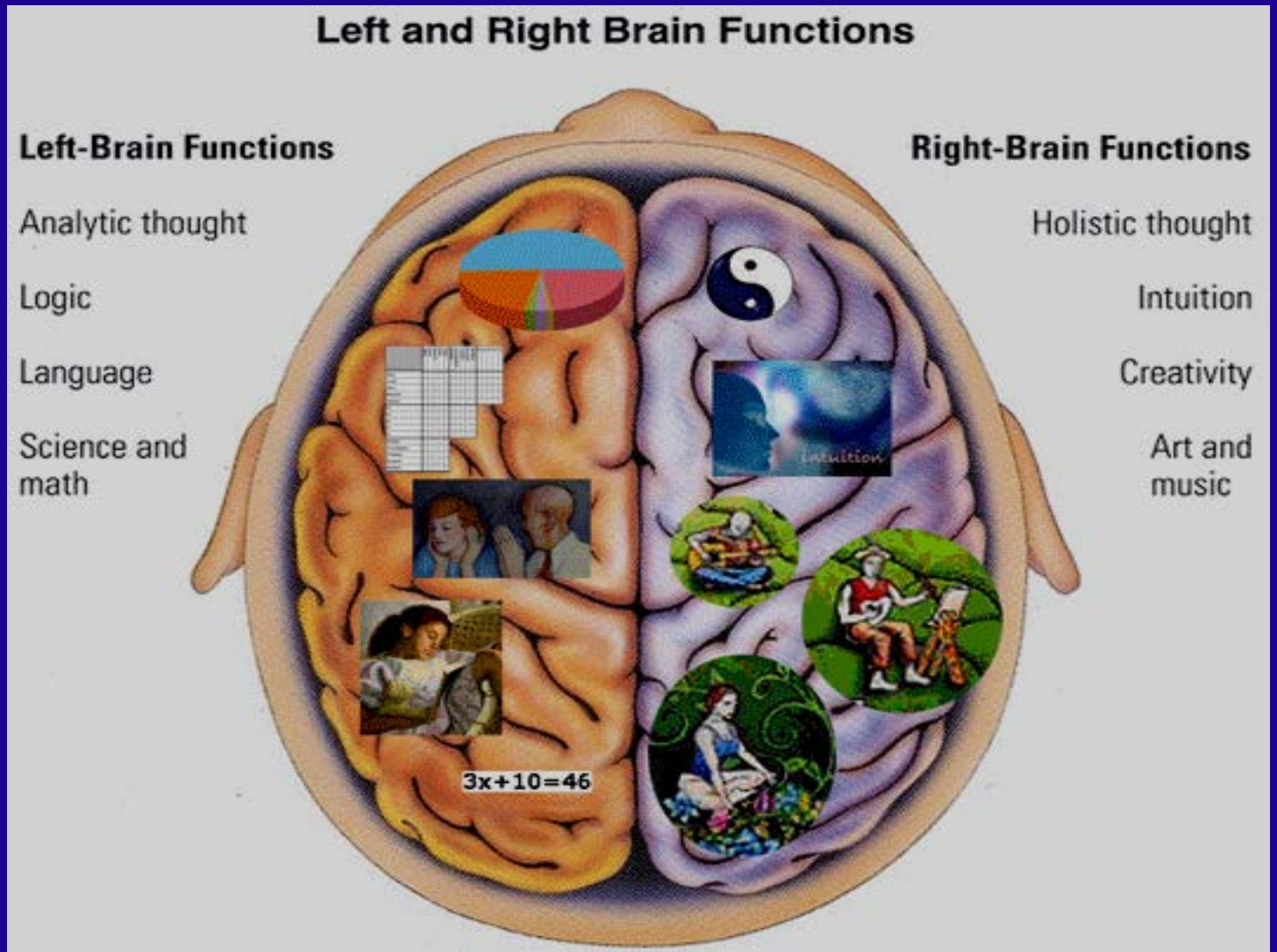
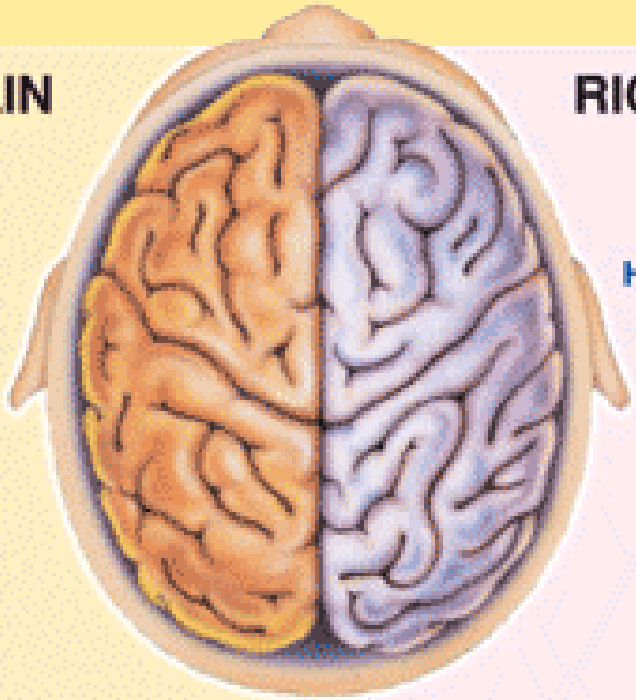
Brain and higher cortical functions



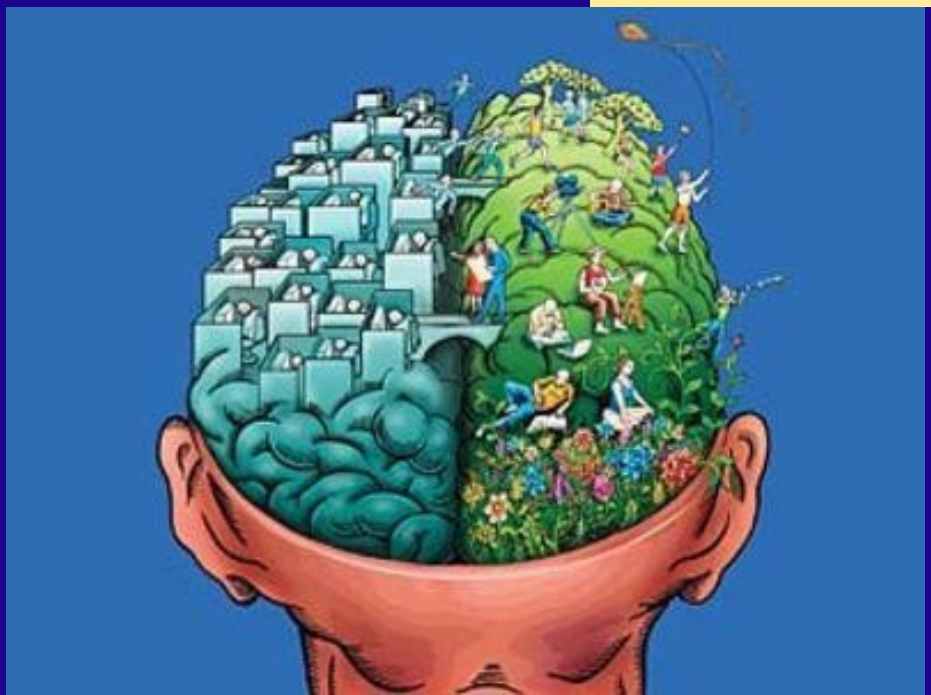
LEFT BRAIN

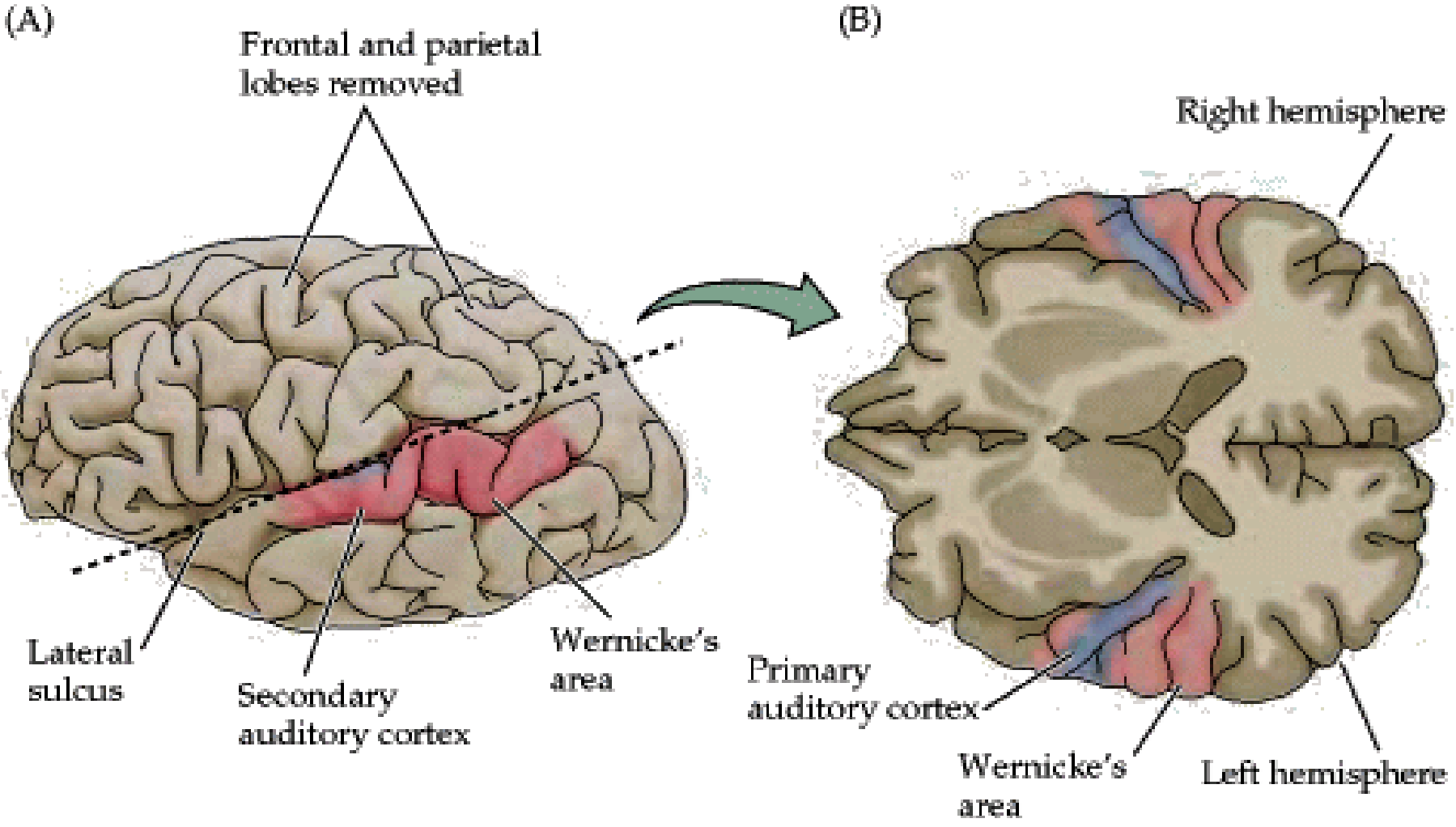
LOGIC
ANALYSIS
SEQUENCING
LINEAR
MATHEMATICS
LANGUAGE
FACTS
THINK IN WORDS
WORDS OF SONGS
COMPUTATION

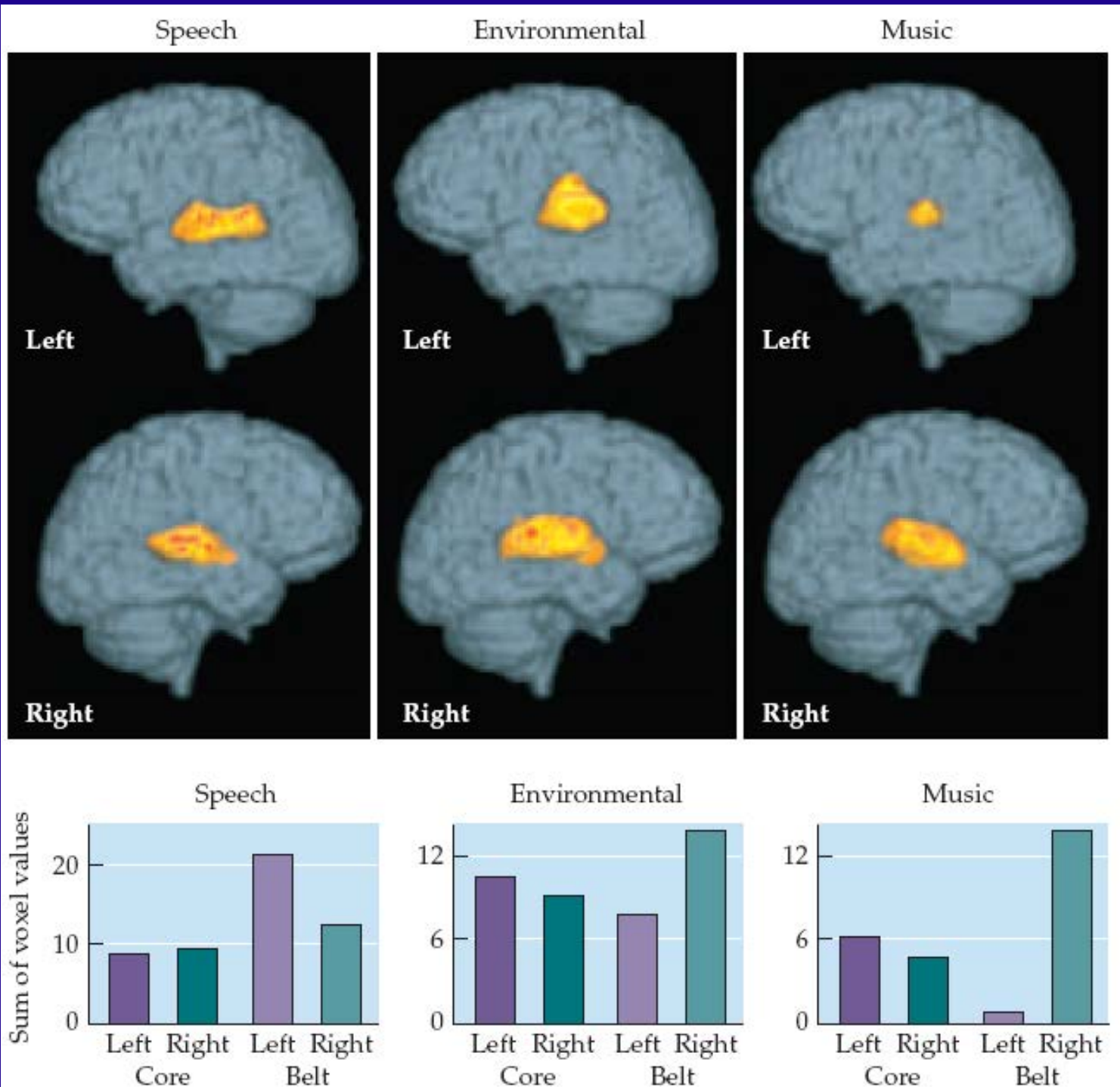


RIGHT BRAIN

CREATIVITY
IMAGINATION
HOLISTIC THINKING
INTUITION
ARTS (Motor skill)
RHYTHM (Beats)
NON-VERBAL
FEELINGS
VISUALISATION
TUNE OF SONGS
DAYDREAMING

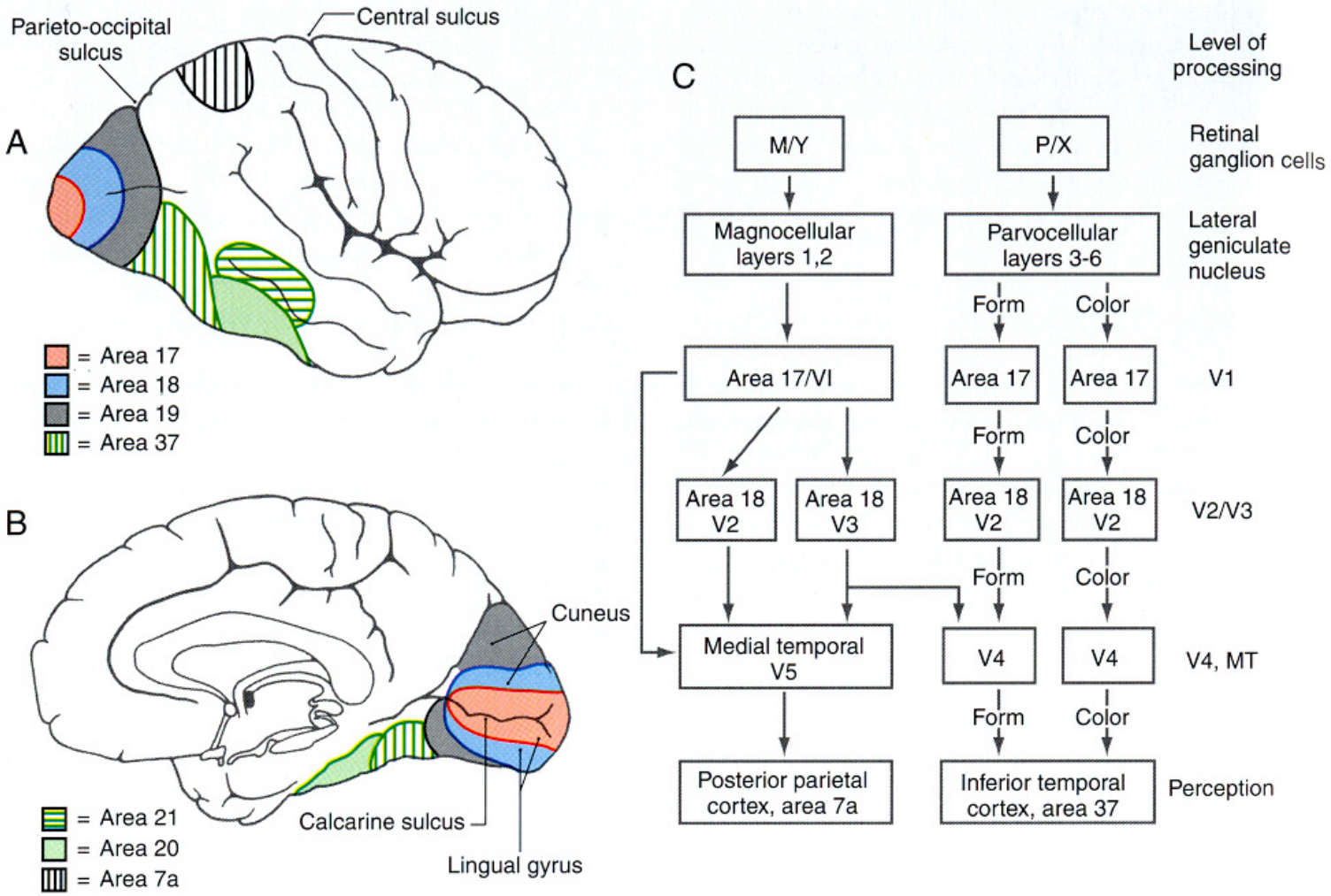



(A)
Frontal and parietal lobes removed
Lateral sulcus
Secondary auditory cortex
Wernicke's area
(B)
Right hemisphere
Primary auditory cortex
Wernicke's area
Left hemisphere

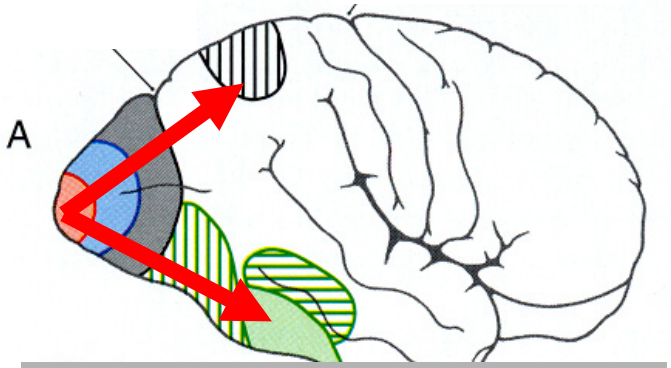

Speech
Environmental
Music
Left
Right
Left
Right
Left
Right
Speech
Environmental
Music
Sum of voxel values
20
10
0
12
6
0
12
6
0
Left Right Left Right
Core Belt
Left Right Left Right
Core Belt
Left Right Left Right
Core Belt

Cortical processing

- Parallel
- Continues

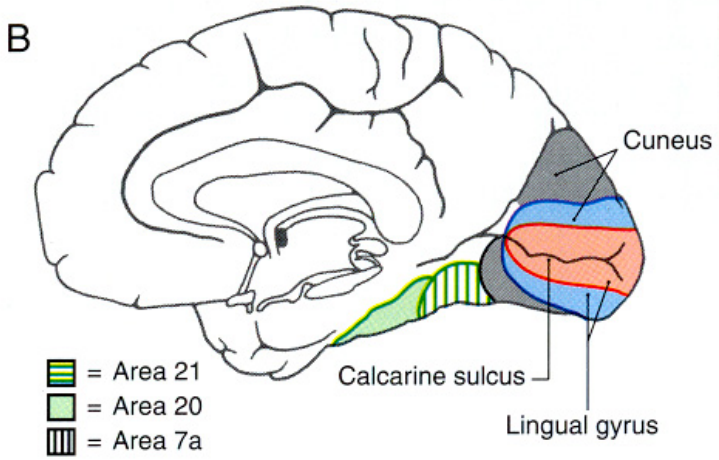

A
Parieto-occipital sulcus
Central sulcus
= Area 17
= Area 18
= Area 19
= Area 37
B
Cuneus
= Area 21
= Area 20
= Area 7a
Calcarine sulcus
Lingual gyrus
C
Level of processing
M/Y
P/X
Retinal ganglion cells
Magnocellular layers 1,2
Parvocellular layers 3-6
Lateral geniculate nucleus
Form
Color
Area 17/VI
Area 17
Area 17
V1
Area 18 V2
Area 18 V3
Area 18 V2
Area 18 V2
V2/V3
Medial temporal V5
V4
V4
V4, MT
Posterior parietal cortex, area 7a
Inferior temporal cortex, area 37
Perception

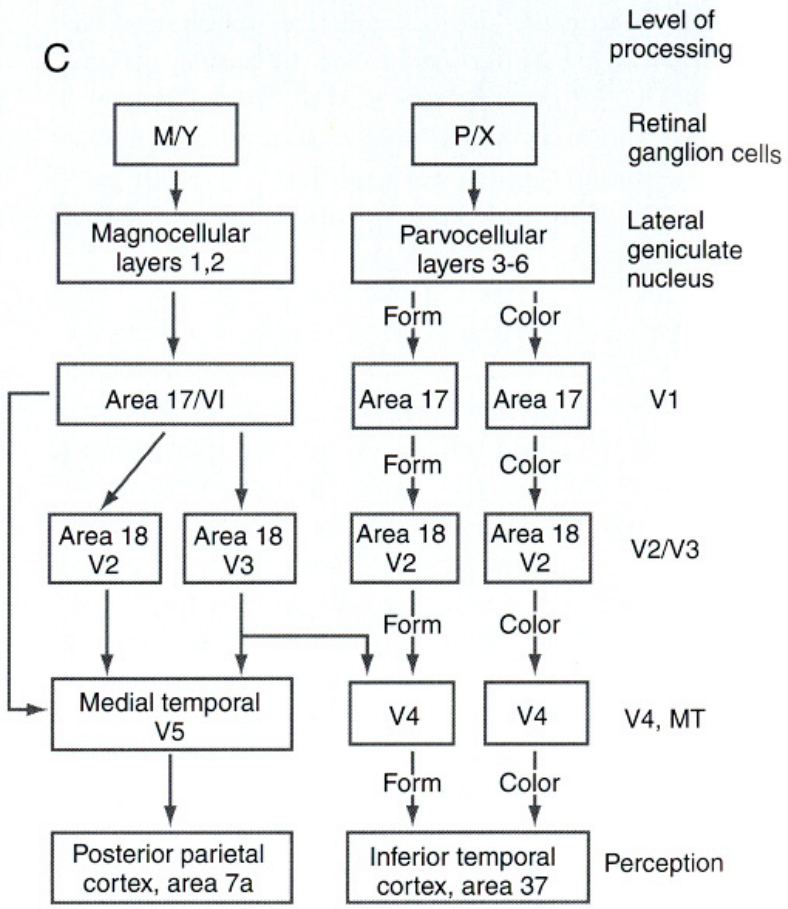
Dorsal “Where” pathway



Ventral “What” pathway

= Area 37

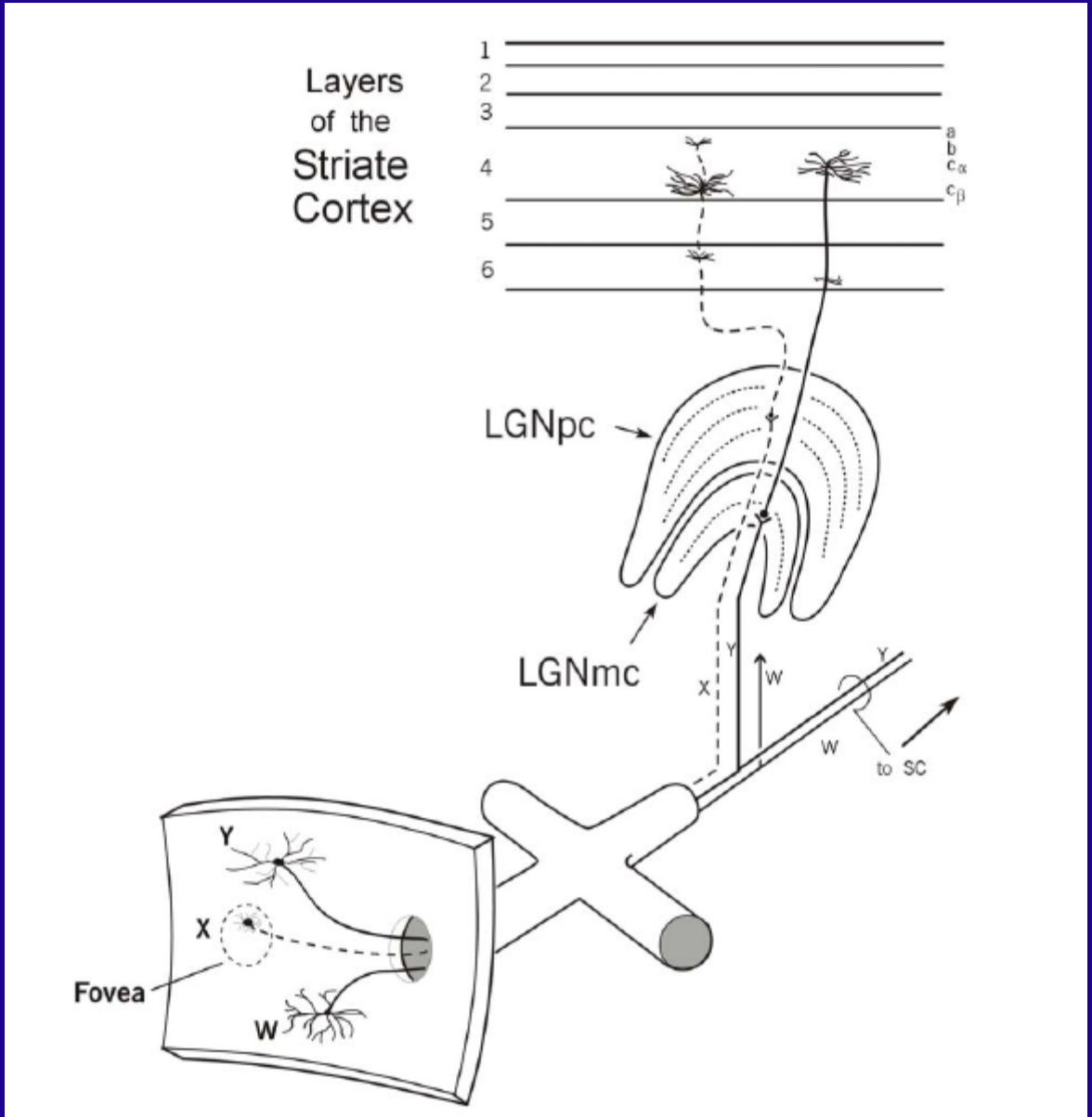


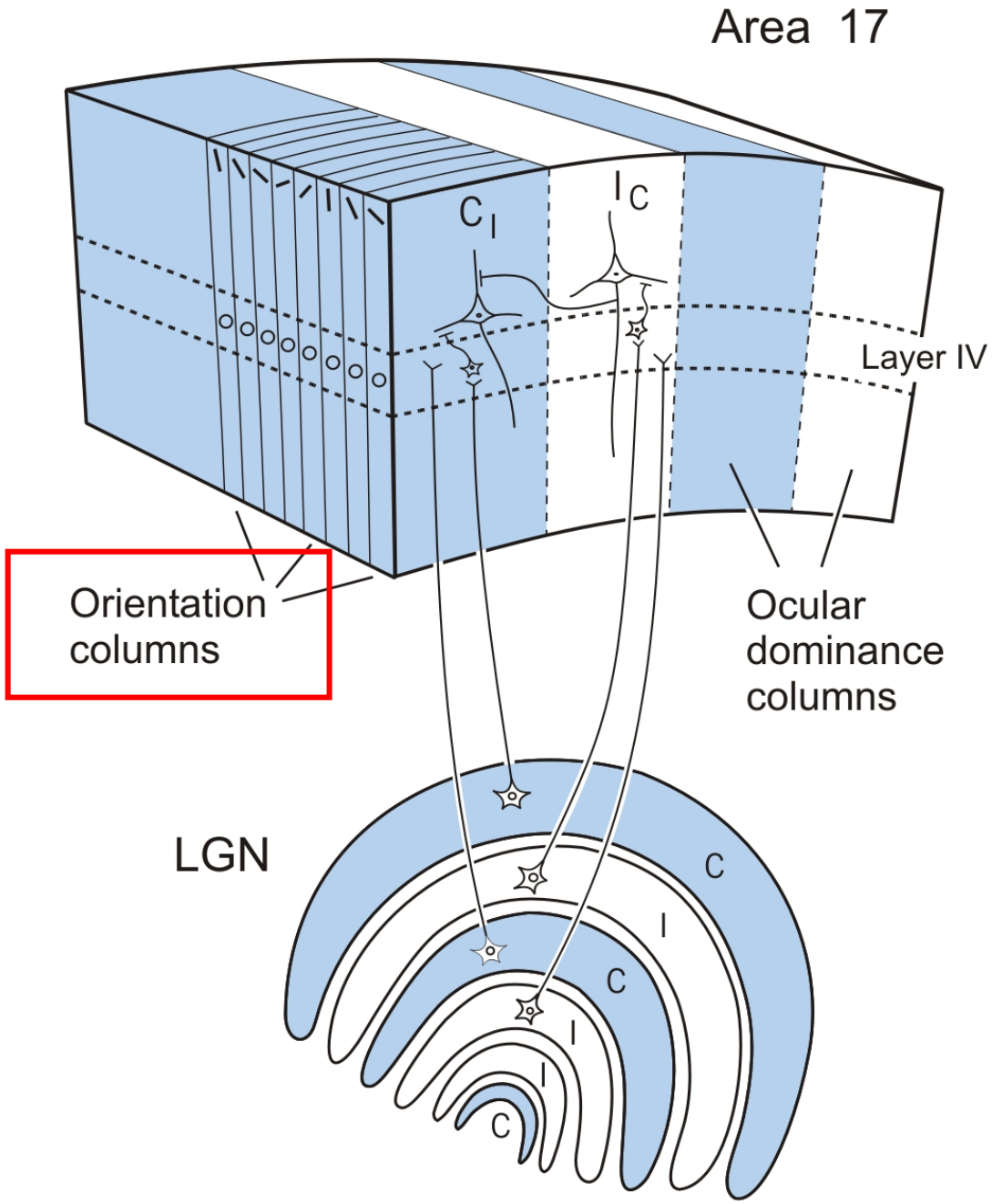


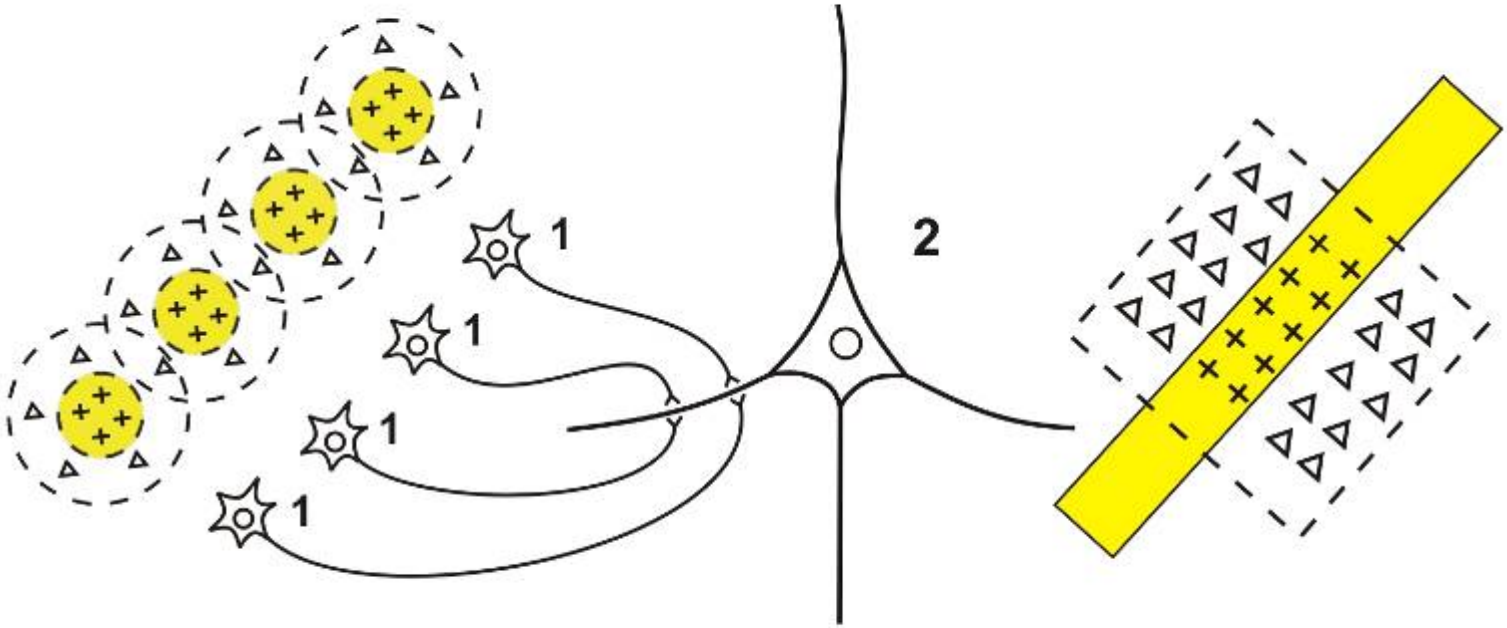
Cortical processing

Visual processing as example

Primary visual cortex



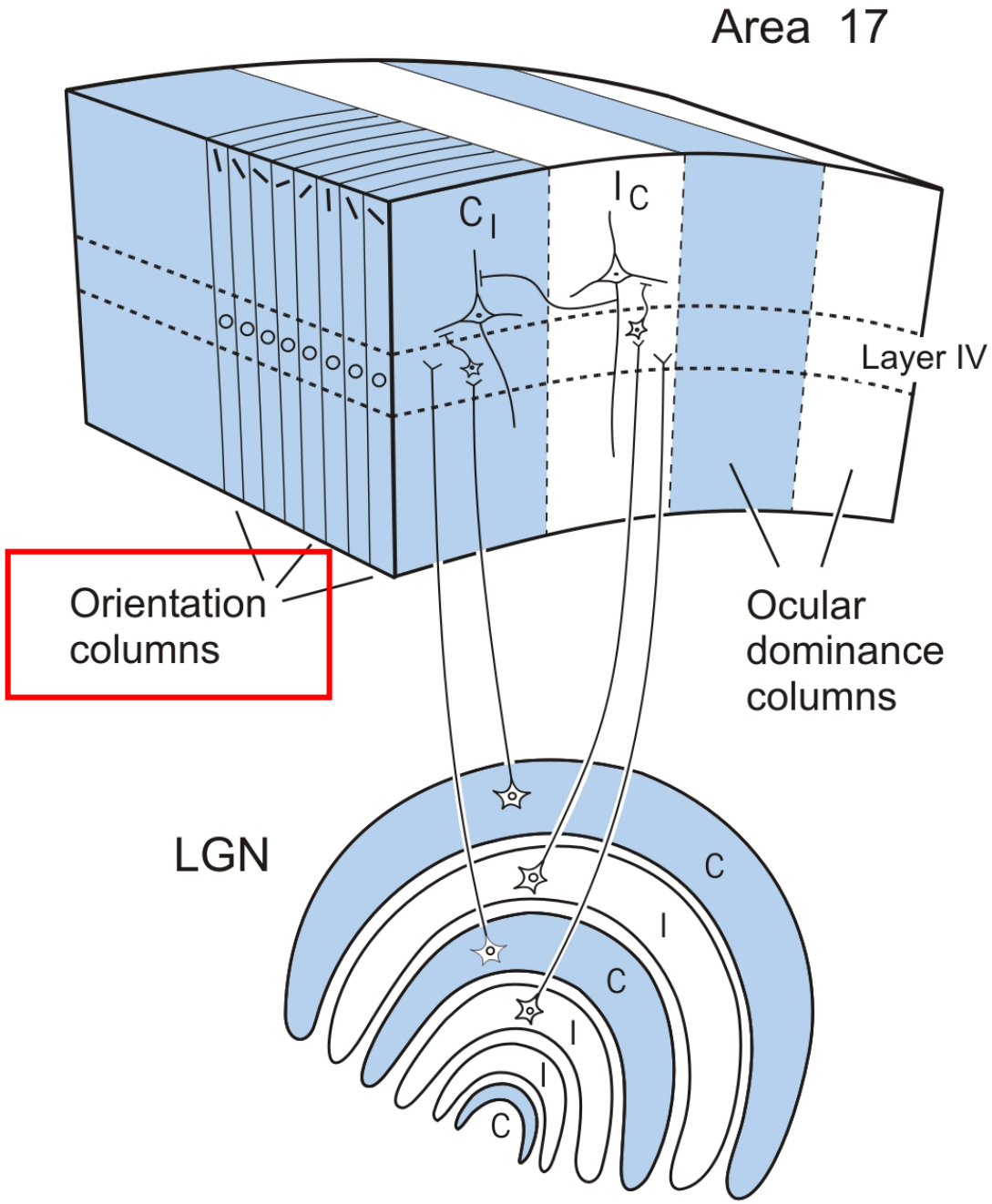

Area 17
C
I
C
Layer IV
Orientation columns
Ocular dominance columns
LGN
C
I
C
I
I
C

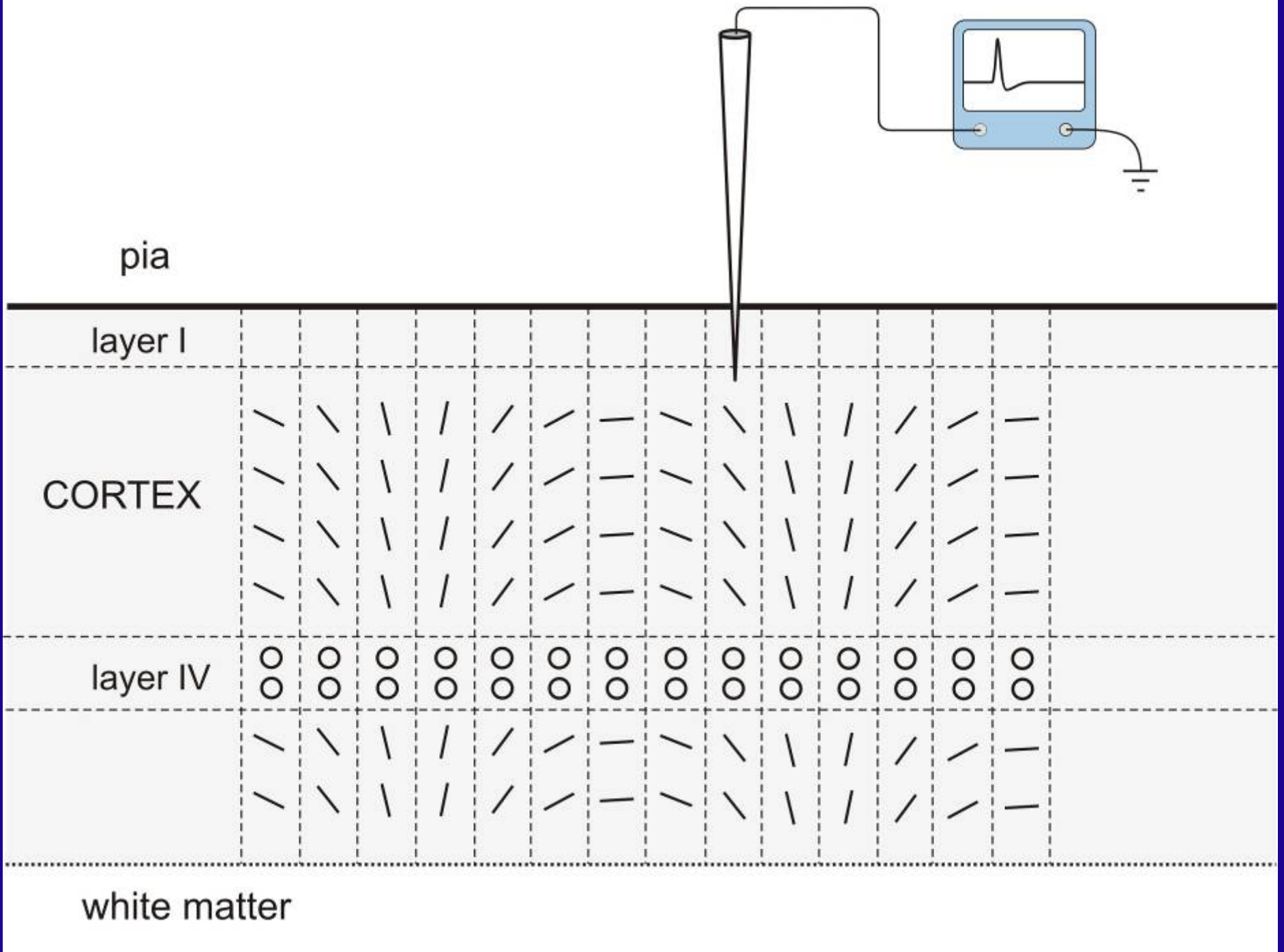


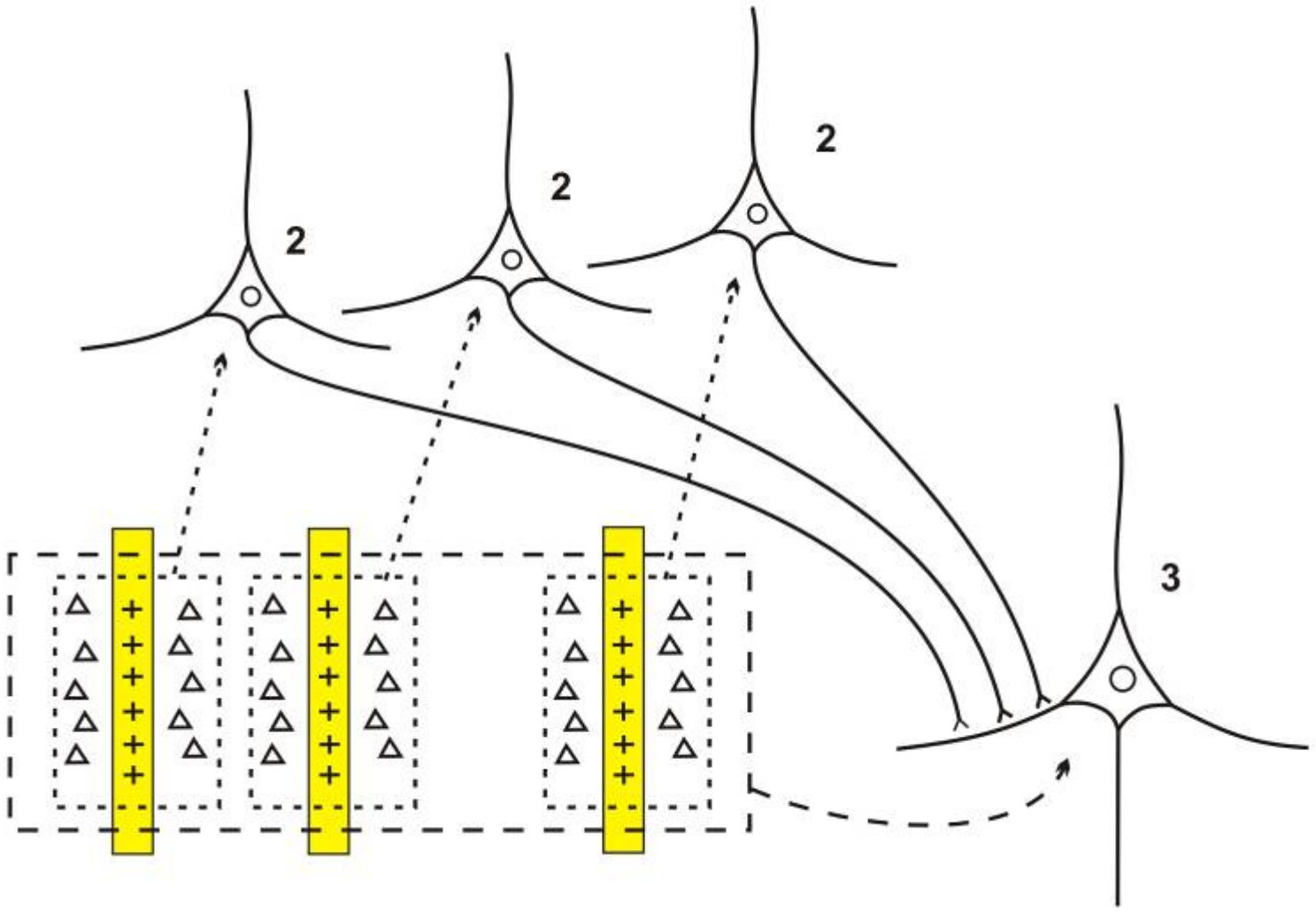
CONCENTRIC RECEPTIVE FIELDS

SIMPLE RECEPTIVE FIELD

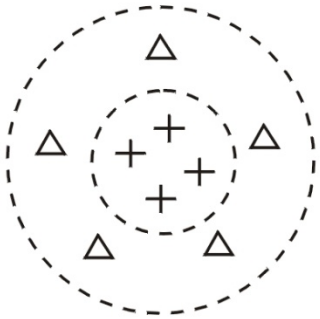
Text Fig. 20-23A


Area 17
C
I
C
Layer IV
Orientation columns
Ocular dominance columns
LGN
C
I
C
I
I
C

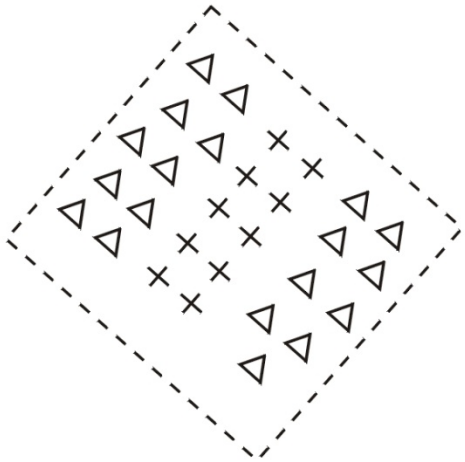

pia
layer I
CORTEX
layer IV
white matter

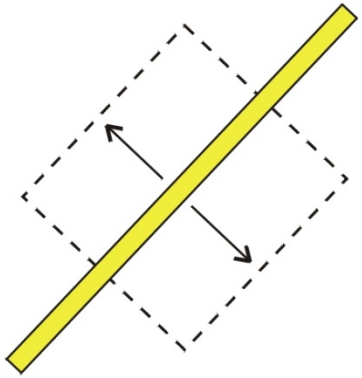


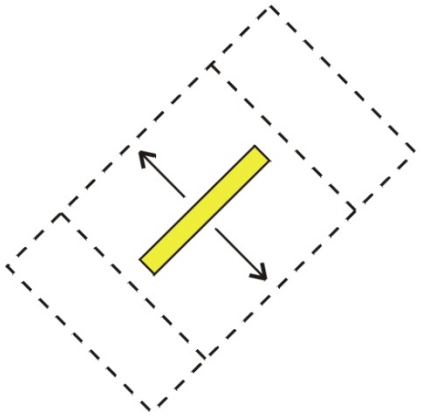
Text Fig. 20-23B



+ = "on" response
△ = "off" response

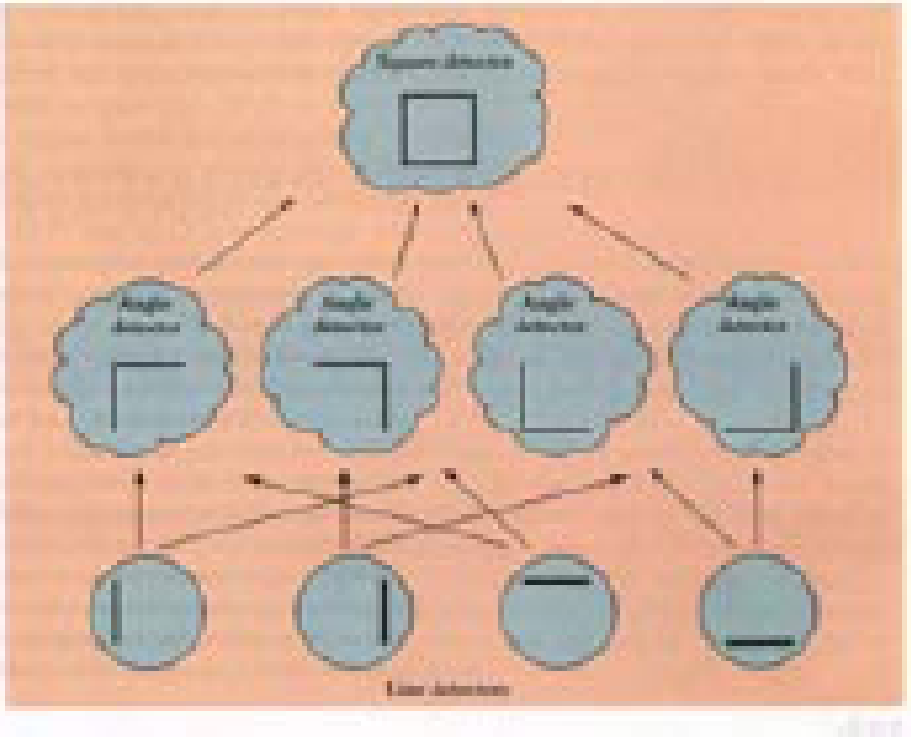


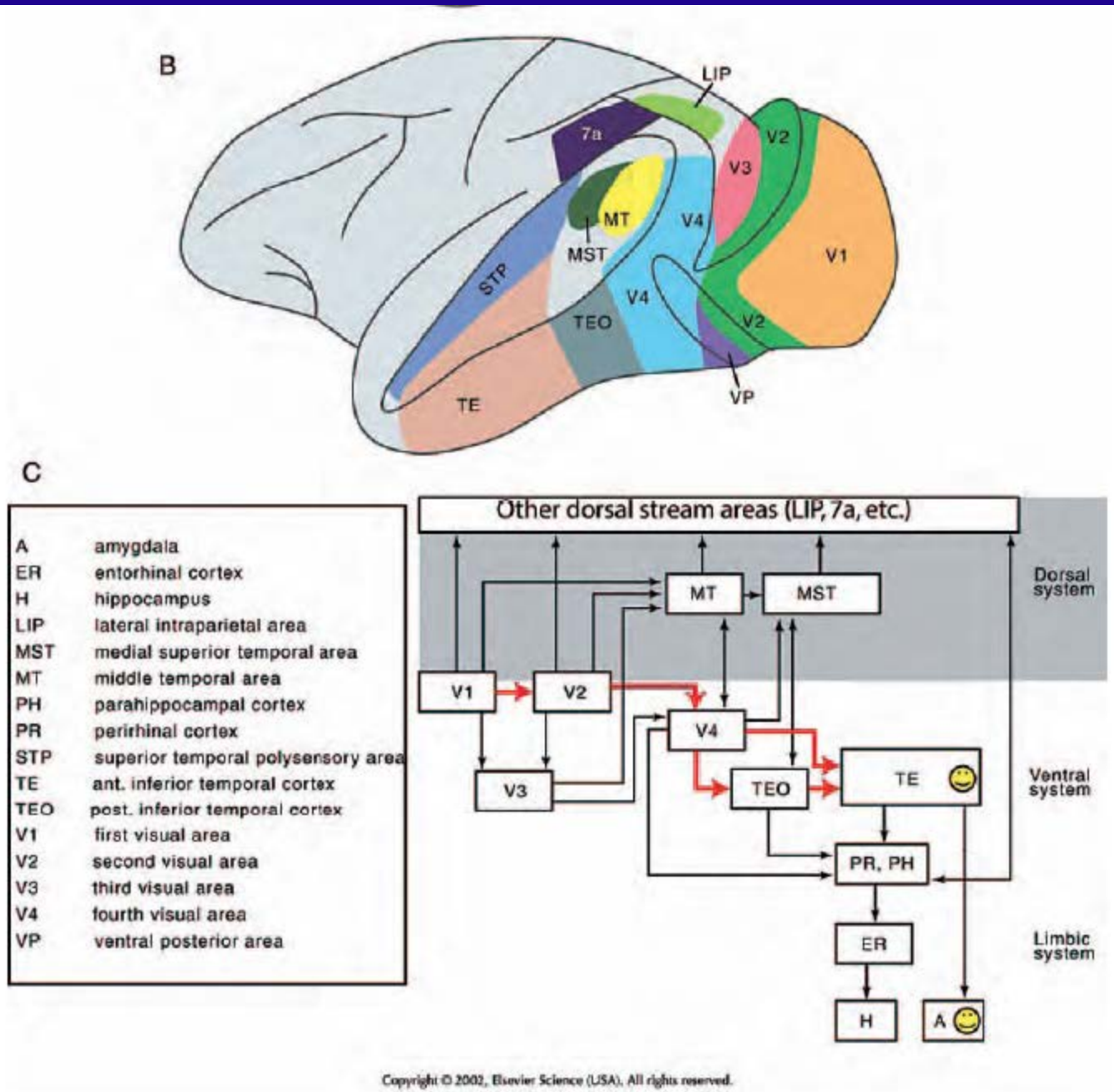


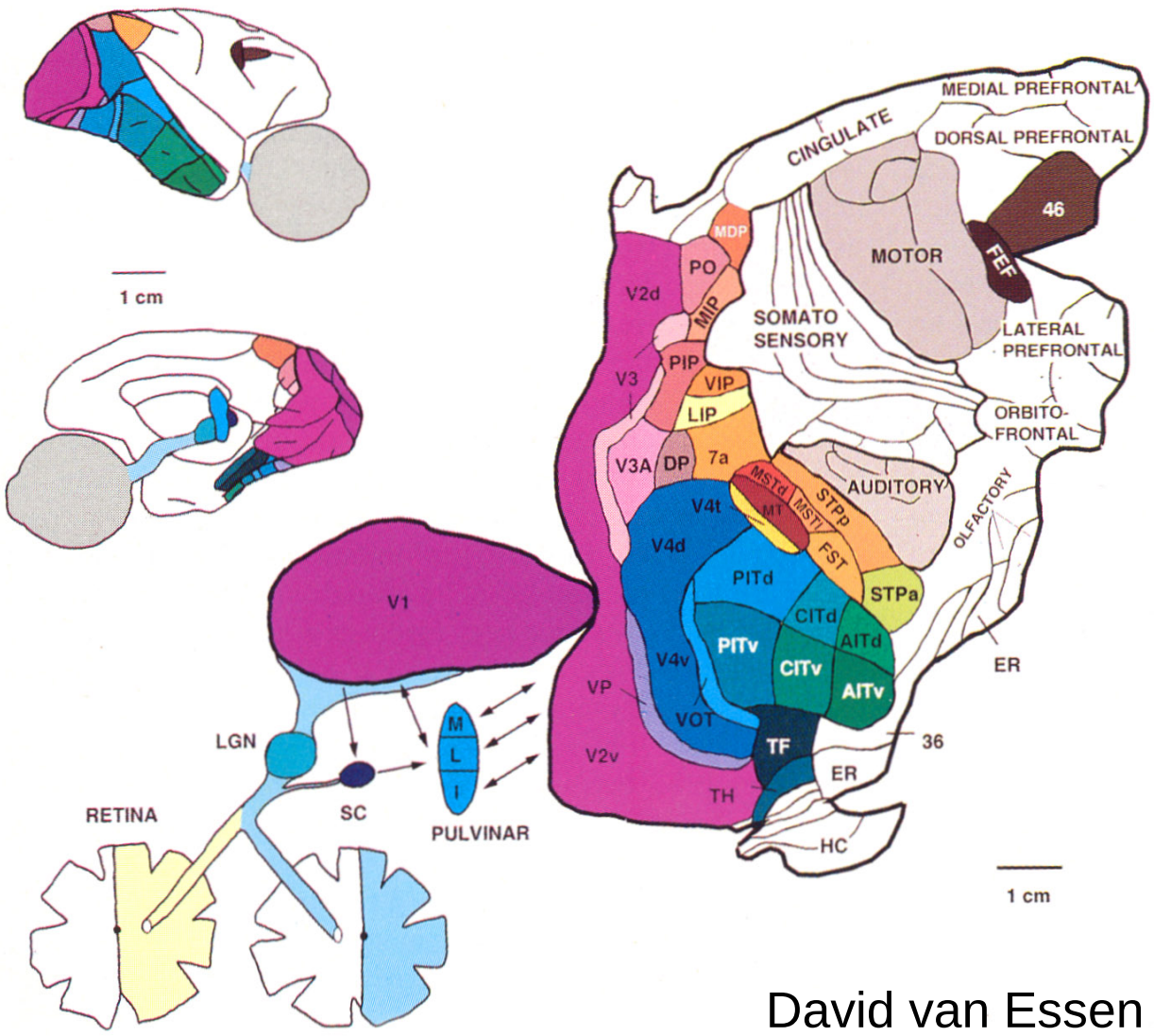


Visual Image Decomposition

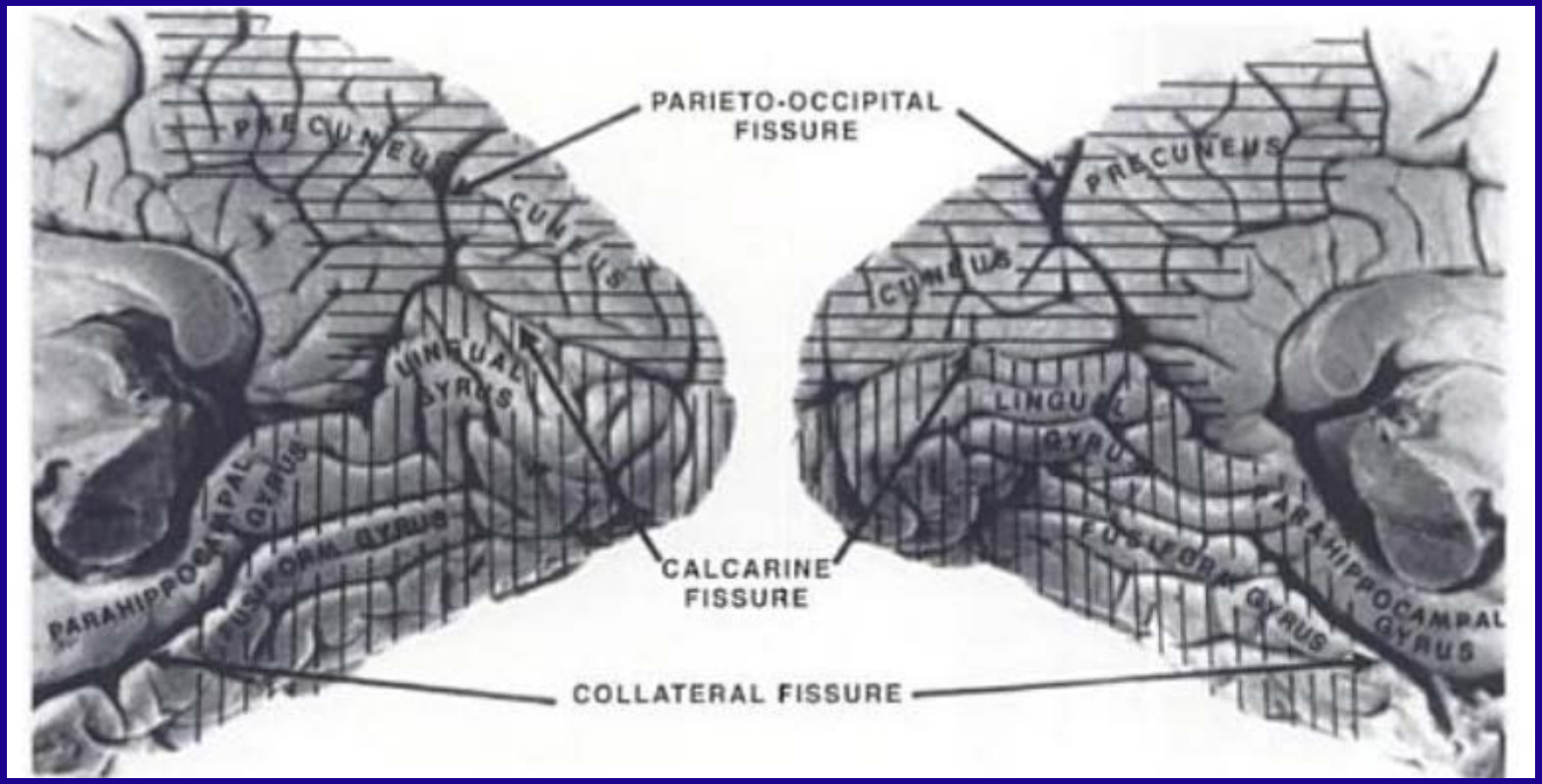
Simple, complex and hypercomplex cells can work together to decompose the outlines of a visual image into short segments, the basis of simple and complex object recognition.

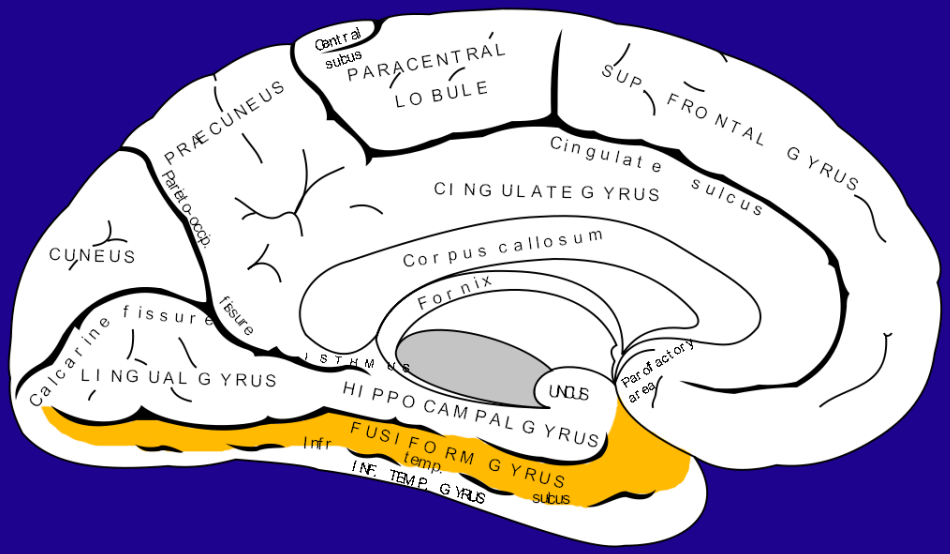


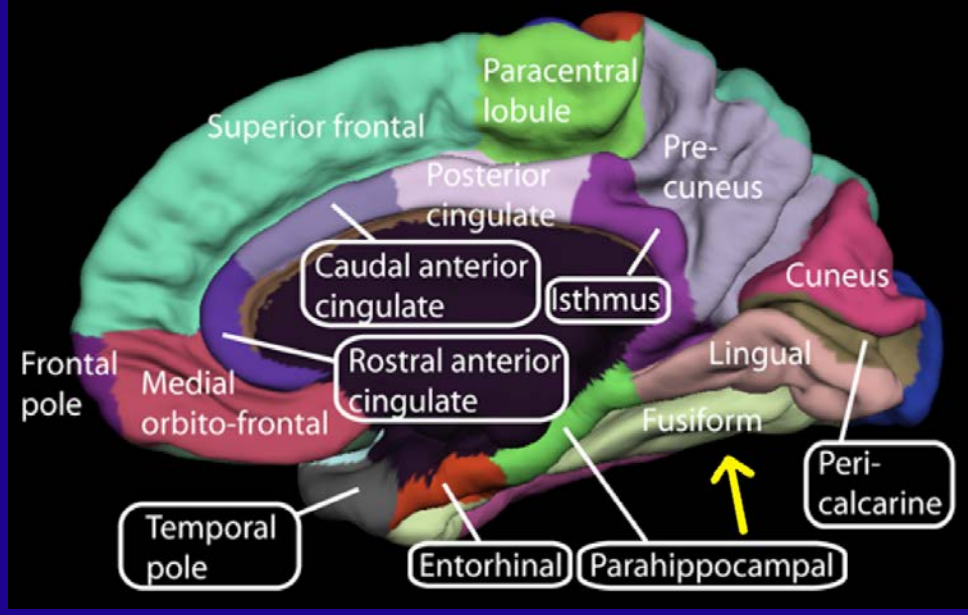


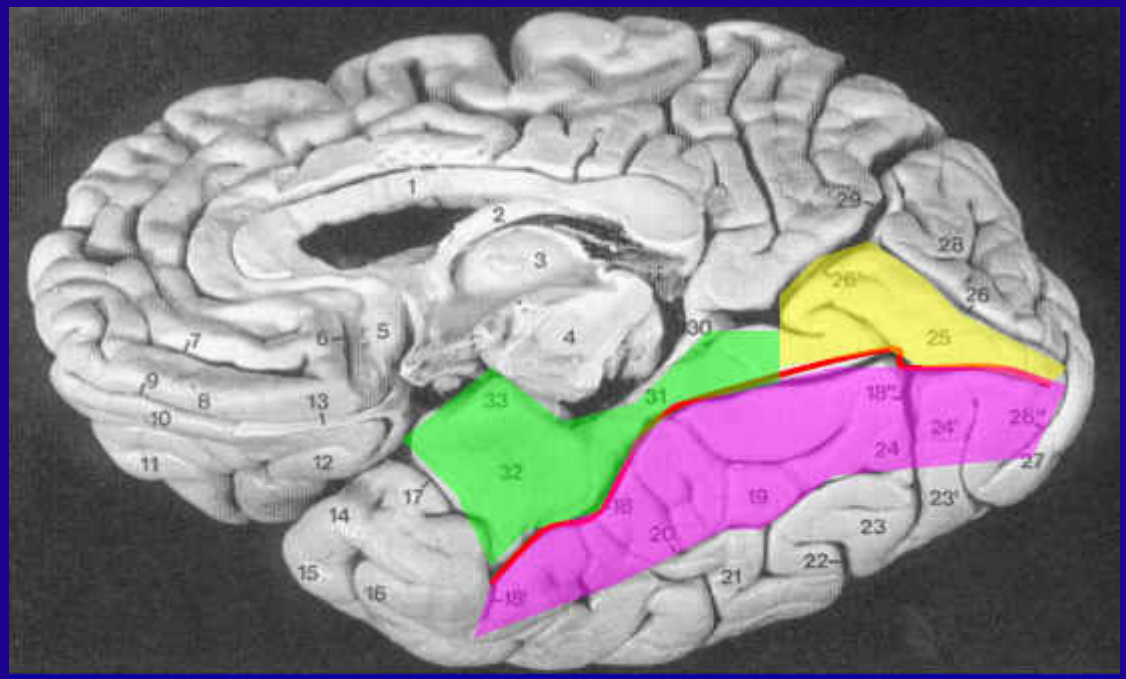


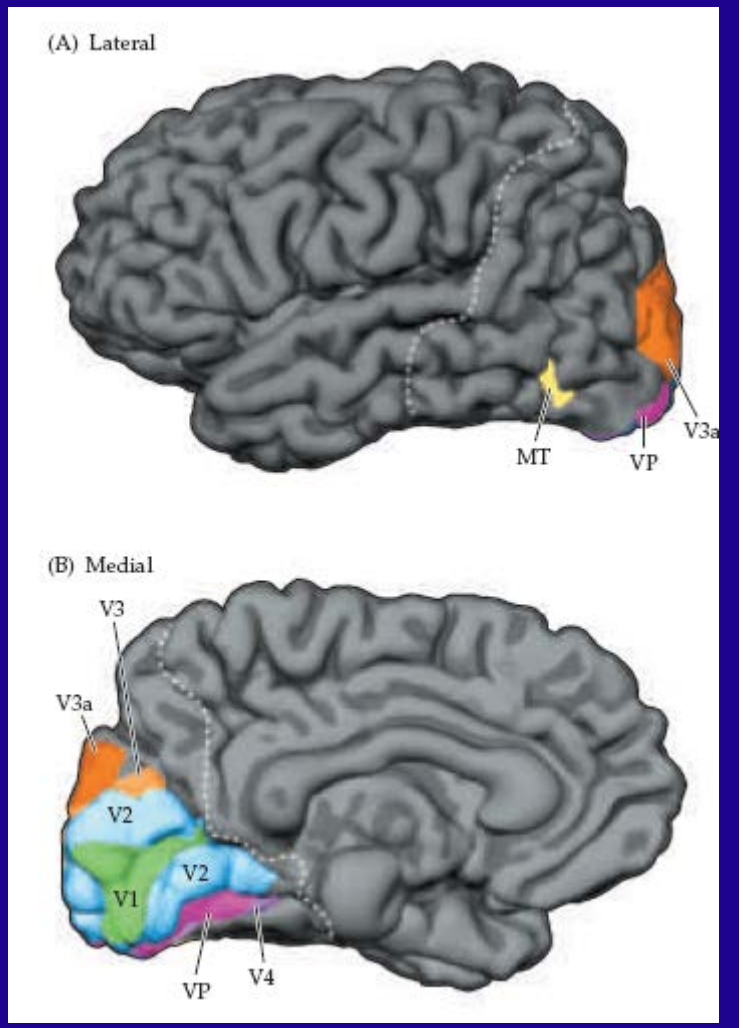
David van Essen

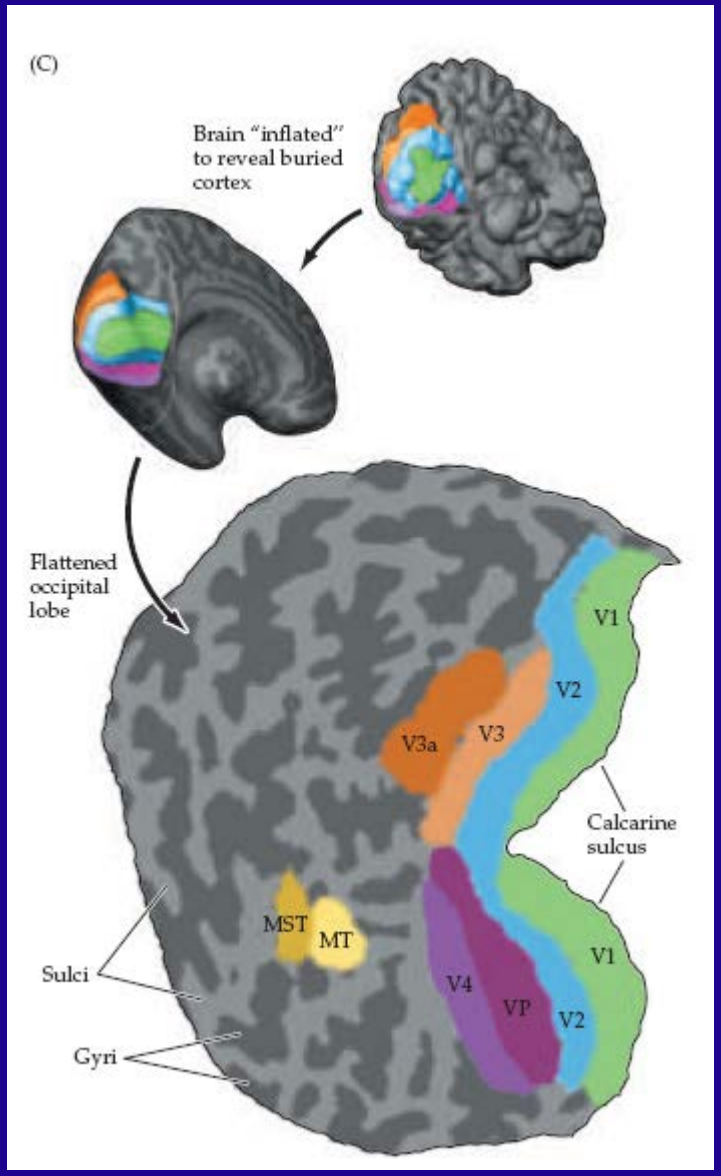

PARIETO-OCCIPITAL FISSURE
PRECUNEUS
CUNEUS
LINGUAL GYRUS
PARAHIPPOCAMPAL GYRUS
FUSIFORM GYRUS
CALCARINE FISSURE
COLLATERAL FISSURE

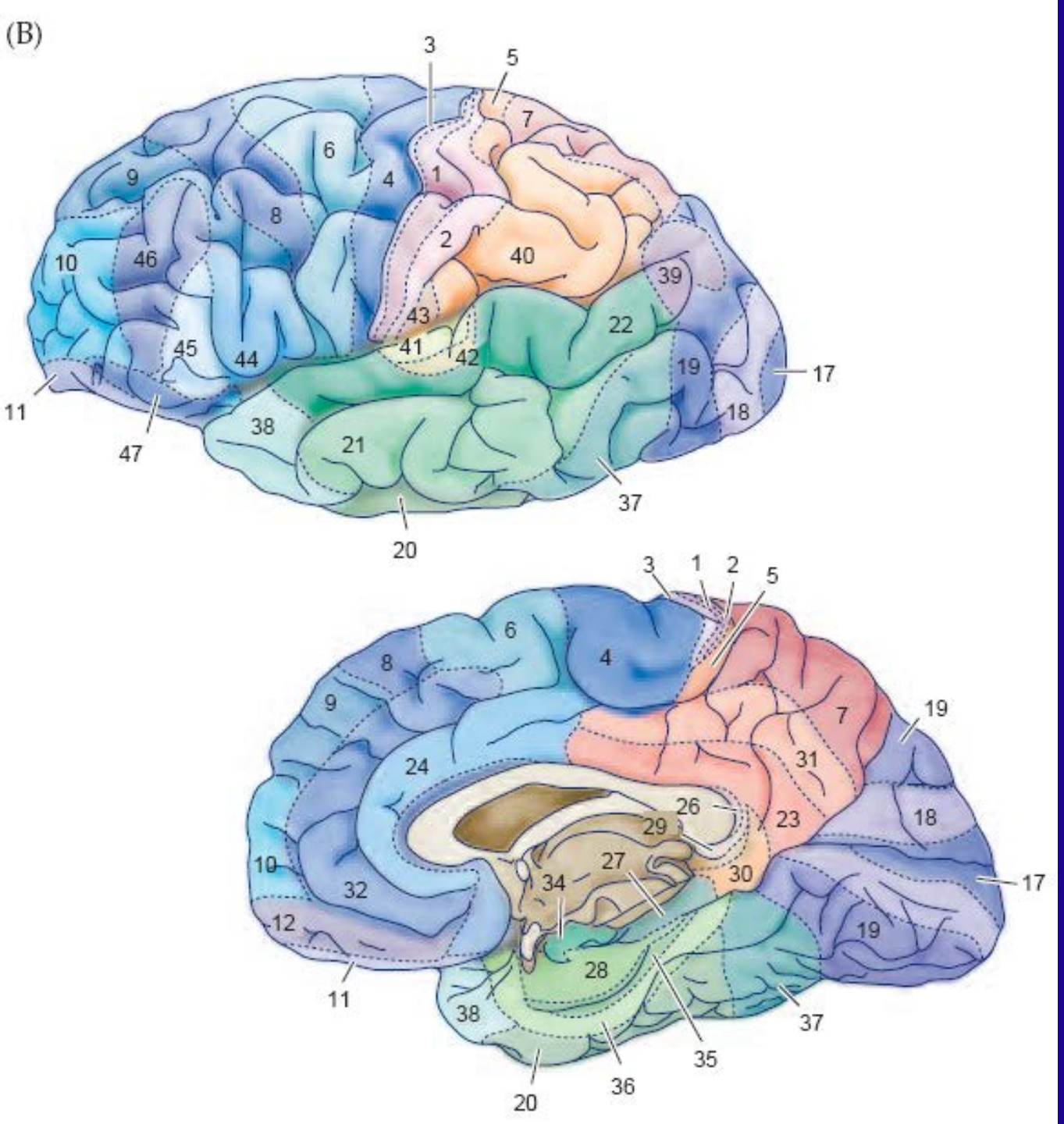

Central sulcus
PARACENTRAL LOBULE
SUP. FRONTAL GYRUS
PRÆCUNEUS
Cingulate sulcus
CINGULATE GYRUS
Parieto-occip. fissure
CUNEUS
Corpus callosum
Fornix
Calcarine fissure
ISTHMUS
UNCUS
Parolfactory area
LINGUAL GYRUS
HIPPOCAMPAL GYRUS
FUSIFORM GYRUS
Infr. temp. sulcus
INF. TEMP. GYRUS


Paracentral lobule
Superior frontal
Pre-cuneus
Posterior cingulate
Caudal anterior cingulate
Isthmus
Cuneus
Frontal pole
Medial orbito-frontal
Rostral anterior cingulate
Lingual
Fusiform
Peri-calcarine
Temporal pole
Entorhinal
Parahippocampal




(A) Lateral
MT
VP
V3a
(B) Medial
V3
V3a
V2
V2
V1
VP
V4


(C)
Brain "inflated" to reveal buried cortex
Flattened occipital lobe
V1
V2
V3a
V3
Calcarine sulcus
MST
MT
Sulci
V4
VP
V1
V2
Gyri

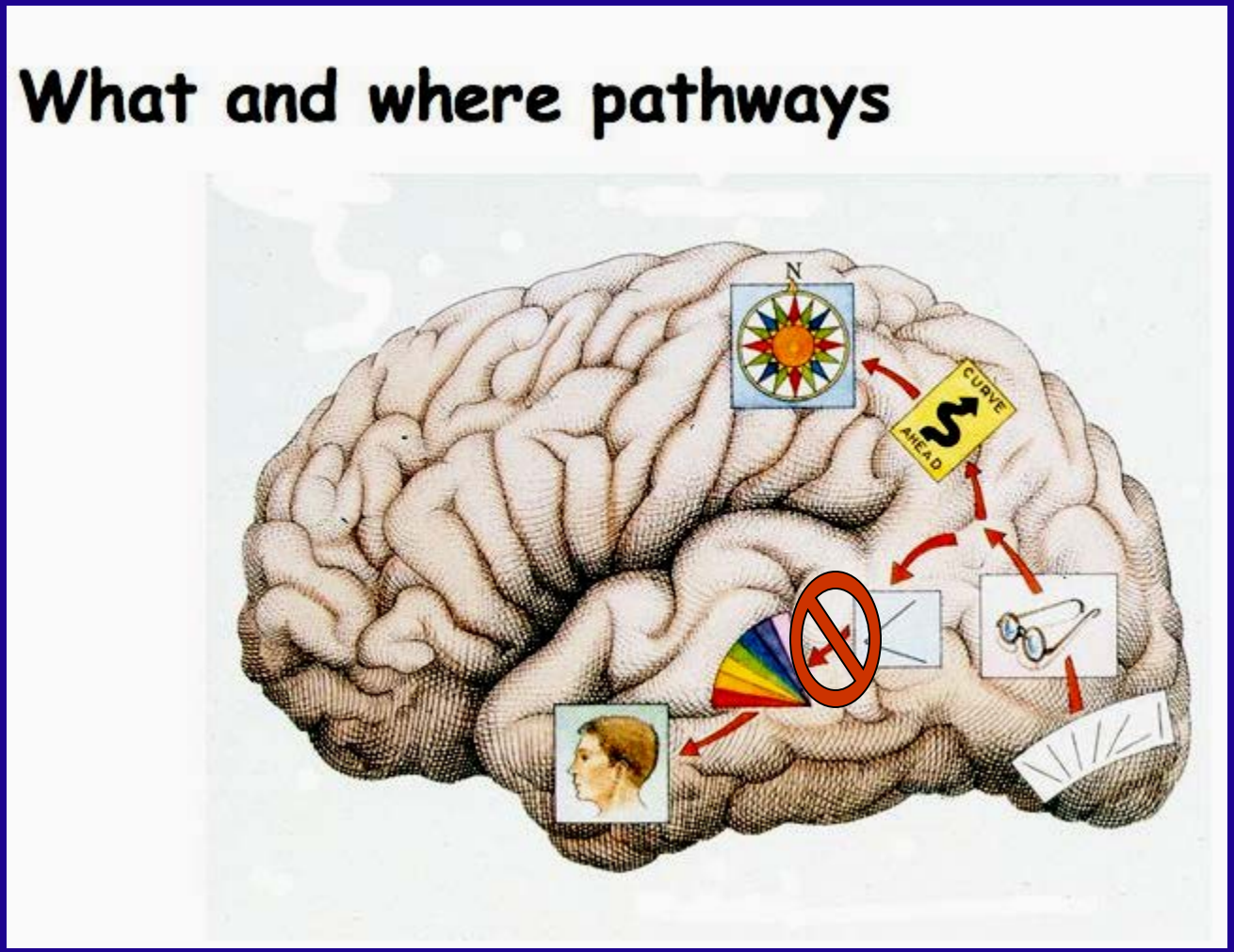

(B)
3
5
7
6
9
4
1
8
2
40
10
46
39
43
22
45
41
42
44
19
17
11
18
38
21
47
37
20
3
1
2
5
6
8
4
9
7
19
24
31
26
23
18
29
10
27
30
17
34
32
12
19
28
11
38
37
35
36
20

Visual processing of information

Damage to V1

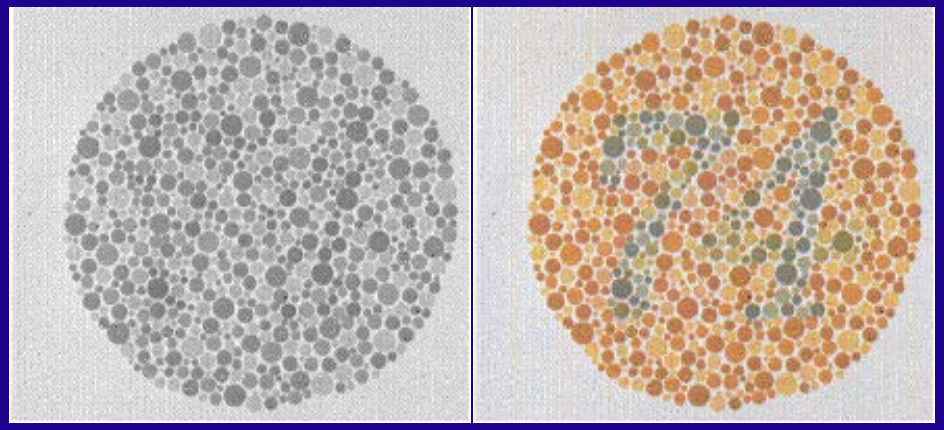
- Blindsight
- Visual hallucination

Damage to “What” pathway



Achromatopsia, agnosia

Achromatopsia



- **Complete achromatopsia-** BL area V4: Lingual/fusiform gyri/occipitotemporal junction

Color agnosia

- **Color agnosia**: loss the ability to retrieve color knowledge
- cannot name colors for objects but can sort
- Cant /Remembering the color of object “even by none verbal way” , like painting pumpkin orange or apple red
- Cant /Color composition

Left or bilateral occipitotemporal region Inferior temporal , fusiform and right lingual

Color anomia

- Inability to name colors or to point to colors given their names, which is not due to aphasia or due to defective color perception

Color anomia

- Inability to name colors or to point to colors given their names, which is not due to aphasia or due to defective color perception

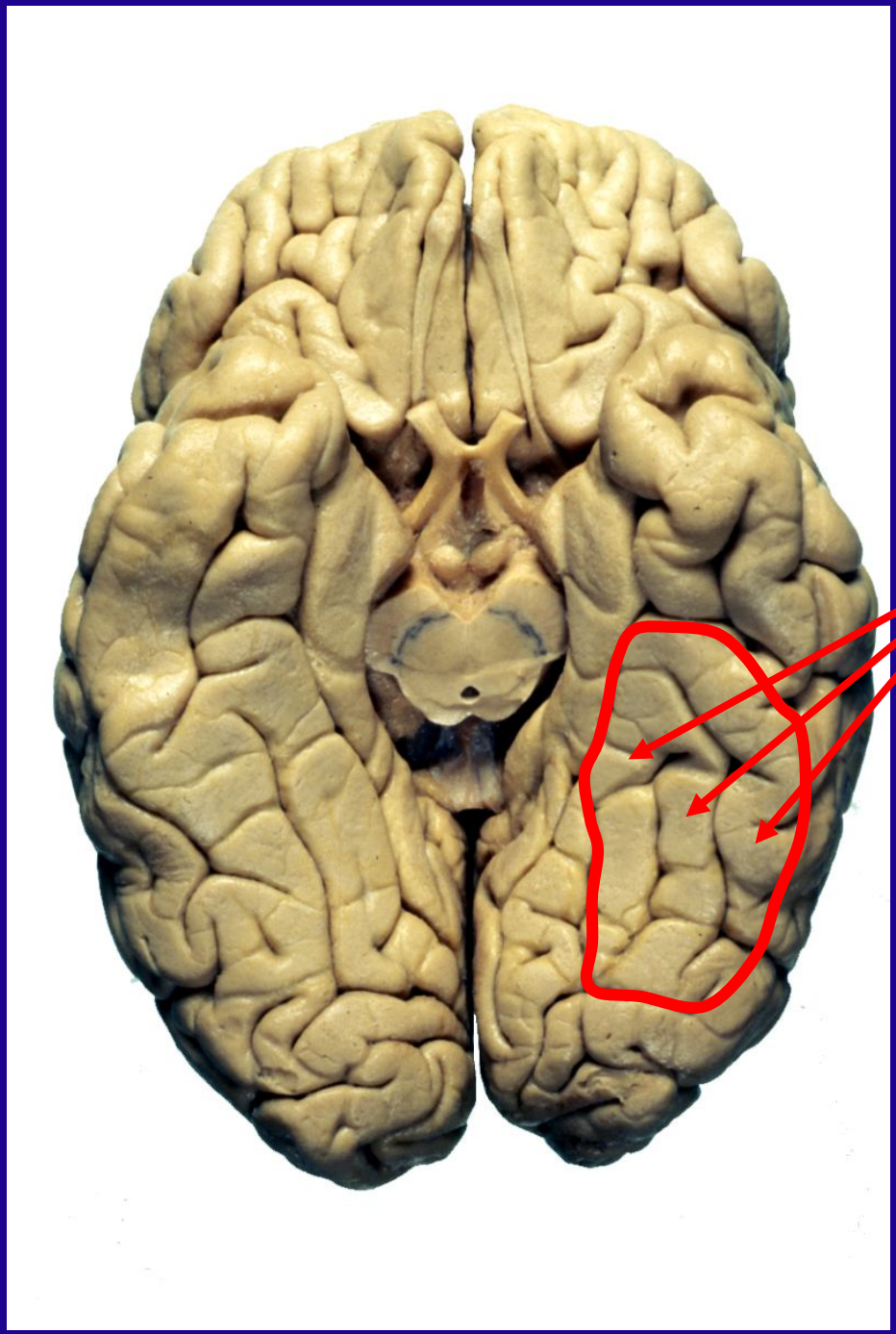
- Usually associated with *left mesial occipitotempora*l region
- hence usually affect the visual cortex or optic rediation leading to right hemianopia , and also associated with alexia

The Neural Basis of Visual Perception

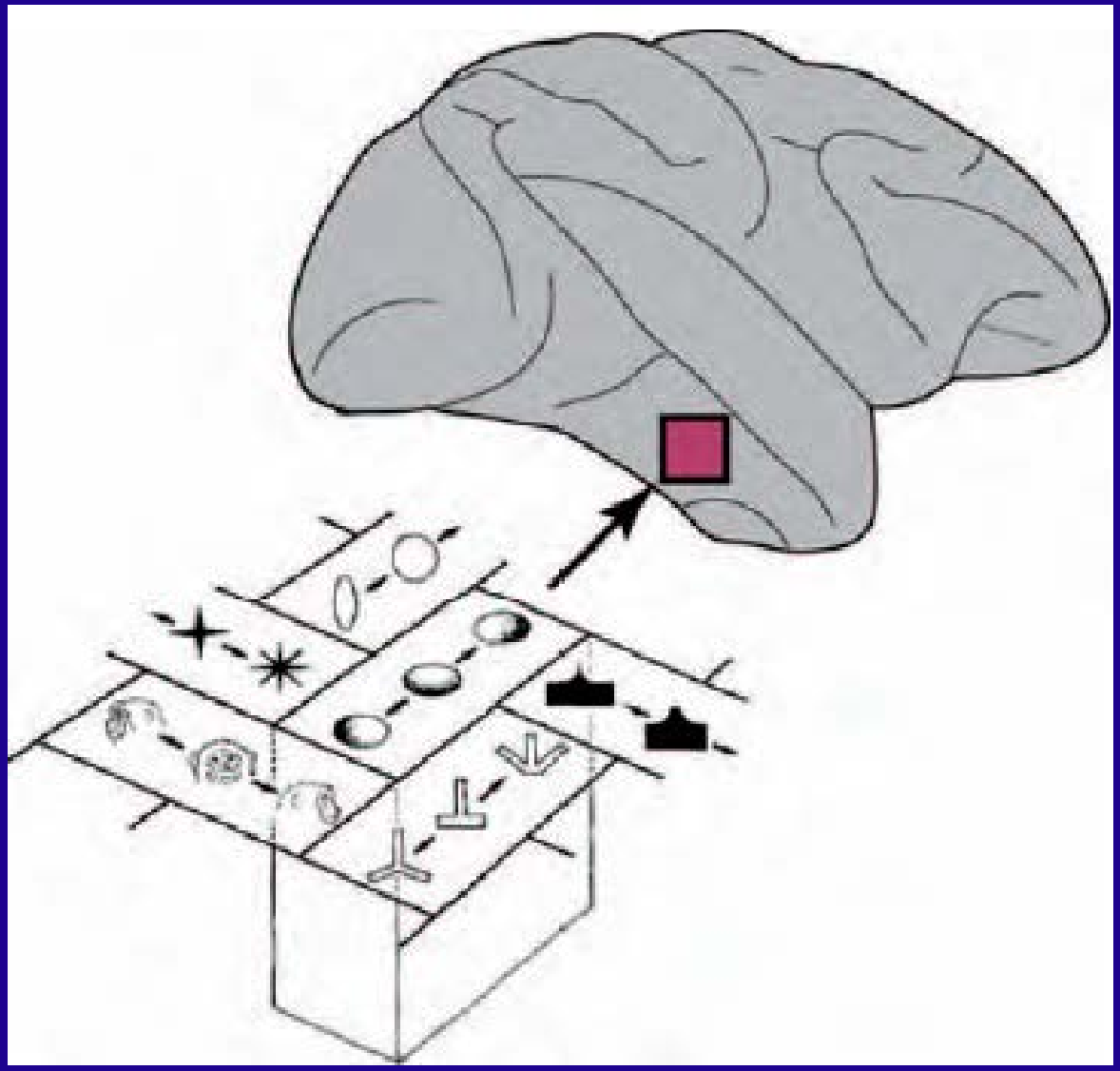
- Visual agnosia is the inability to recognize objects despite satisfactory vision.
  - Caused by damage to the pattern pathway usually in the temporal cortex.
  - For words : Alexia

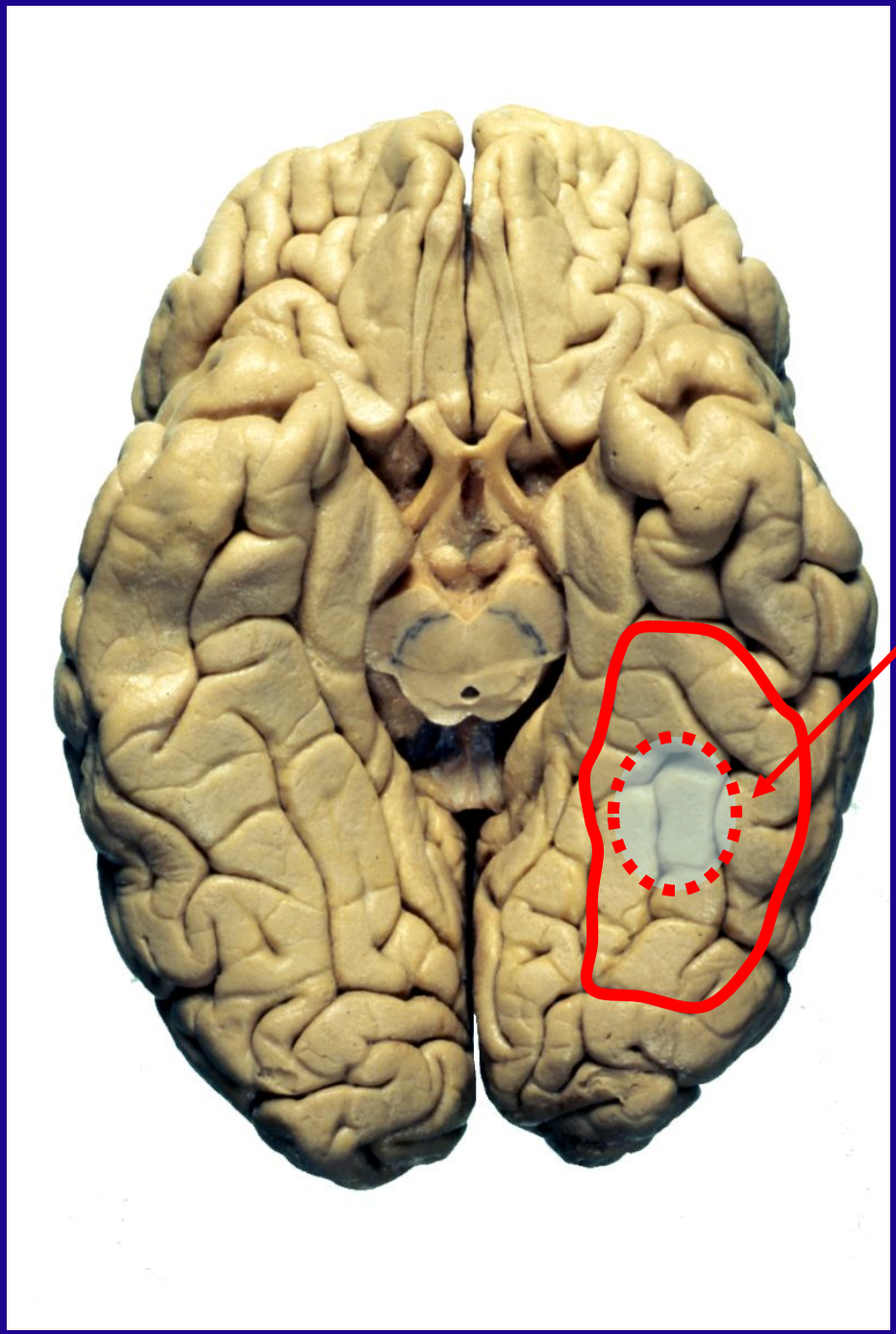
Agnosia

- Topographagnosia
  - Inability to navigate routes using familiar landmarks - deficit in familiar scene perception
  - **Right lingual gyrus**
- Alexia
  - **Left** (dominant lobe) fusiform/lingual areas

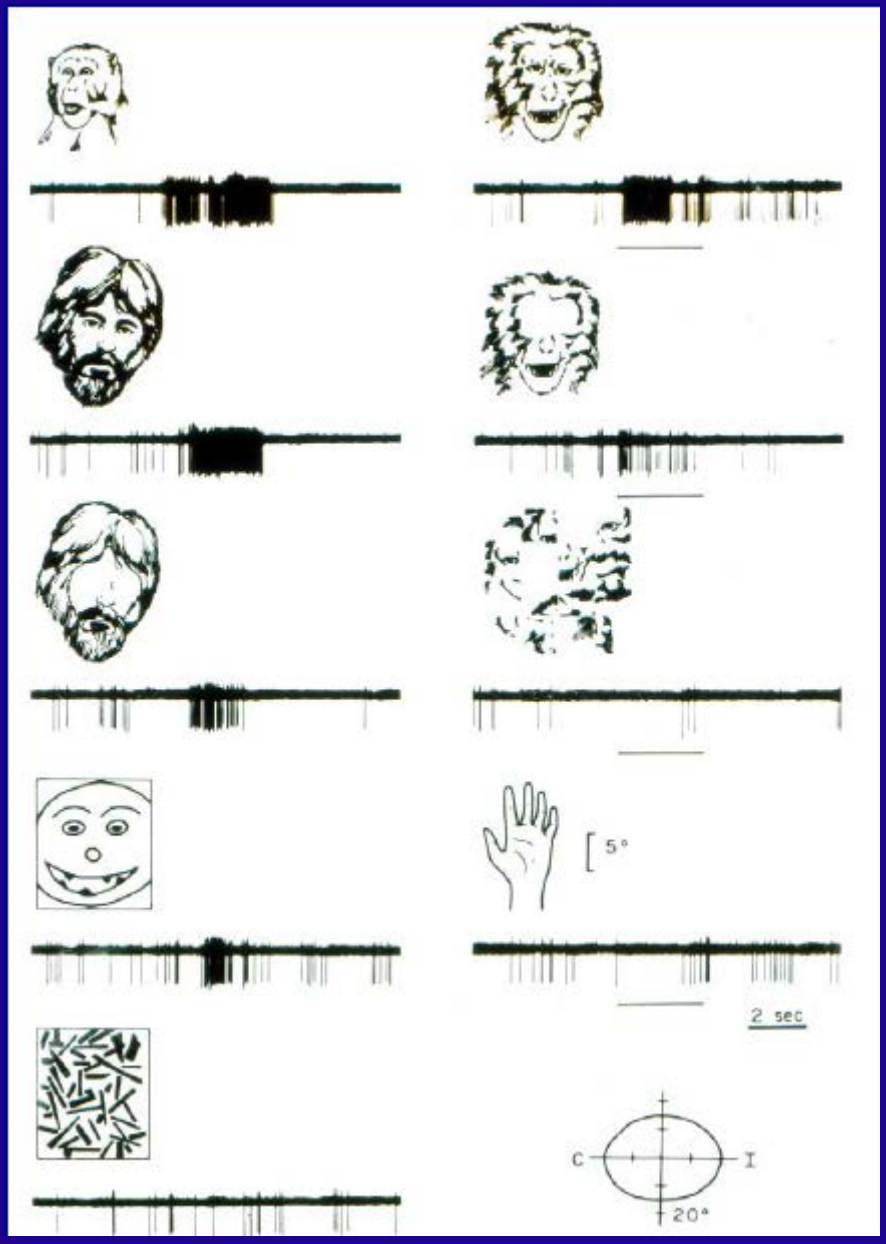


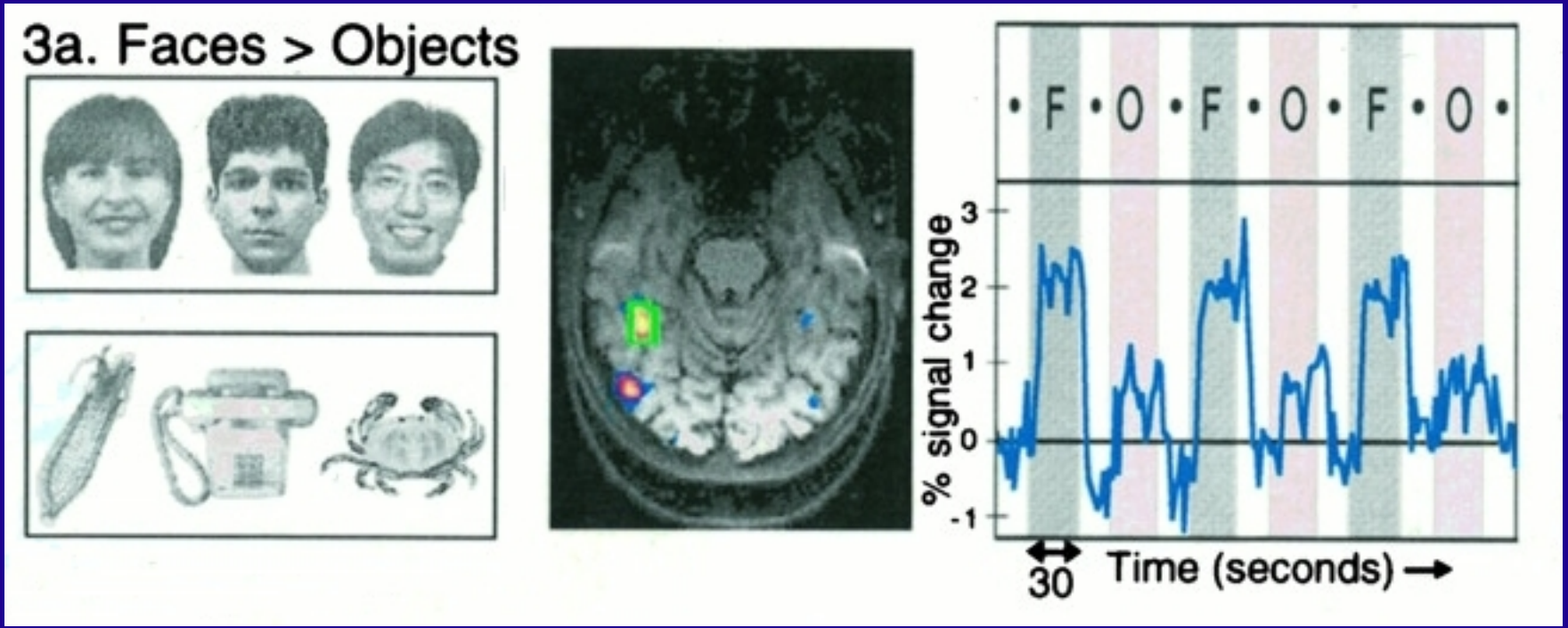
Occipitotemporal gyri



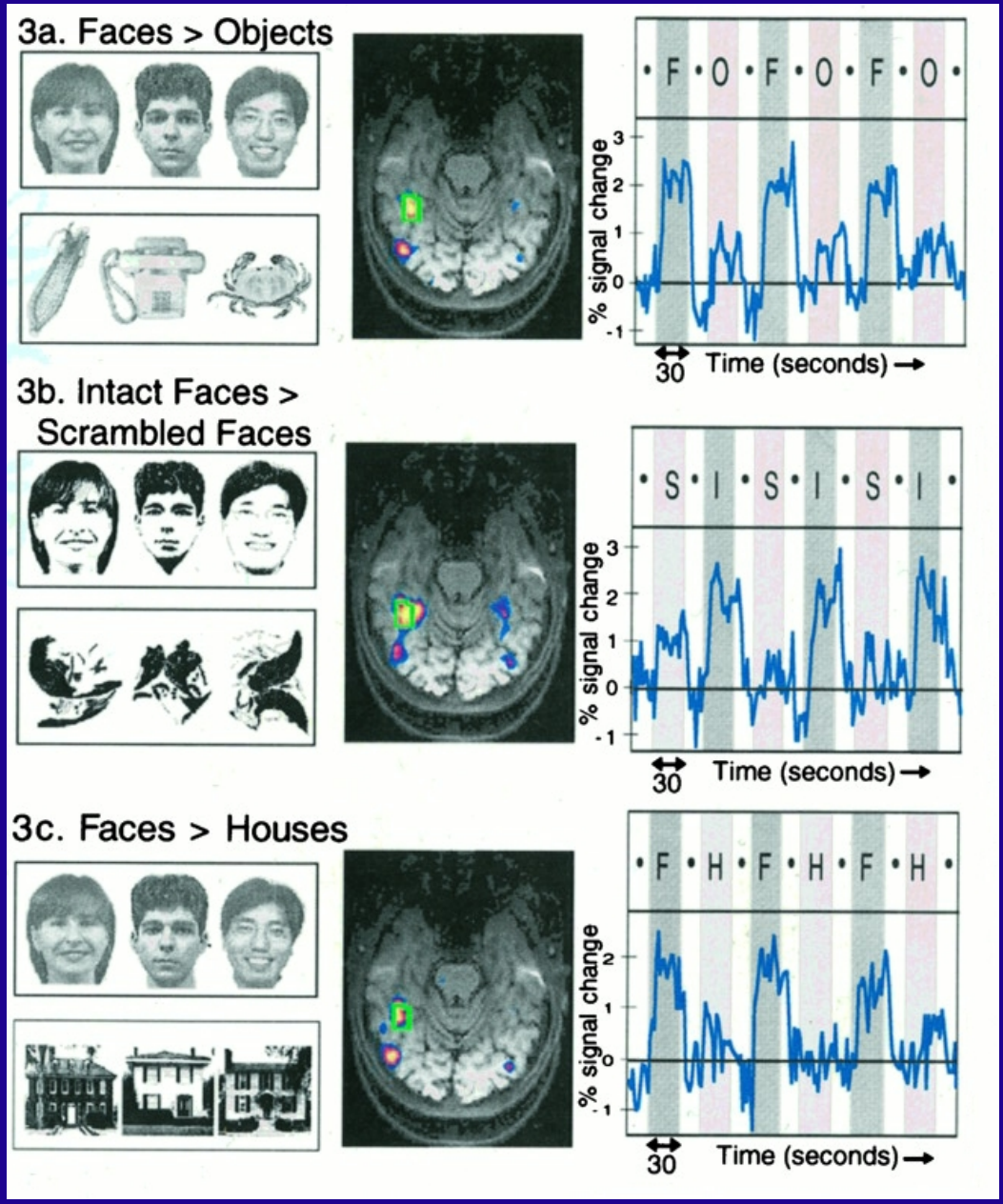


Occipitotemporal gyri

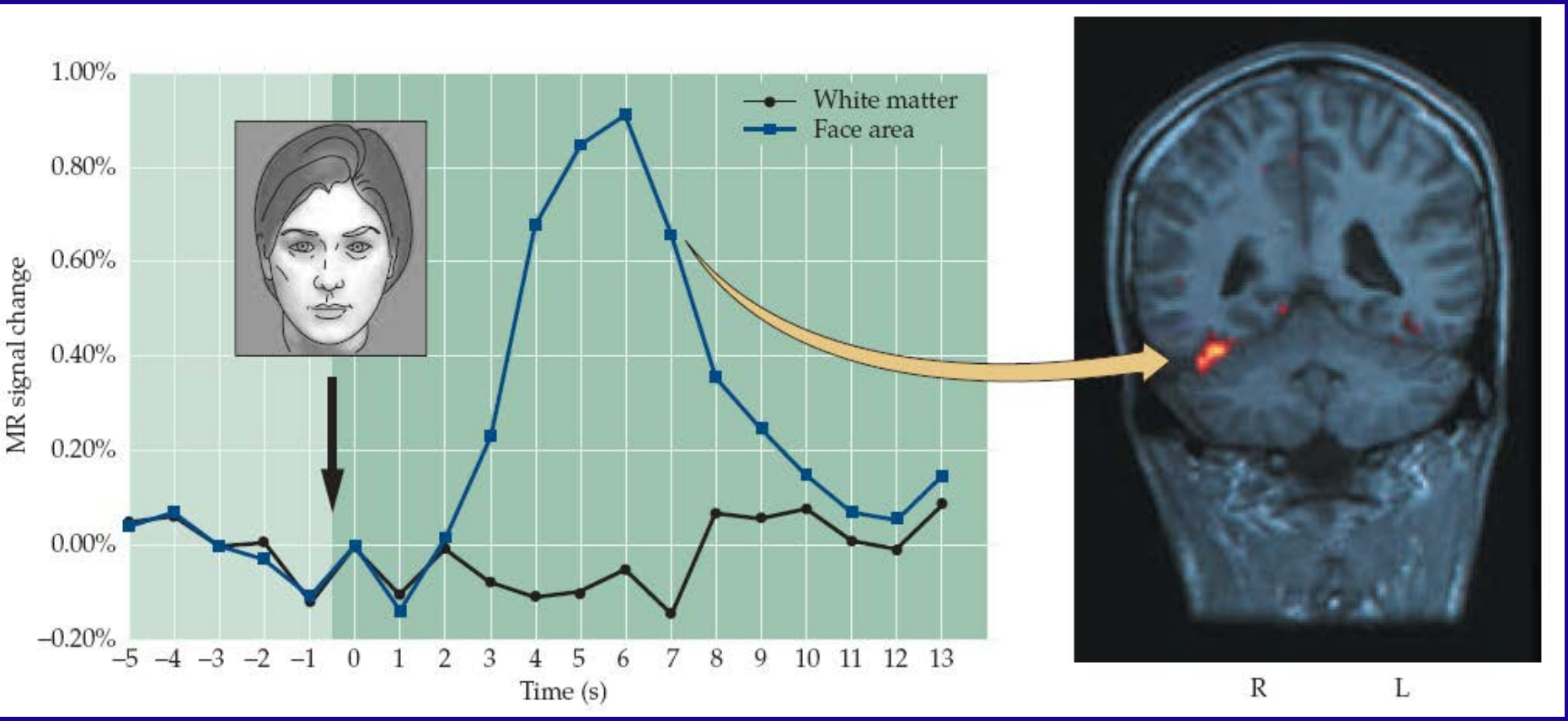

5°
2 sec
C
I
20°



Kanwisher , McDermott, and Chun, 1997

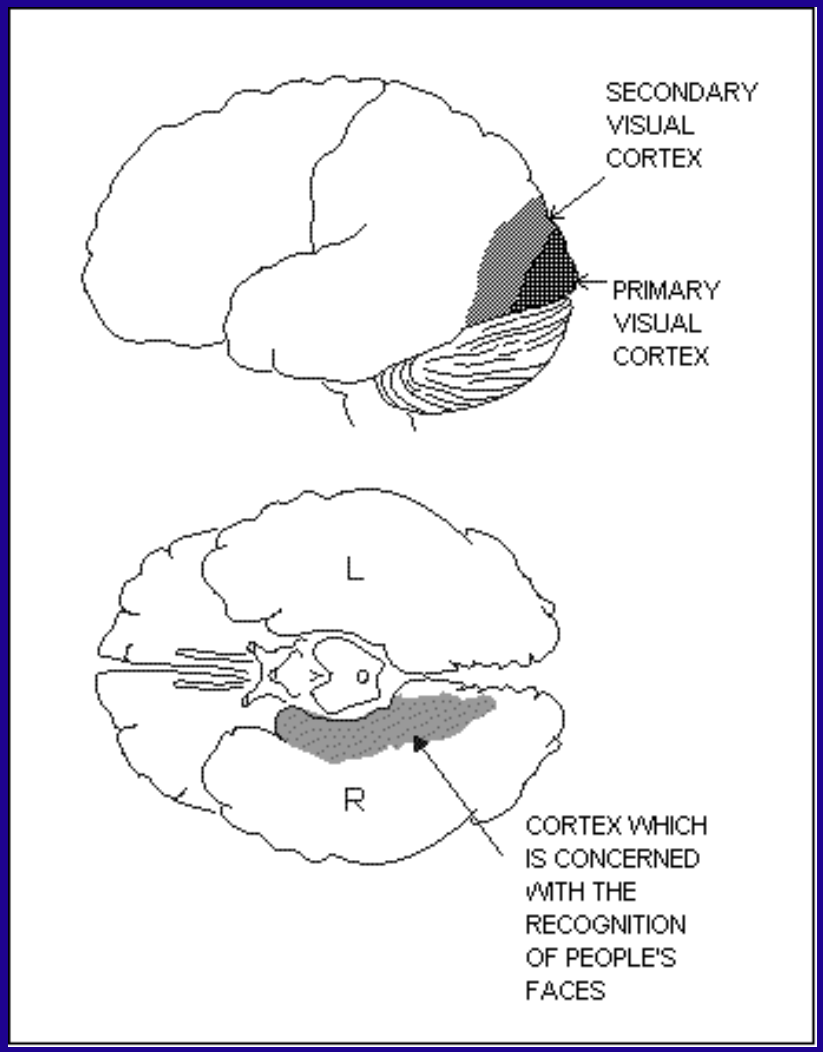


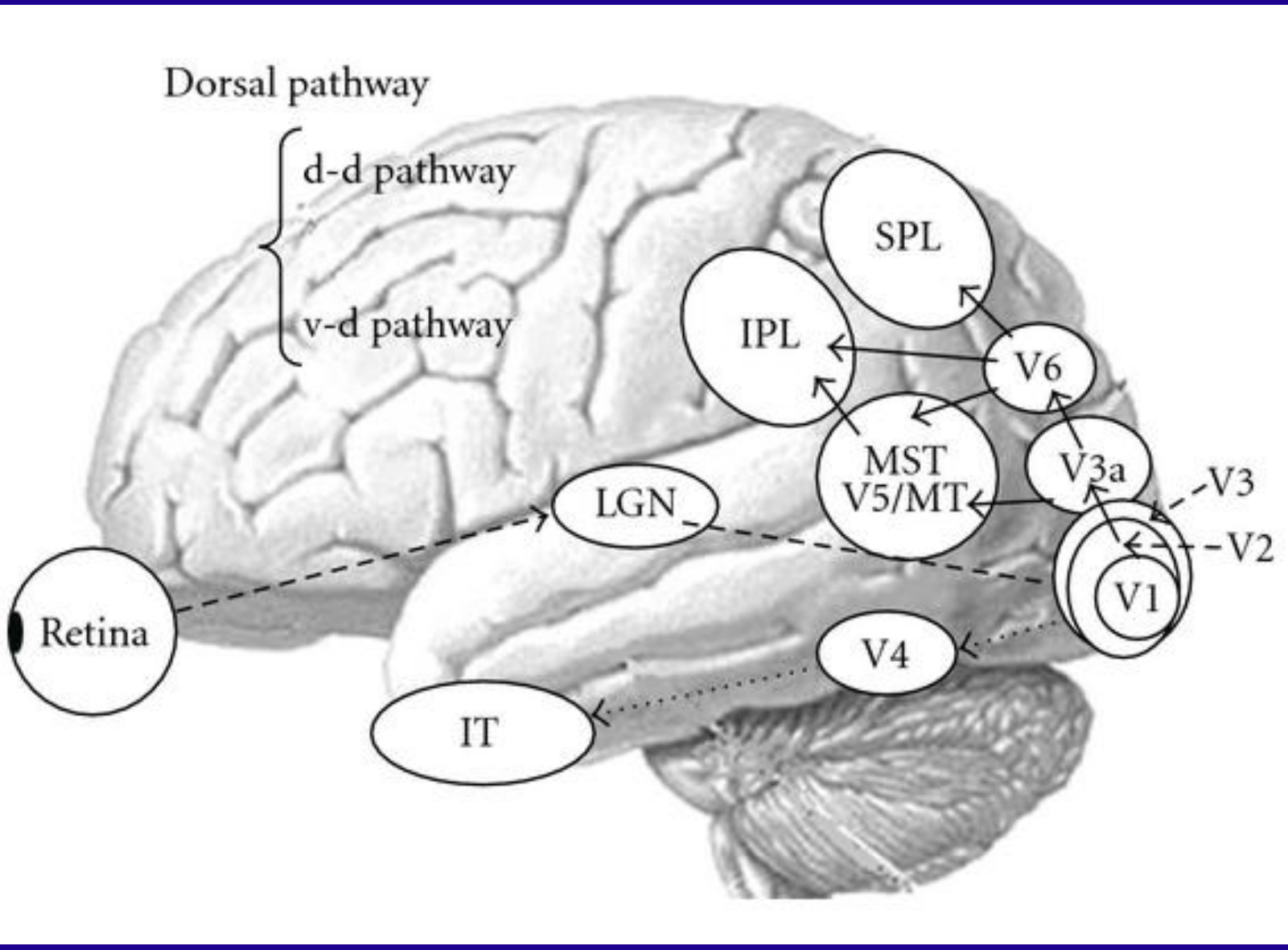
Kanwisher , McDermott, and Chun, 1997


1.00%
0.80%
0.60%
0.40%
0.20%
0.00%
–0.20%
MR signal change
White matter
Face area
–5 –4 –3 –2 –1 0 1 2 3 4 5 6 7 8 9 10 11 12 13
Time (s)
R
L

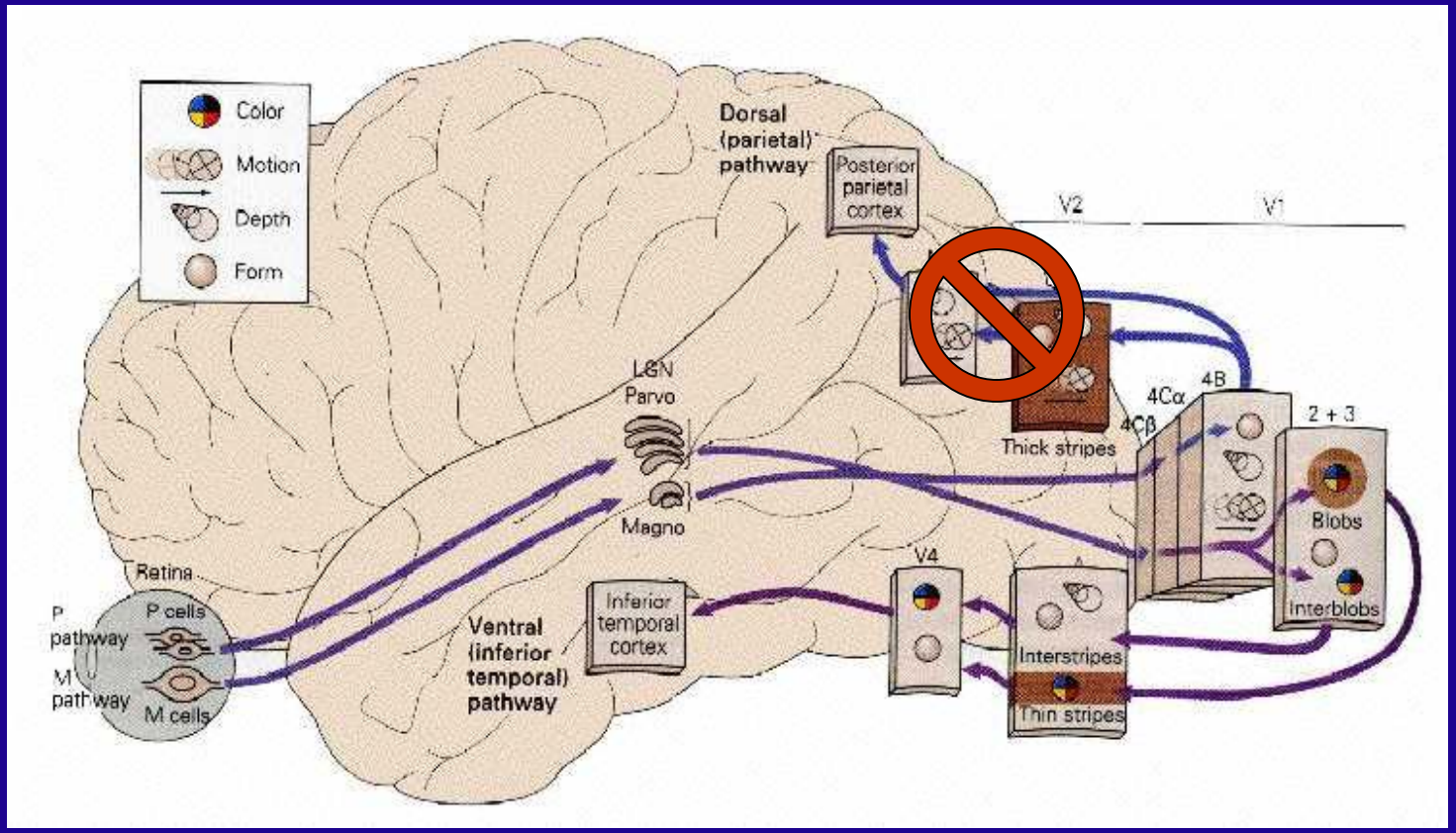
Agnosia

- Prosopagnosia-
  - Inability to recognize or learn faces
  - Identify people by other cues- gait, mannerisms or facial features- spectacles, gait
  - Aware of defect
  - **BL lingual and fusiform gyri of medial occipitotemporal cortex**.




Dorsal pathway
d-d pathway
v-d pathway
SPL
IPL
V6
MST
V5/MT
V3a
V3
V2
V1
LGN
Retina
V4
IT

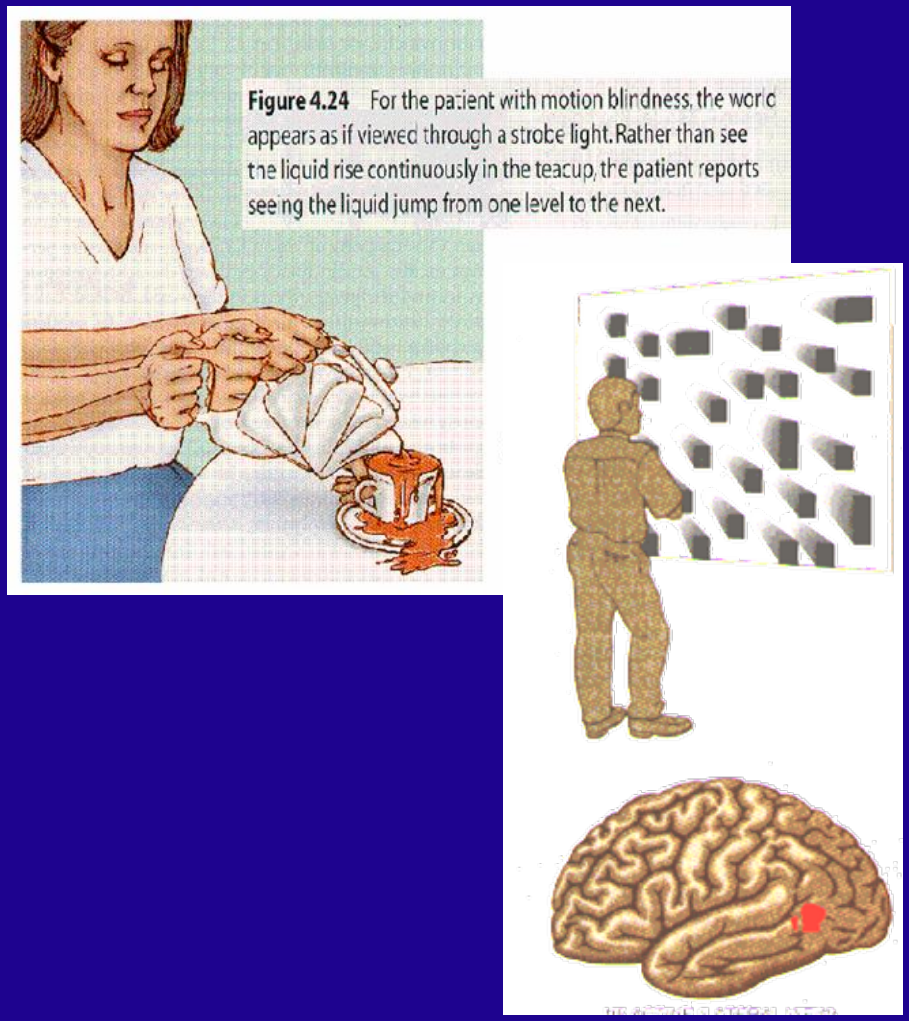
Damage to “where” pathway



Abnormal motion processing & Visuspatial neglect

Akinetopsia

- Clinical features
  - Can't see moving objects (as if under strobe lights); can see still objects
  - People appear suddenly
- Neuropathology
  - **BL lesion** to area MT (V5; T-O-P junction)
  - UL lesions cause subtle defects



Akinetopsia

- Clinical features
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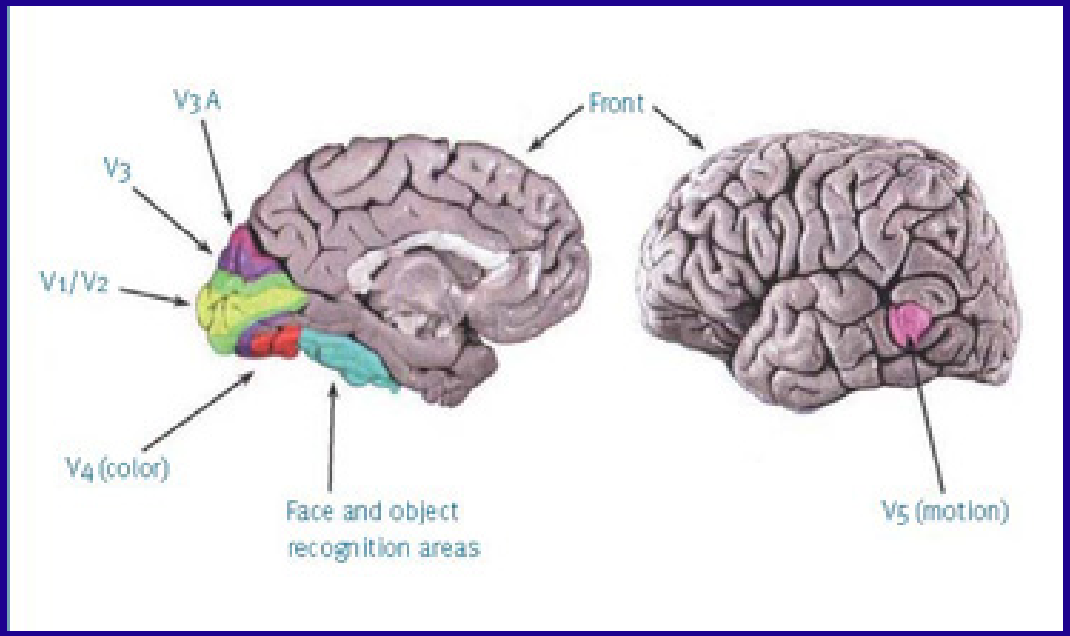
  - People appear suddenly
- Neuropathology
  - **BL lesion** to area MT (V5; T-O-P junction)
  - UL lesions cause subtle defects



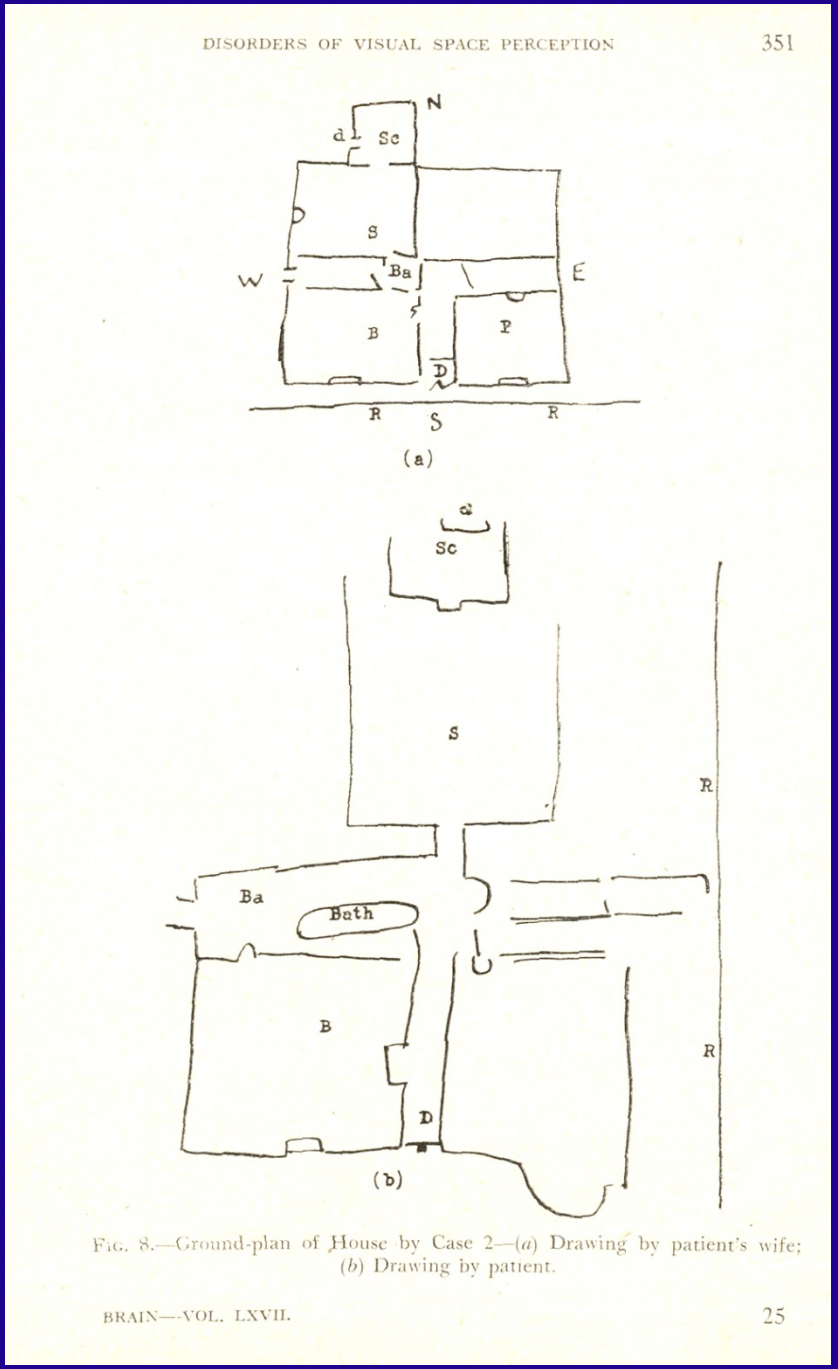
Topographagnosia

- Inability to navigate routes using familiar landmarks - deficit in familiar scene perception
- right ventral temporo-occipital lesions like **Right lingual gyrus**

VS

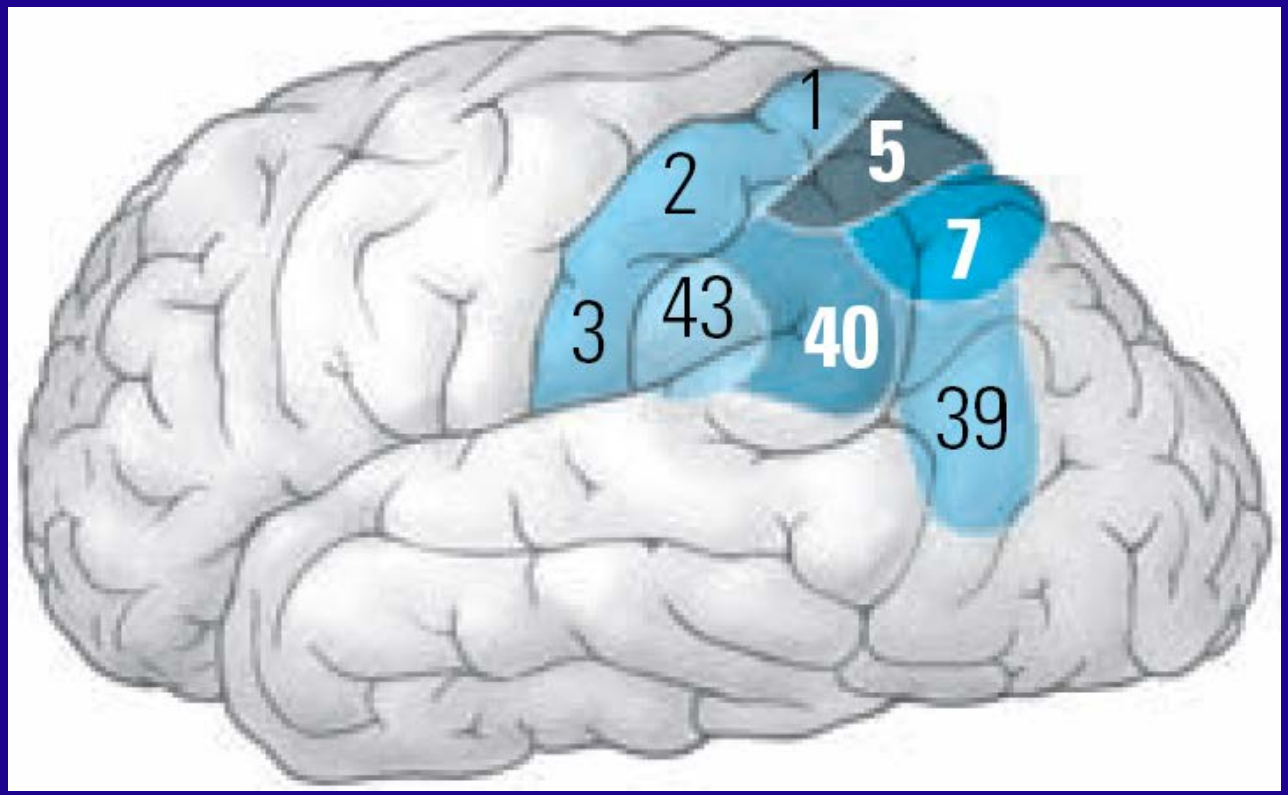
- right parietotemporal lesions

Spatial relationships distorted

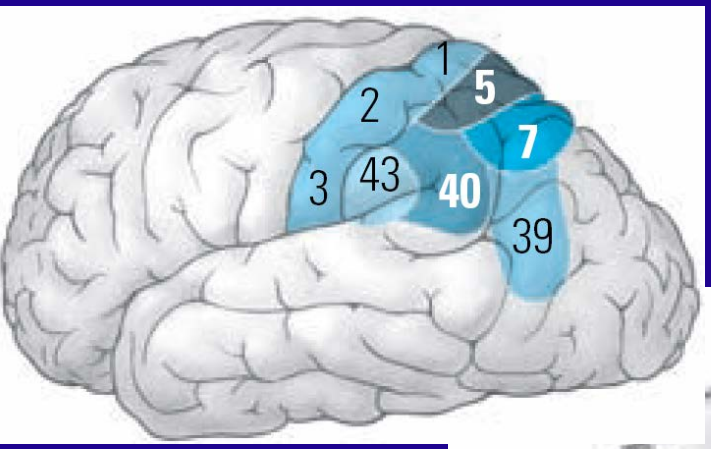


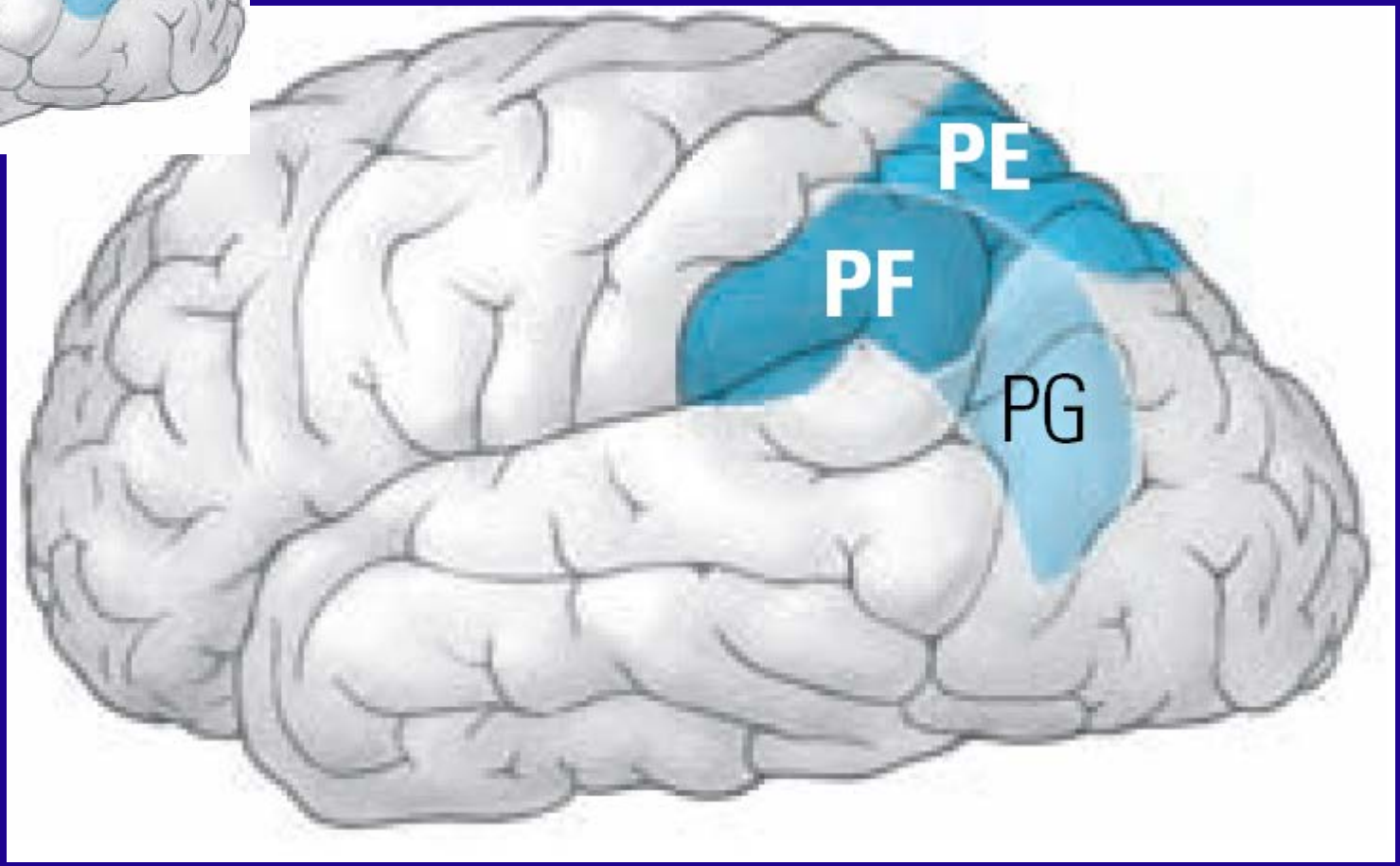
Spatial relationships distorted

Parietal lobe



Parietal lobe

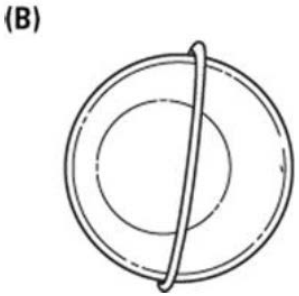


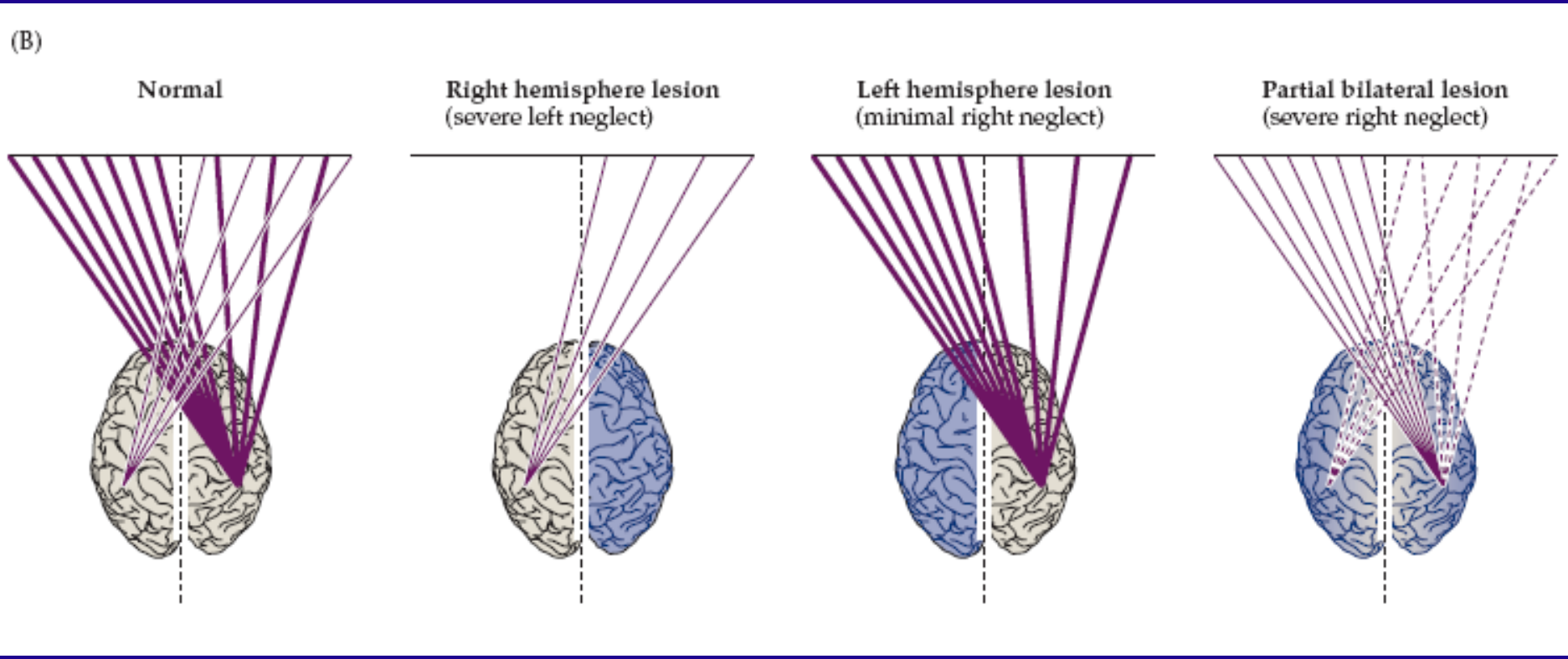


Object Recognition

Object Recognition

– After right parietal lobe lesions patients are poor at recognizing objects in unfamiliar views




(B)
Normal
Right hemisphere lesion
(severe left neglect)
Left hemisphere lesion
(minimal right neglect)
Partial bilateral lesion
(severe right neglect)

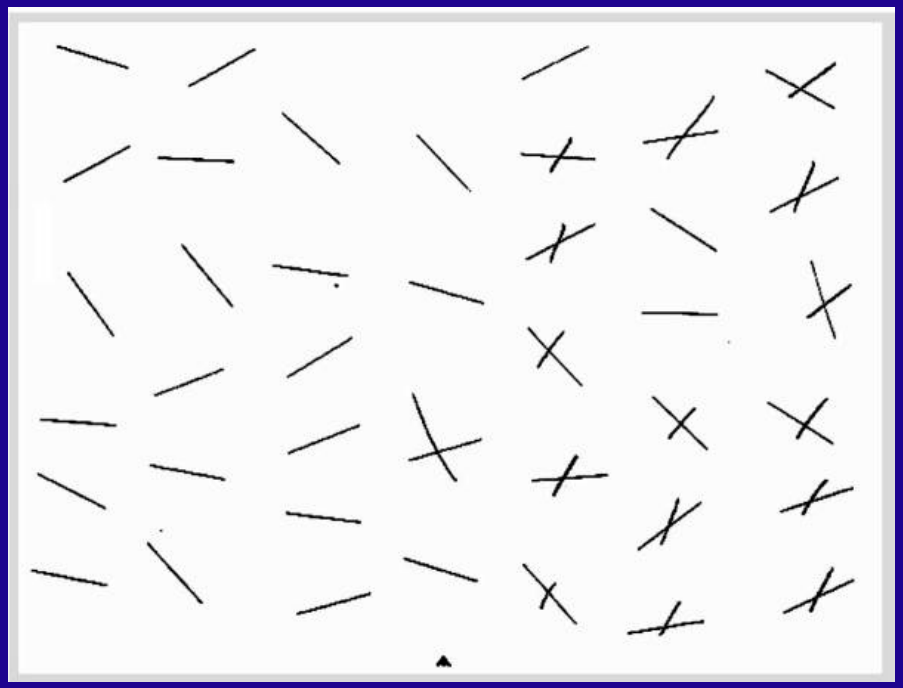
Neglect syndrome

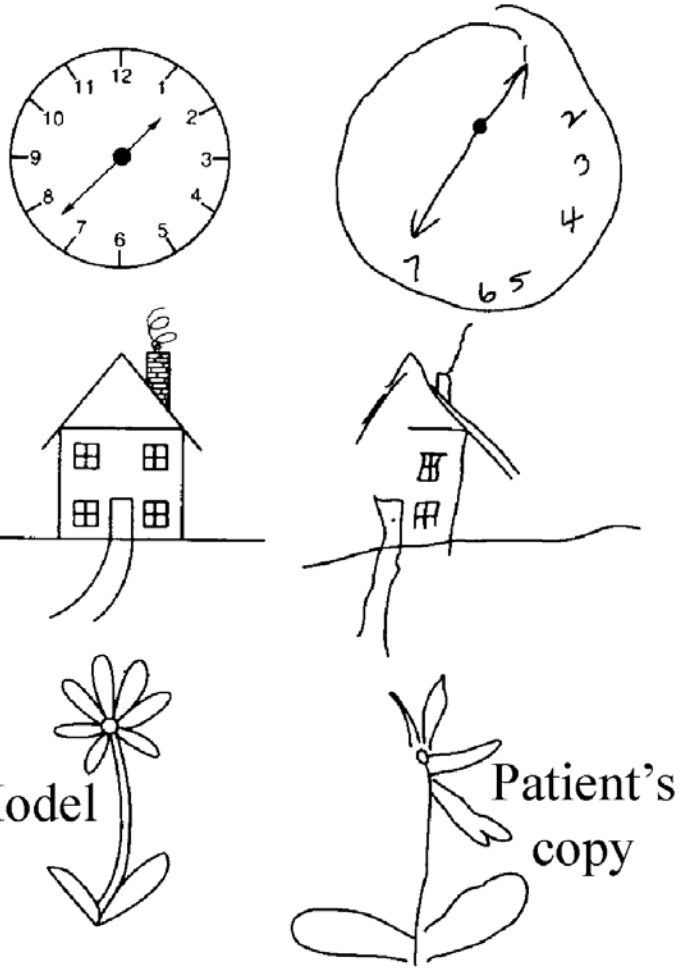
(right parietal association cortex)

The cat ran up the tree to catch a squirrel for his lunch. The squirrel was smart and ran out to the end of a thin branch. The branch broke, but the cat landed on his feet. No fat squirrel for lunch today, No sir!

A

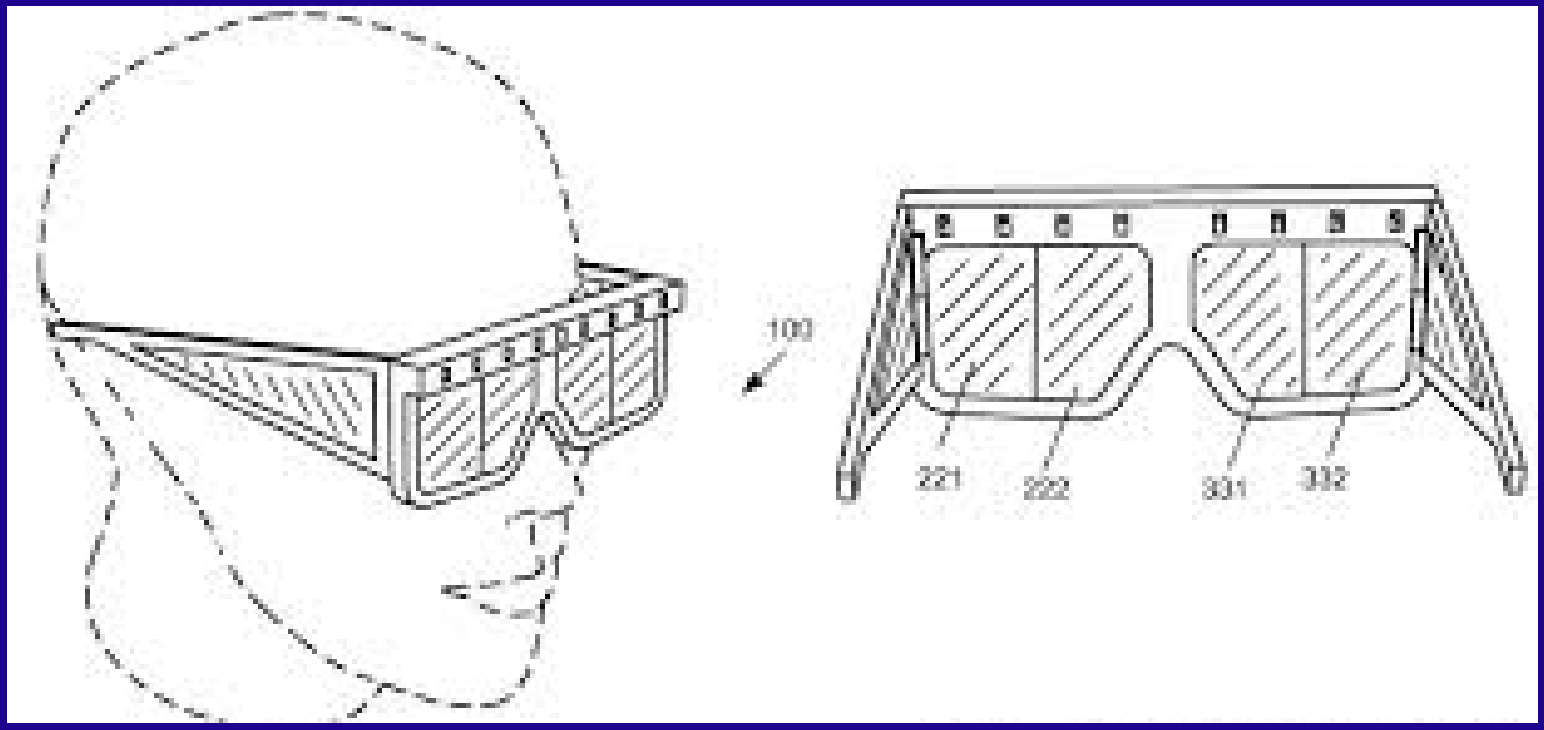
B





Spatial relationships distorted

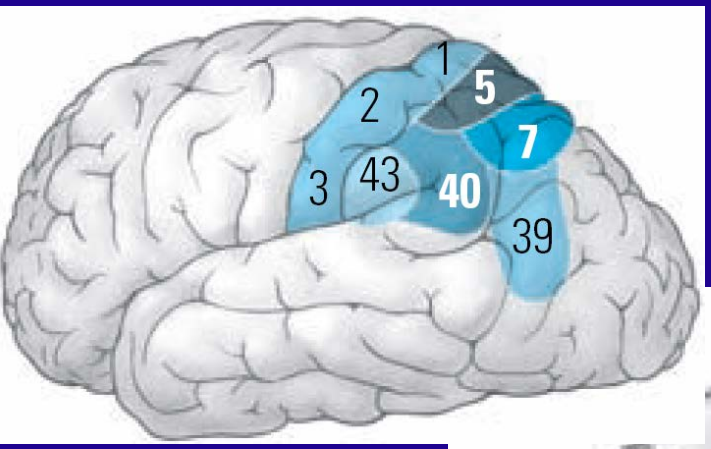
Assembly of "Manikin" Figure by Case 2. A. Correct Assembly. B. Assembly by Patient.

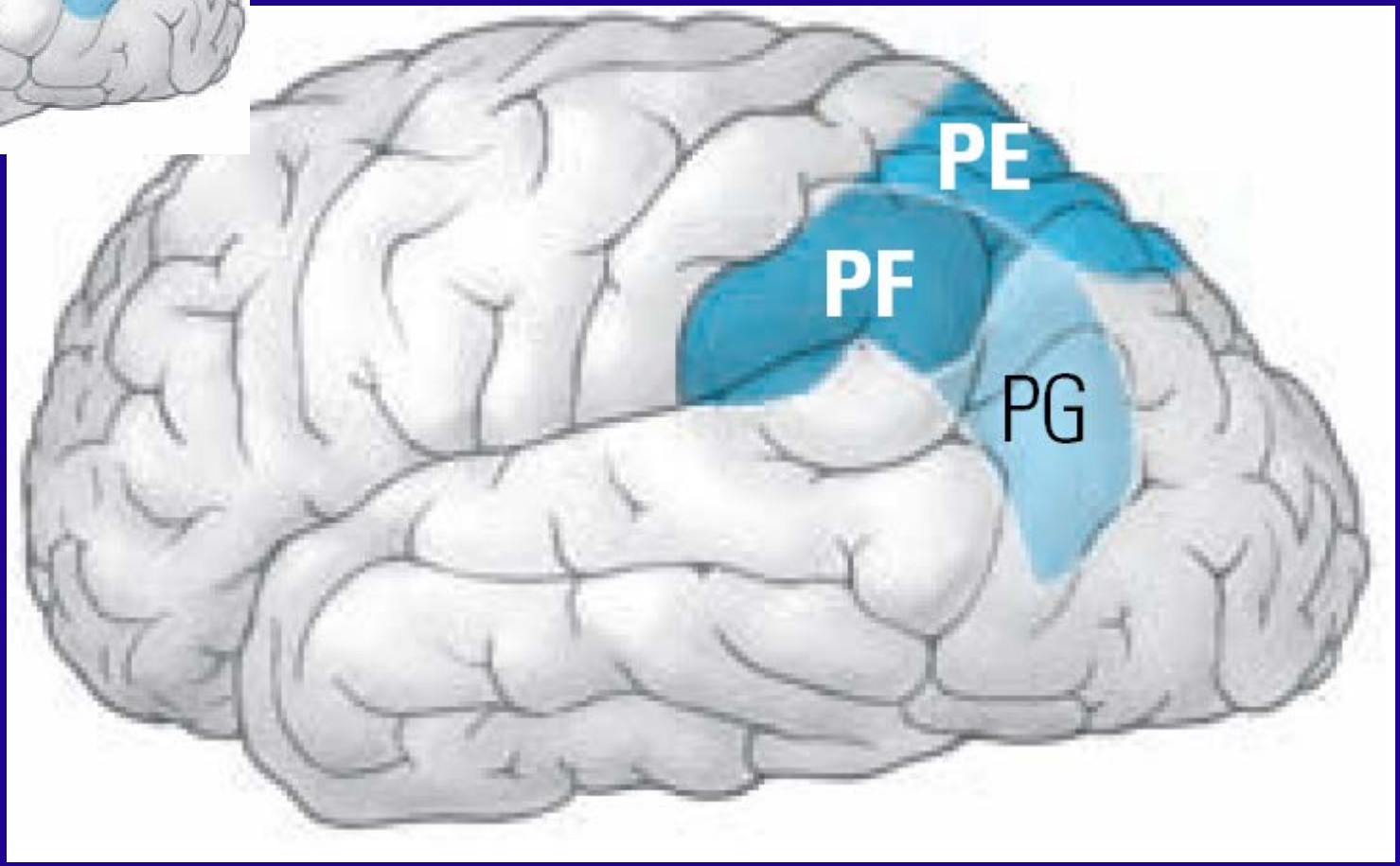

100
221
222
331
332

- Anosognosia
  - Unawareness or denial of illness

Left parietal

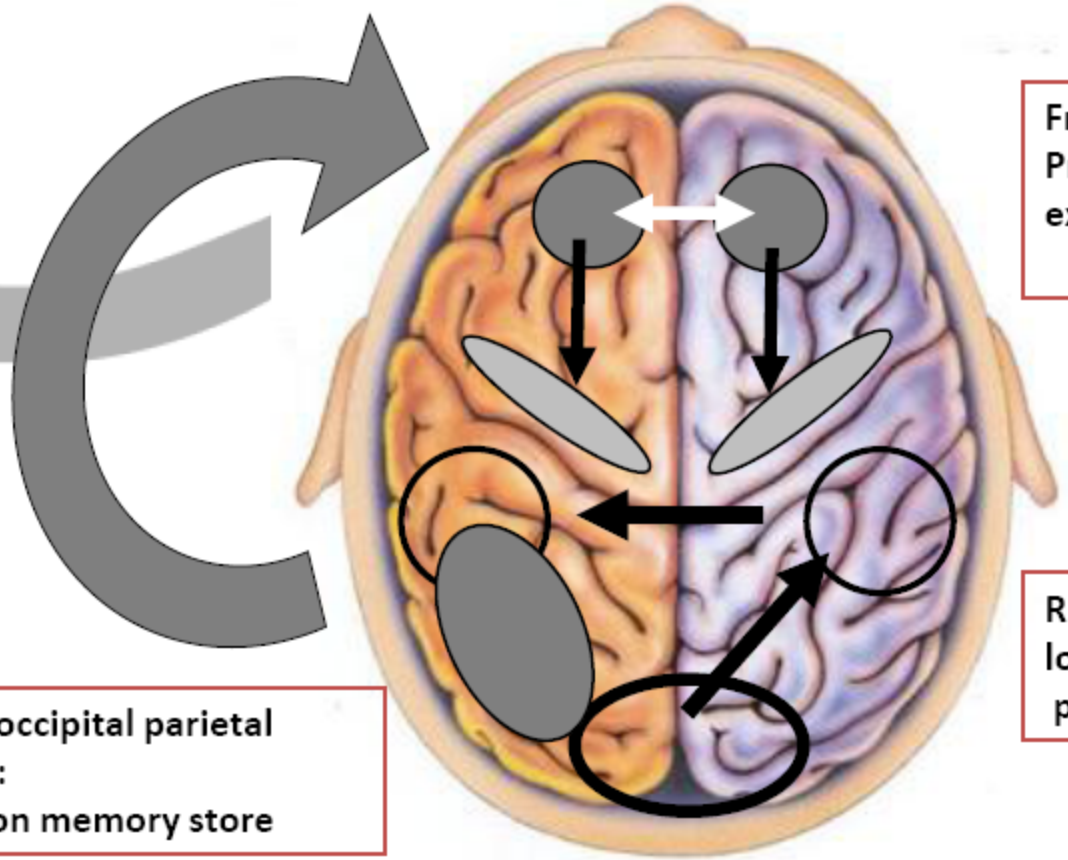
Parietal lobe





- Acalculia
- Language
- Agraphia
- Apraxia

Frontal lobe:
Pre-motor cortex



Frontal lobe:
Primary motor area for execution of movement

Right and left parietal lobe:
perceptual analysis

Left occipital parietal lobe:
Action memory store

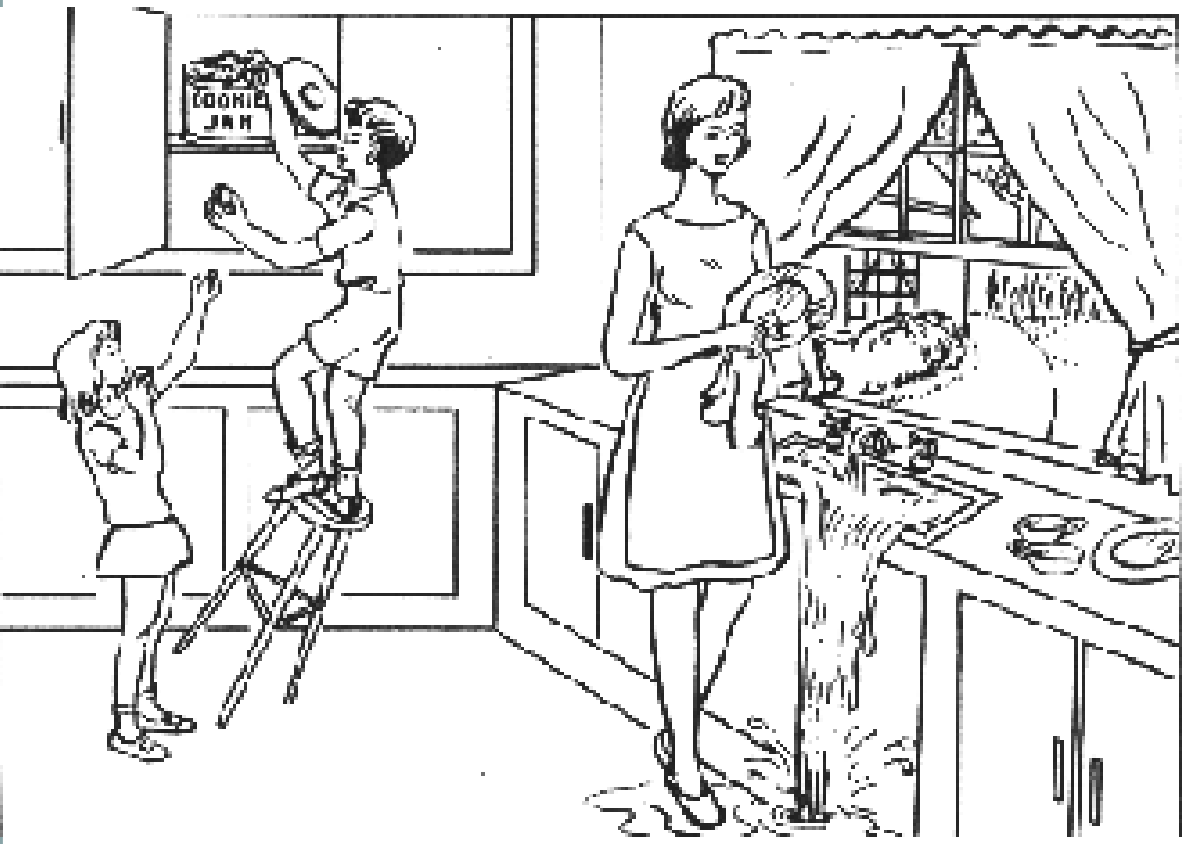
Dominant occipital lobe:
visual information

Bilateral Parietal Damage (Balint's Syndrome)

- Impaired control over the focus of visual attention due to inattentional amnesia
- Complex defects in perception of visual object structure, motion and depth.
- Neglect (hemifield)

Bilateral Parietal Damage (Balint's Syndrome)

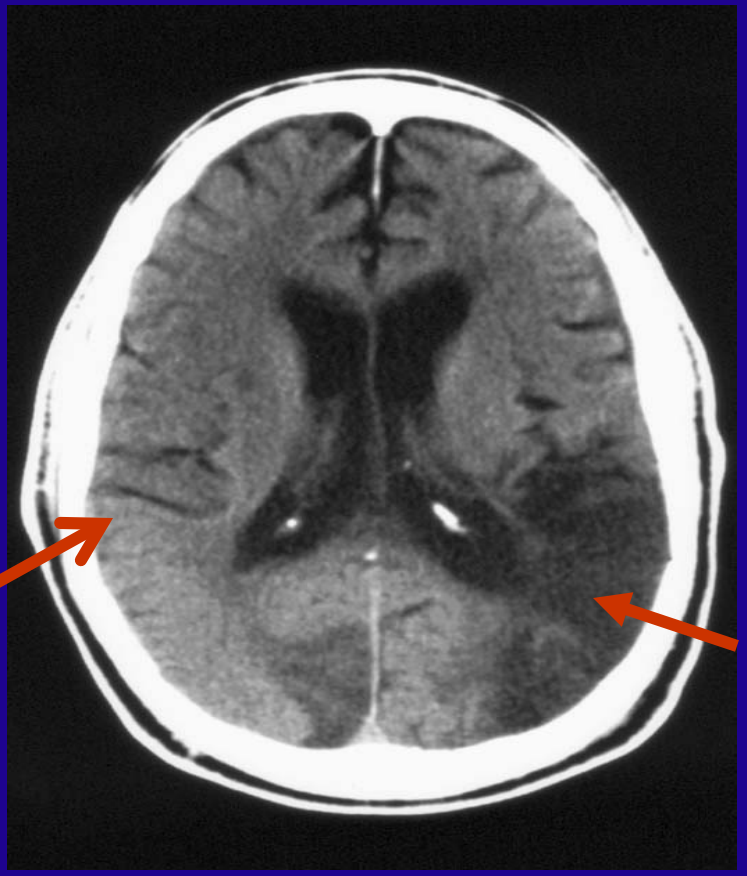
- **SIMULTANAGNOSIA :** Inability to interpret the totality of a picture scene (can identify individual portions of the whole picture)

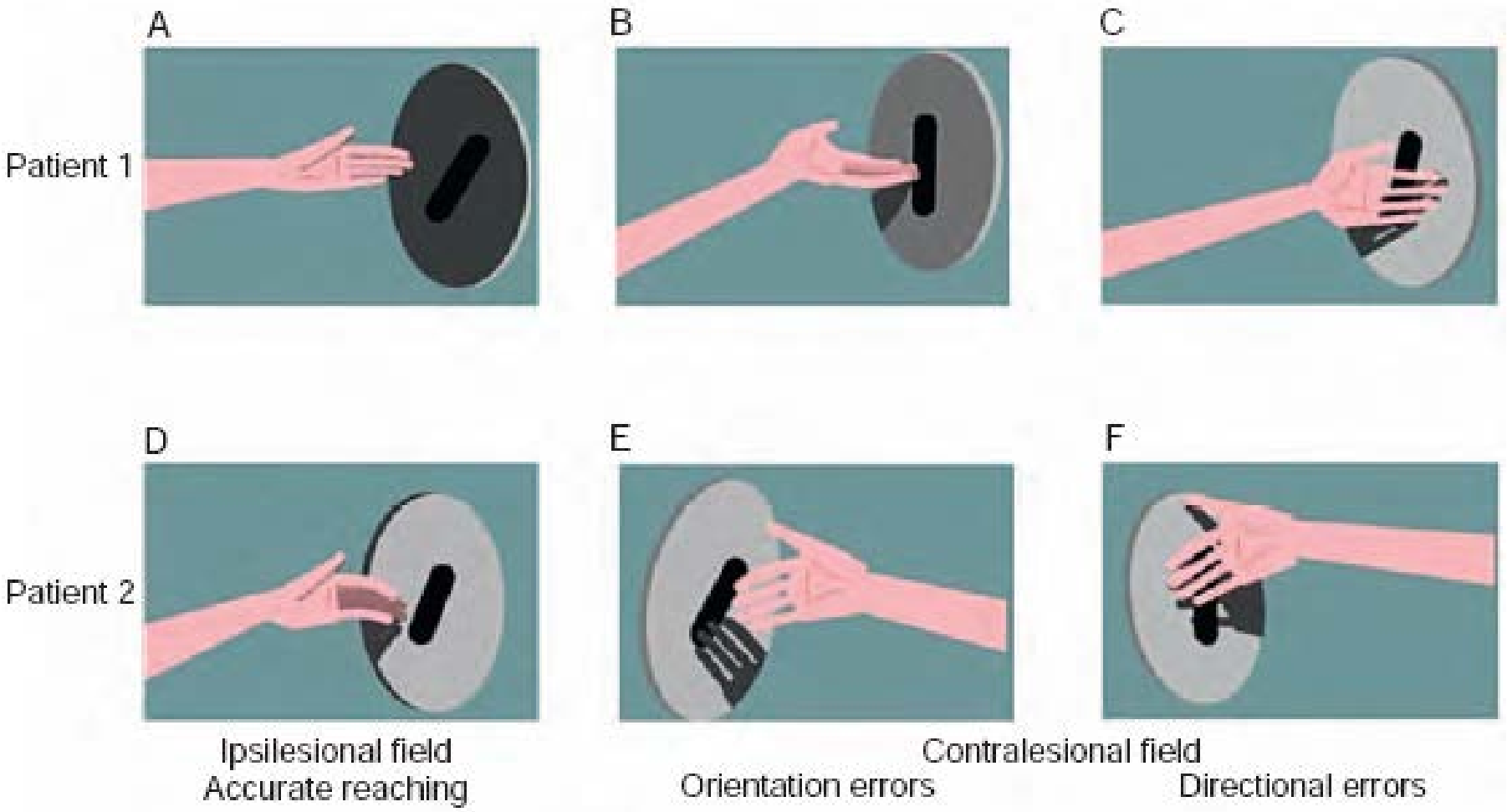



```
T  T  T        T  T  T
T  T  T        T  T  T
T  T  T        T  T  T
T  T  T  T  T  T  T  T
T  T  T  T  T  T  T  T
T  T  T  T  T  T  T  T
T  T  T        T  T  T
T  T  T        T  T  T
T  T  T        T  T  T
T  T  T        T  T  T
```

Bilateral Parietal Damage (Balint's Syndrome)

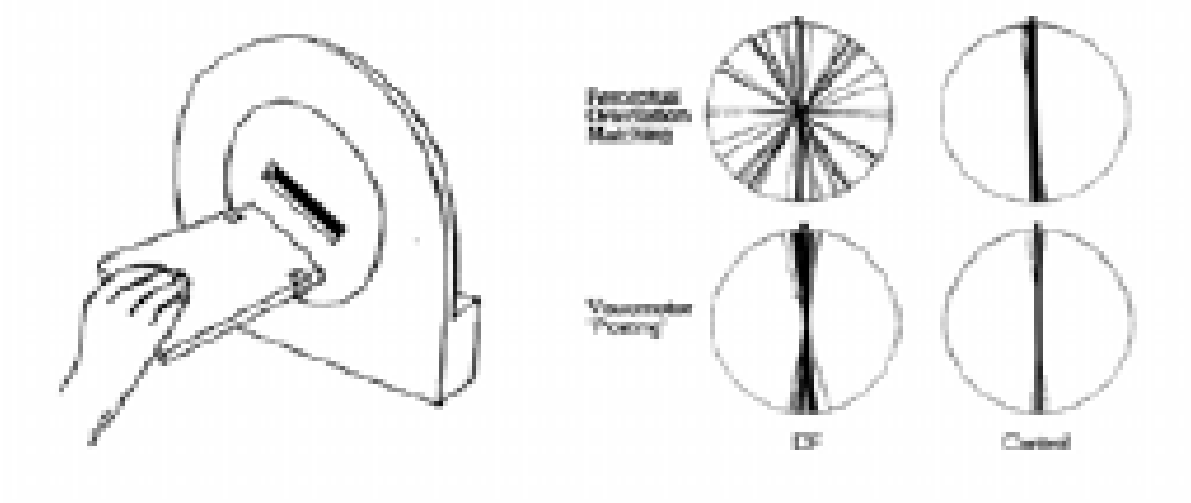
- **Simultanagnosia:** Inability to interpret the totality of a picture scene (can identify individual portions of the whole picture)
- **Optic ataxia:** Defects of visually guided hand movement




A
B
C
Patient 1
D
E
F
Patient 2
Ipsilesional field
Accurate reaching
Contralesional field
Orientation errors
Directional errors

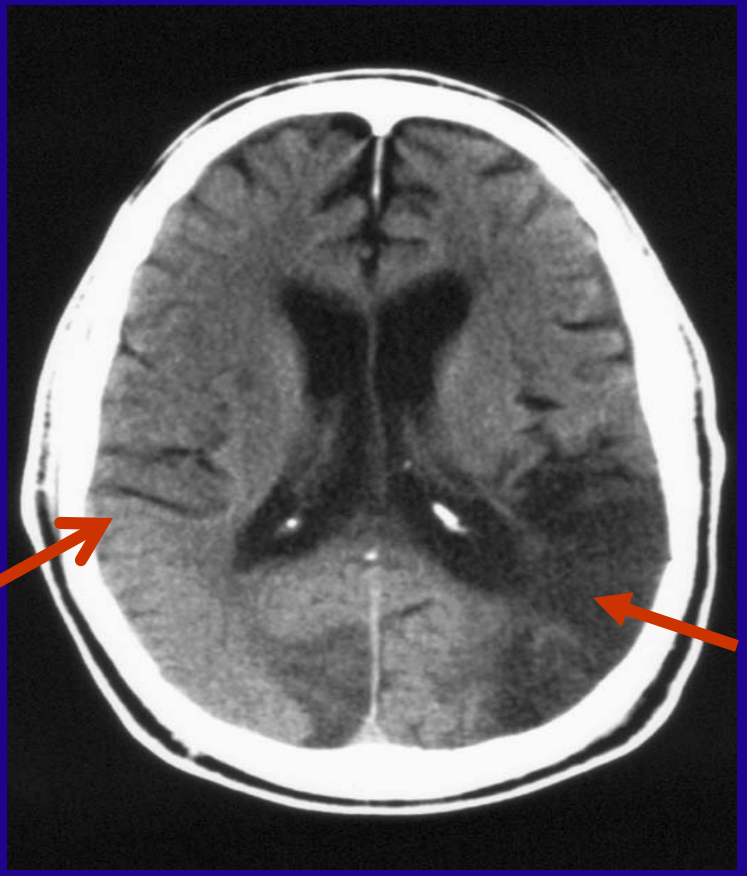
Temporal Cortex Damage

Nevertheless, the visually guided behavior of patients with *agnosia* is preserved. Thus, agnosic patients have difficulty identifying an object, but they can grasp and manipulate it.



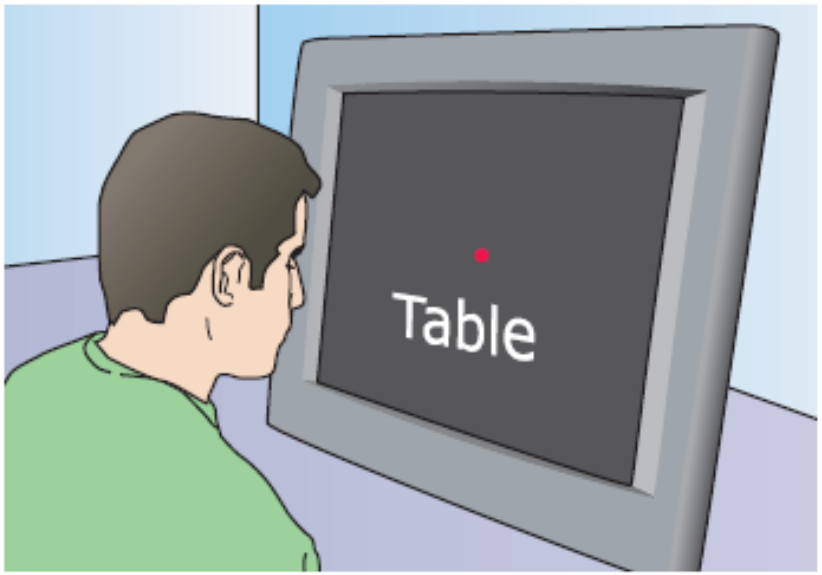
Bilateral Parietal Damage (Balint's Syndrome)

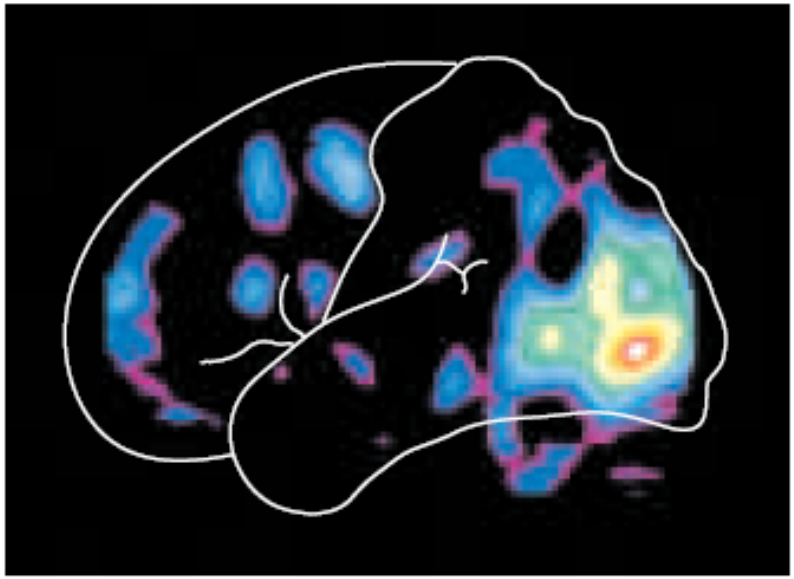
- **Simultanagnosia:** Inability to interpret the totality of a picture scene (can identify individual portions of the whole picture)
- **Optic ataxia:** Defects of visually guided hand movement
- **Ocular apraxia:** Inability to voluntarily move eyes to objects of interest (difficulty volitionally redirecting gaze



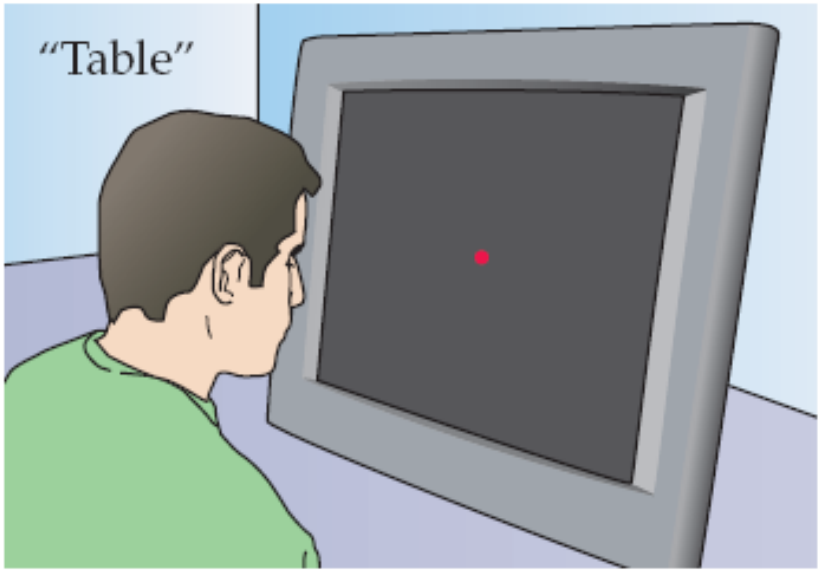
language

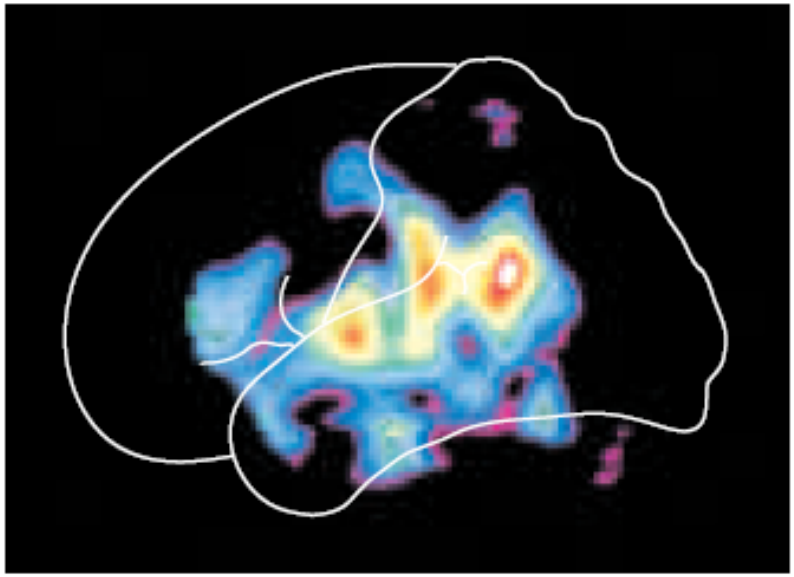
Passively viewing words



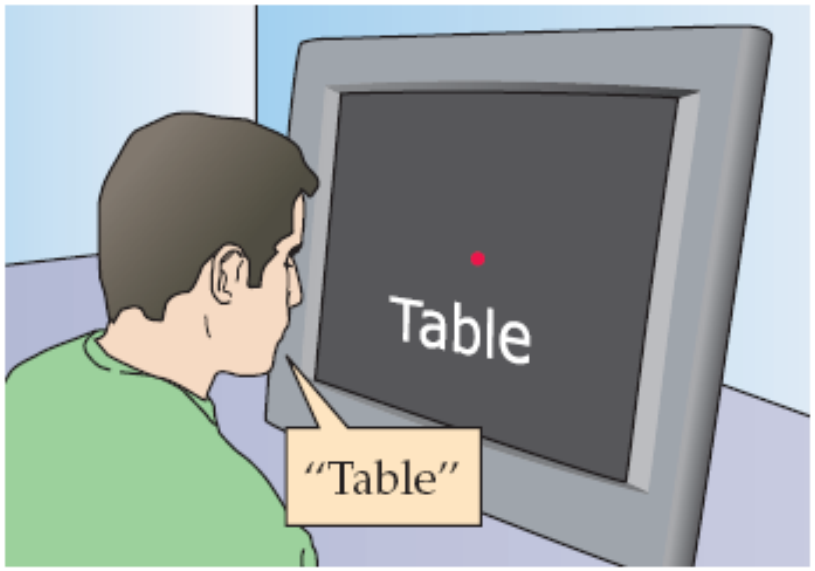


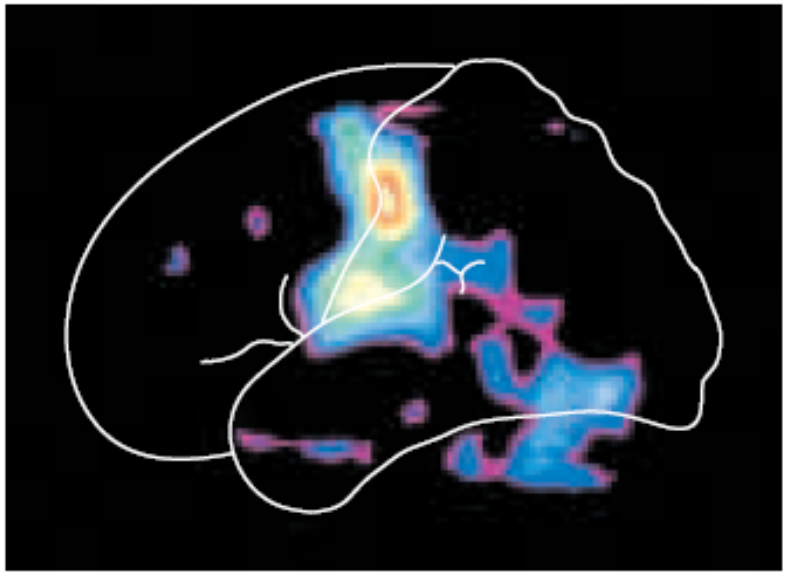
Listening to words



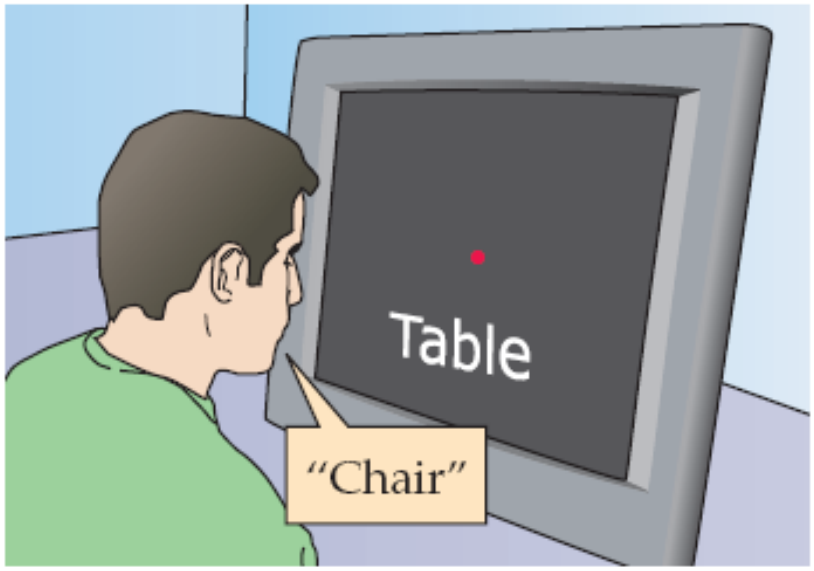


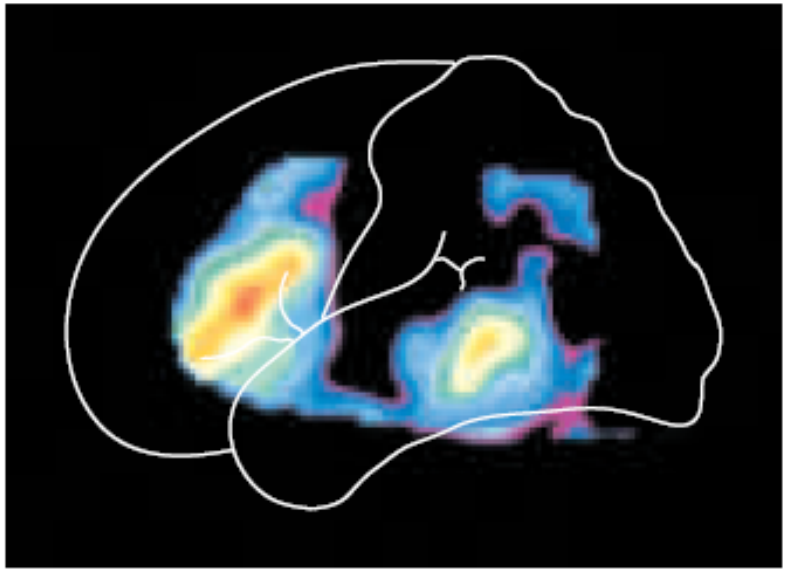
Speaking words

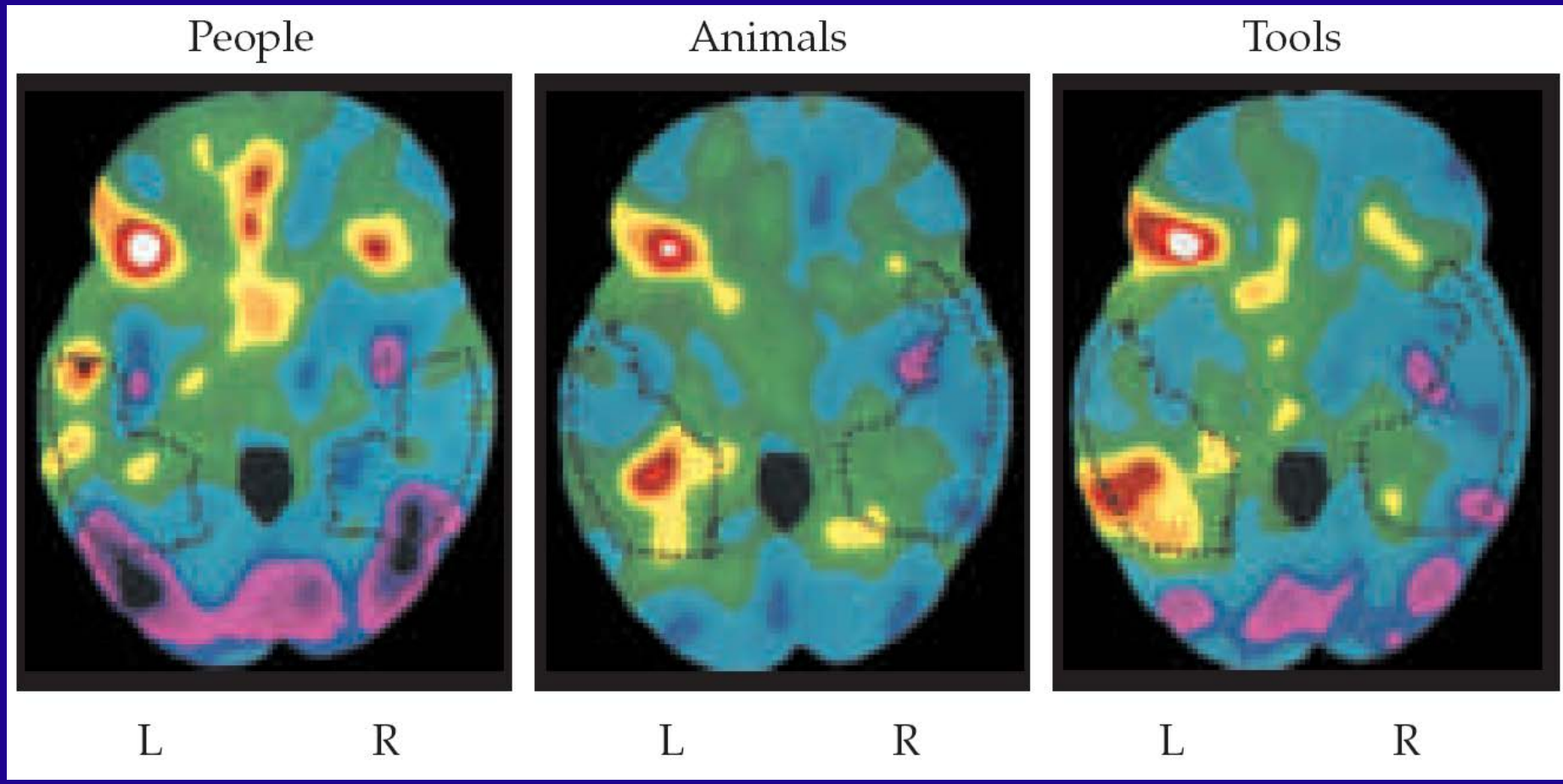




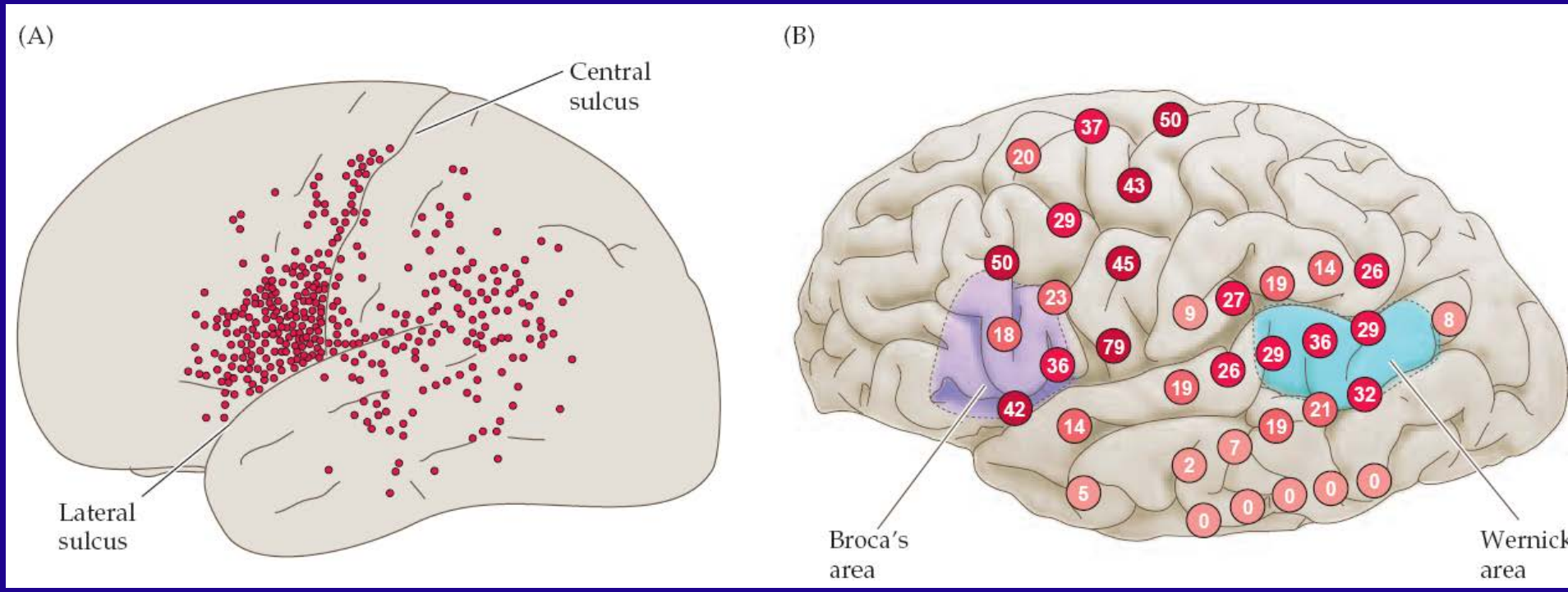
Generating word associations






People
Animals
Tools
L
R
L
R
L
R
Low
Level of activity
High

language

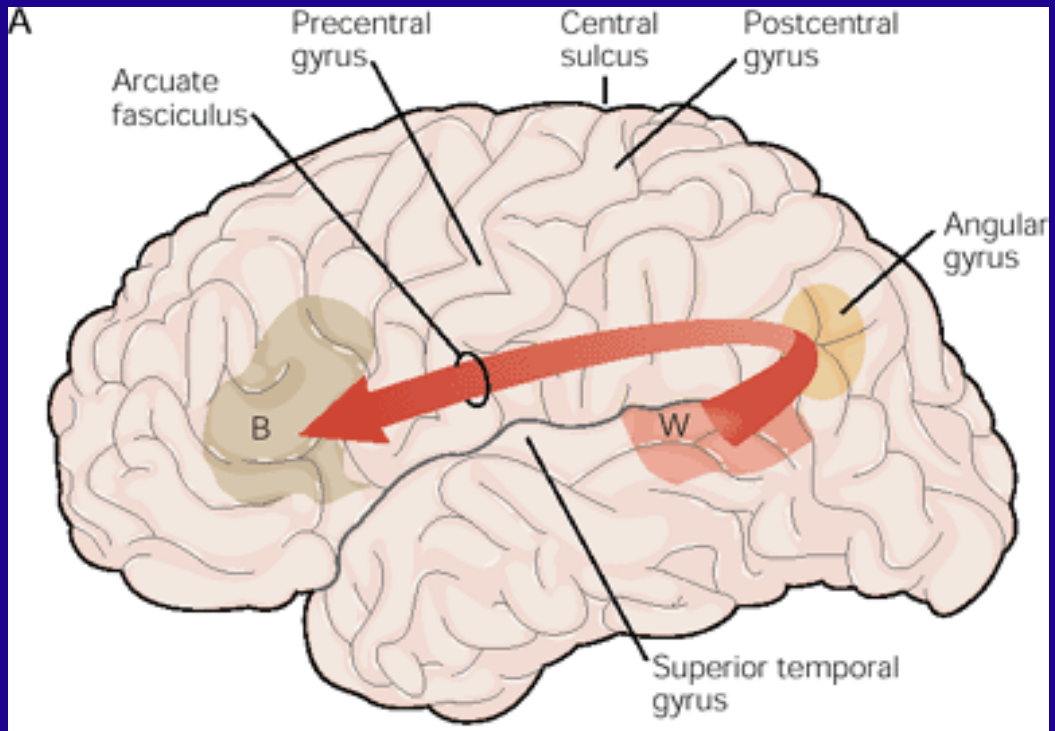


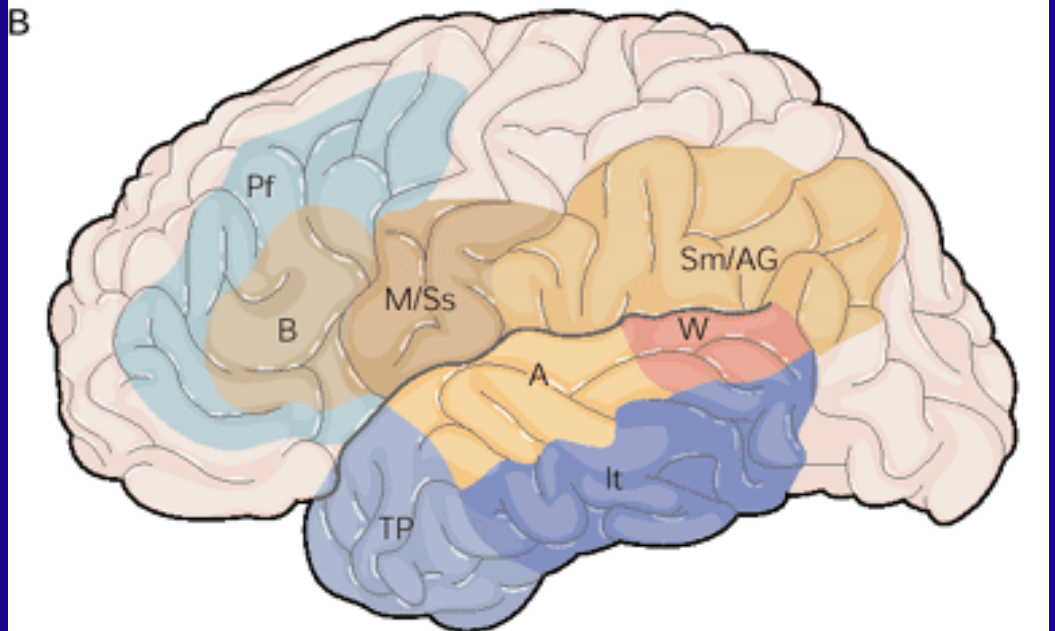
117

the implementation system

the mediation system

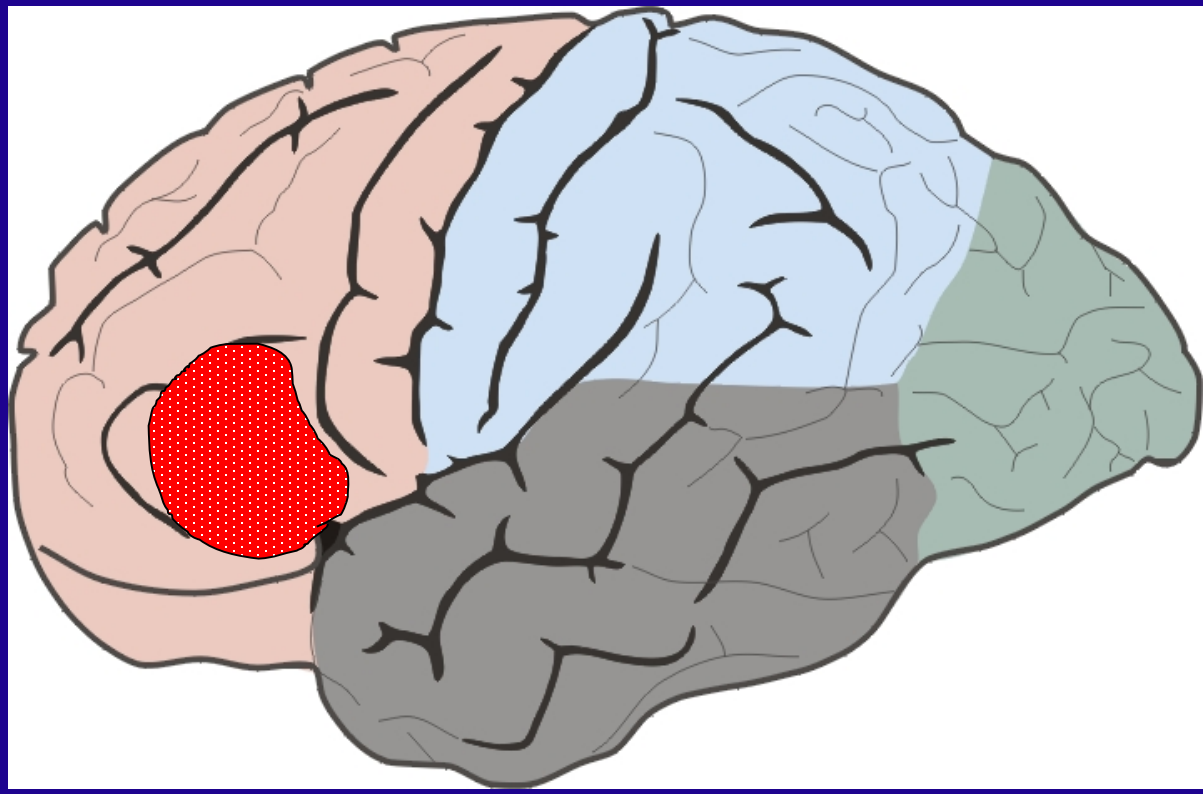
the conceptual system





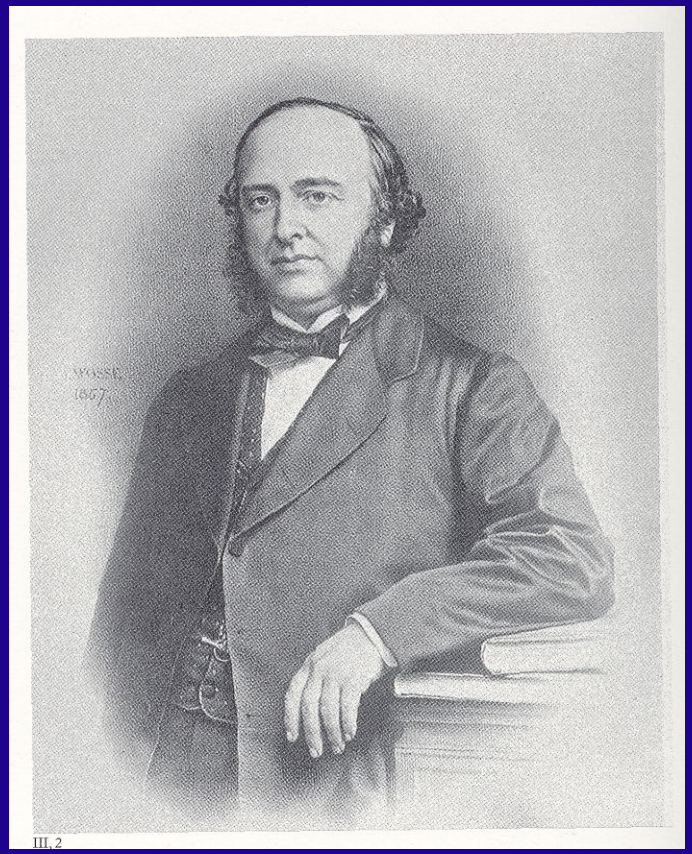
Broca Aphasia (Expressive aphasia)

Left hemisphere



Broca's aphasia - Sarah Scott - teenage stroke

http://www.youtube.com/watch?v=1aplTvEQ6ew



III, 2

Paul Broca

physician, anatomist, anthropologist

1824-1880

III, 3

L'Hopital Royal de Bicestre

Paris

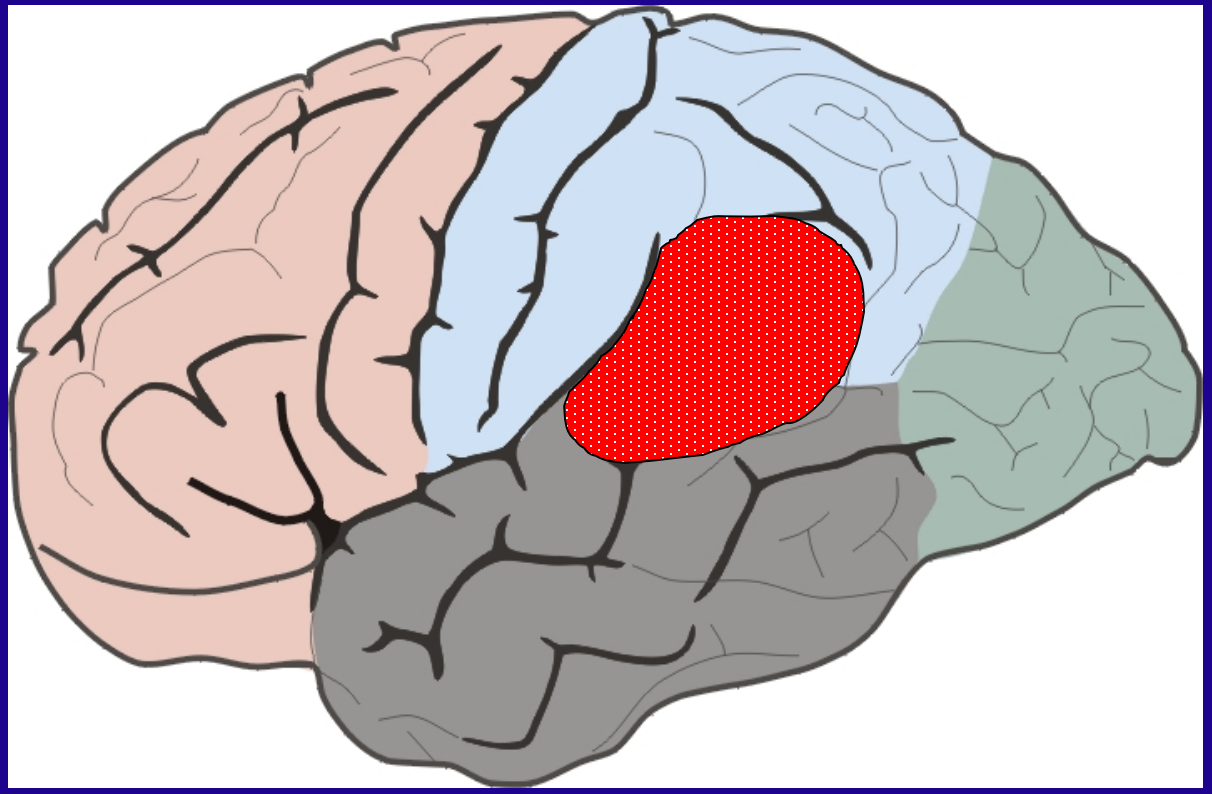
about 1750

Brain of “Tan” Leborgne

(for the last 20 years of his life,
the only word M. Leborgne could say was “tan”)

Wernicke Aphasia (Receptive aphasia)

Left hemisphere



Wernicke's Aphasia Interview with Amelia Carter

http://www.youtube.com/watch?v=UtadyCc_ybo

(right hemisphere)

Prosody of speech

(right hemisphere)

Plans for Action

(prefrontal cortex)

Functions of the prefrontal cortex:

1) Planning

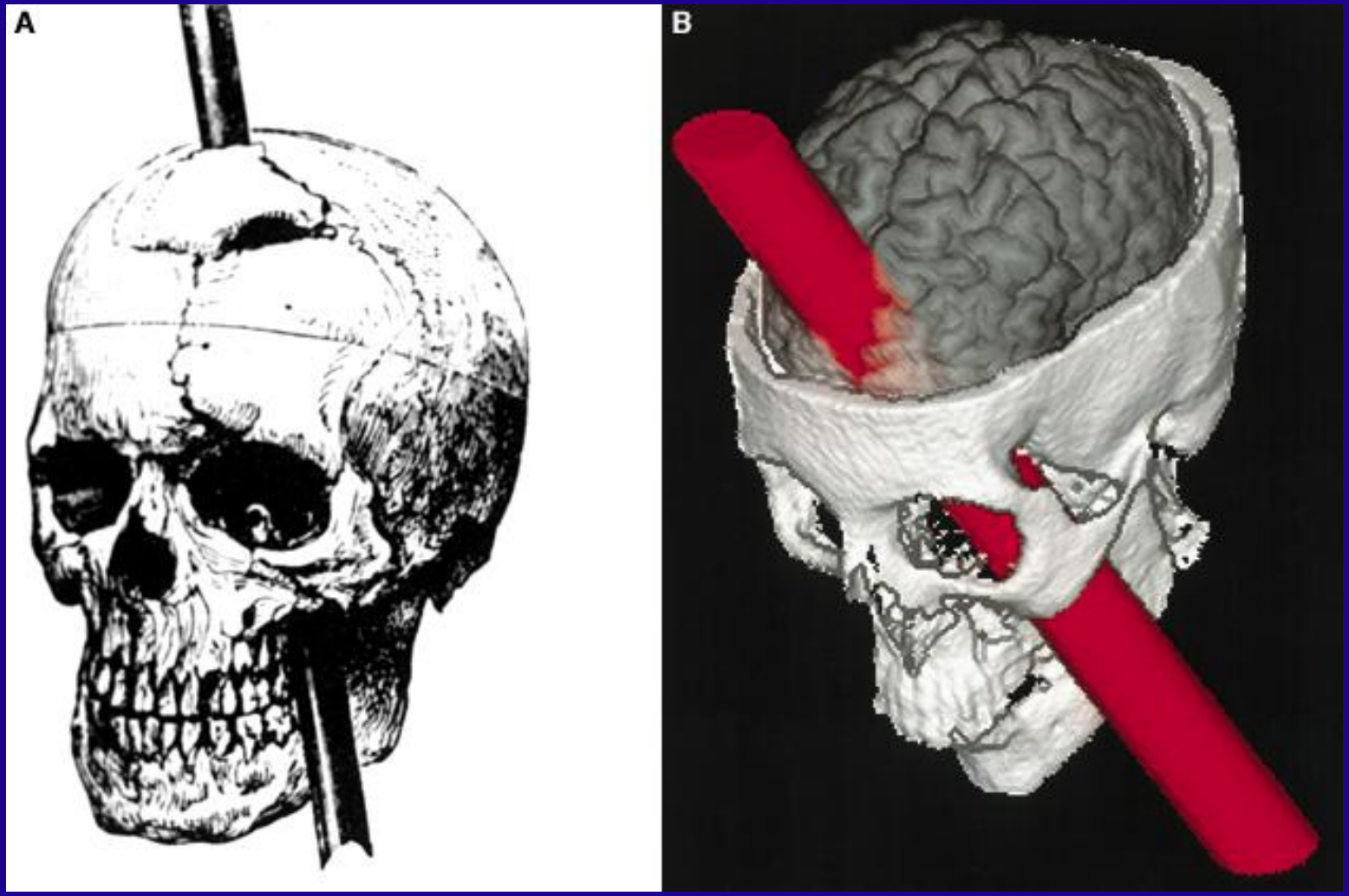
This is the area where volition, thinking ahead, problem solving are located. Before you can have these, and do them flexibly, fluently, adaptively, have to inhibit more primitive, automatic, instinctive behavior patterns; hence

↓

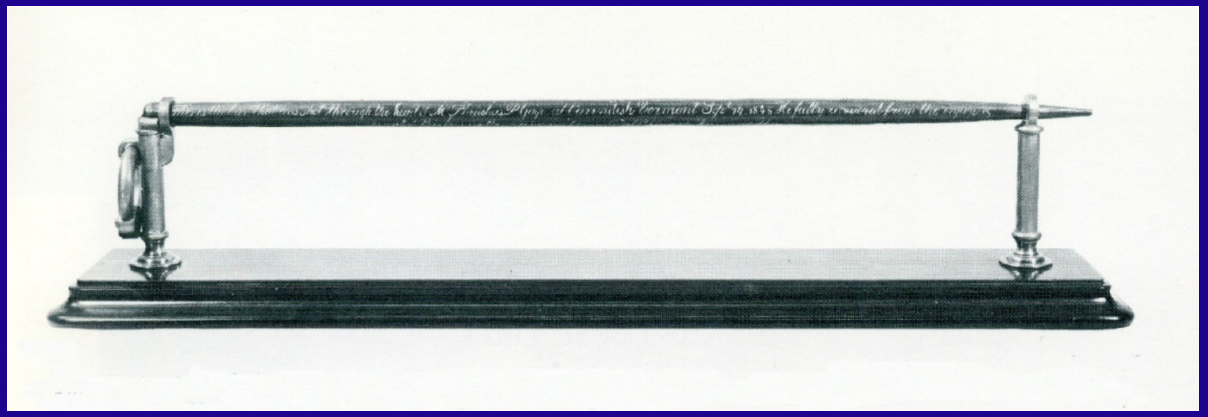
2) Inhibition

3) Selectivity

‘I will do this, I will not do that’


A
B

Phineas Gage




Skull of Phineas Gage

Prefrontal Cortex Damage:

- Lack of foresight
- Frequent stubbornness
- Inattentive and moody
- Lack of ambitions, sense of responsibility, sense of propriety (rude)
- Less creative and unable to plan forthe future

Pay attention to

- Drugs

Akinetopsia From Nefazodone Toxicity

Jonathan C. Horton, MD, PhD, and
Jonathan D. Trobe, MD

Pay attention to

- Drugs
- Transient problems (CO)

Aust N Z J Ophthalmol. 1996 May;24(2):137-41.

Disturbance of central vision after carbon monoxide poisoning.

Fine RD[1], Parker GD.

Pay attention to

- Drugs
- Transient problems (CO)
- Chronic problems (alcohol)

Pay attention to

- Drugs
- Transient problems (CO)
- Chronic problems (alcohol)
- MS

Case report

Alexia without agraphia in multiple sclerosis: case report with magnetic resonance imaging localization

*Yang Mao-Draayer and Hillel Panitch**
Department of Neurology, University of Vermont College of Medicine, Burlington, VT, USA

Pay attention to

- Drugs
- Transient problems (CO)
- Chronic problems (alcohol)
- MS
- Degeneration (Alzheimer)