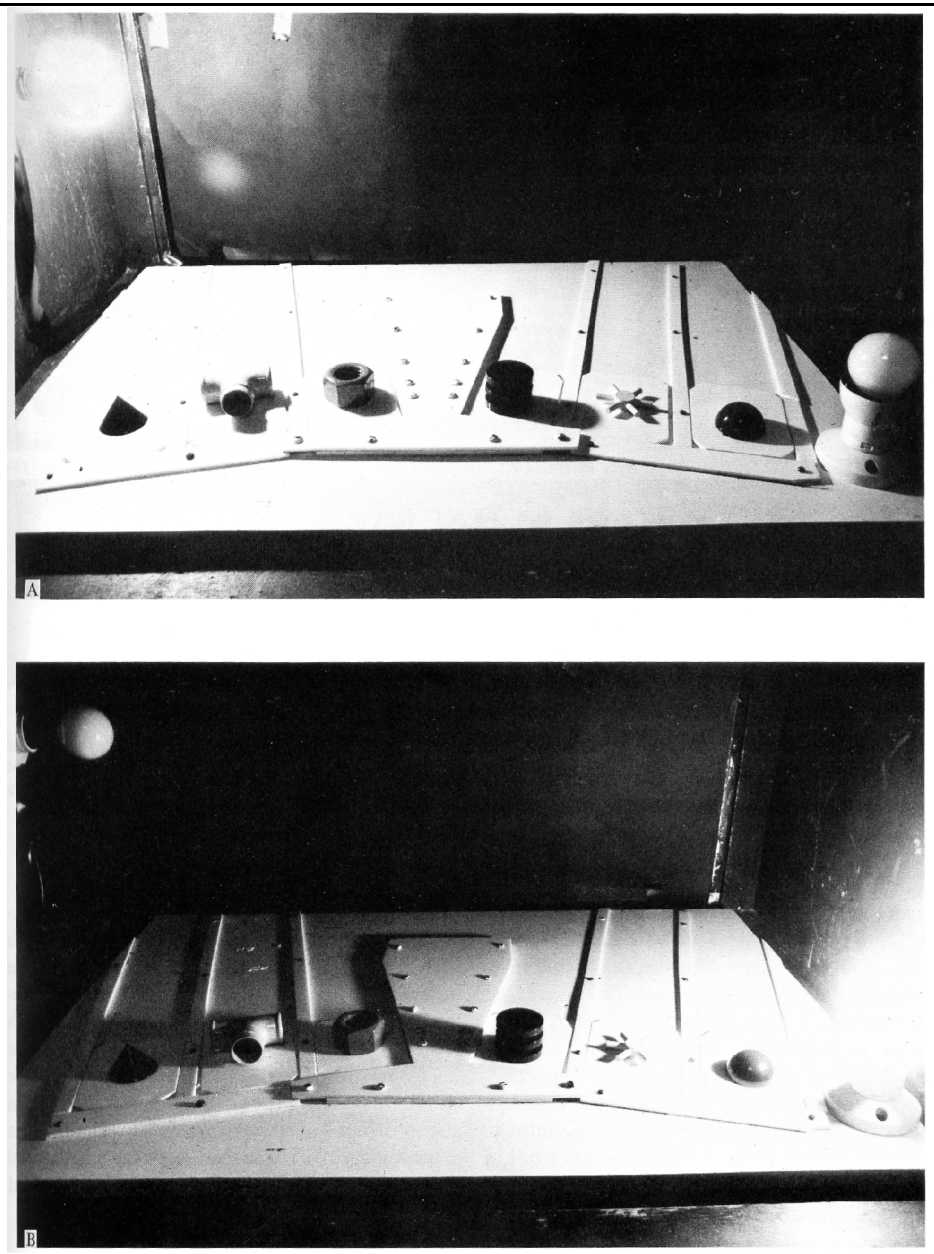
Patient D.F.; ventral stream lesion (due to anoxia secondary to carbon monoxide poisoning); esp. areas 18/19





Milner et al. (1991) Brain 114: 405

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)

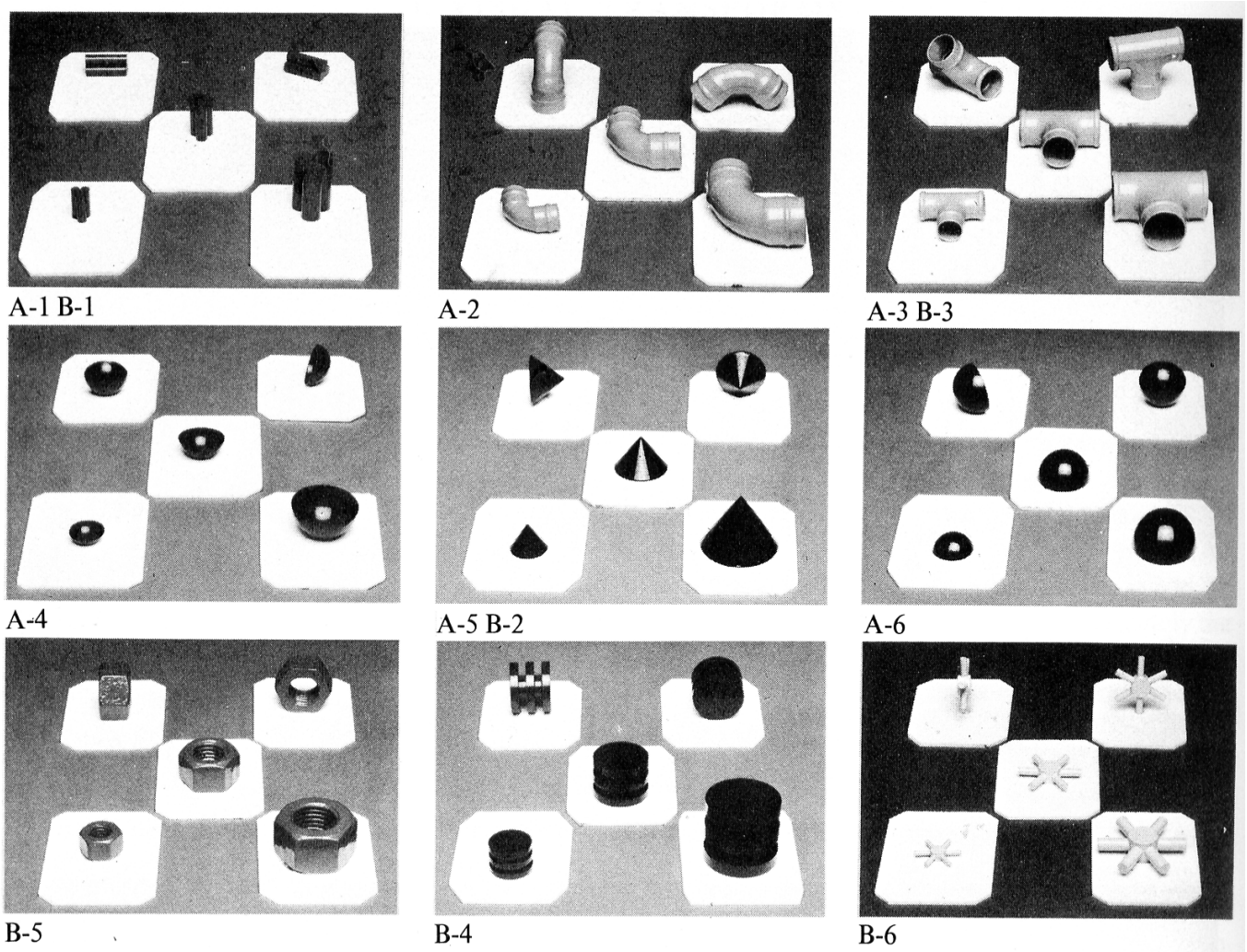


FIG. 3. Photographs of all stimulus objects with size and orientation transforms. View of object in the centre of each panel is of the standard training object. The forward views are of the two size transforms, and the back views are of the two orientation transforms. The label for each panel indicates the order in which the problem was presented to each group (*see* Appendix).

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...