Object Recognition

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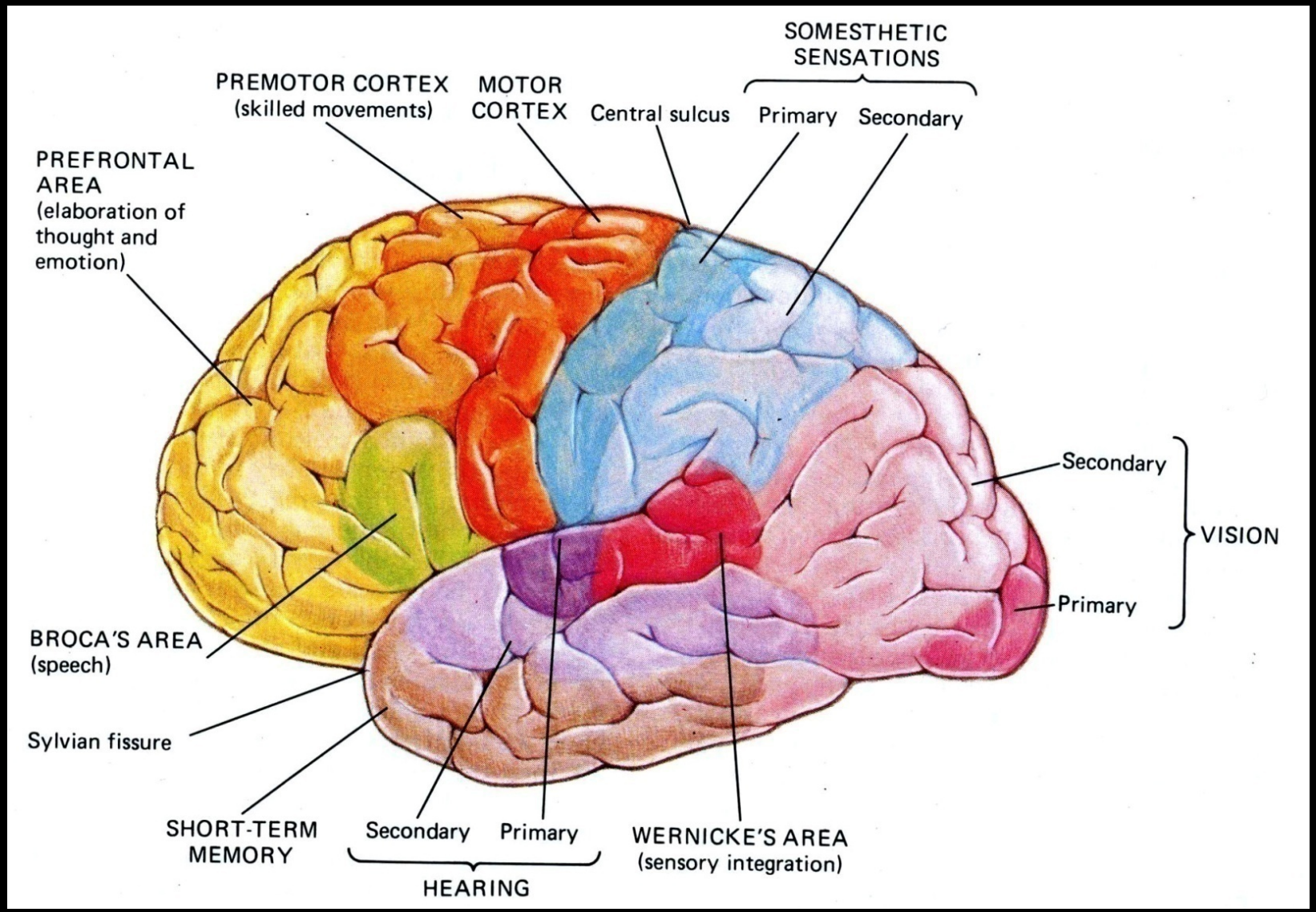
Introduction



Relationship between object recognition and multisensory integration

- Independent sources of information about the world

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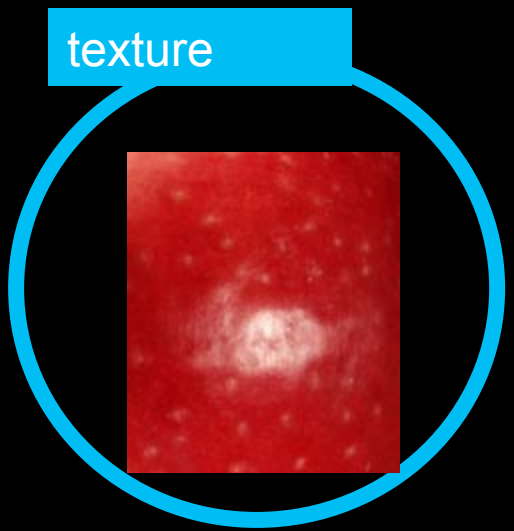
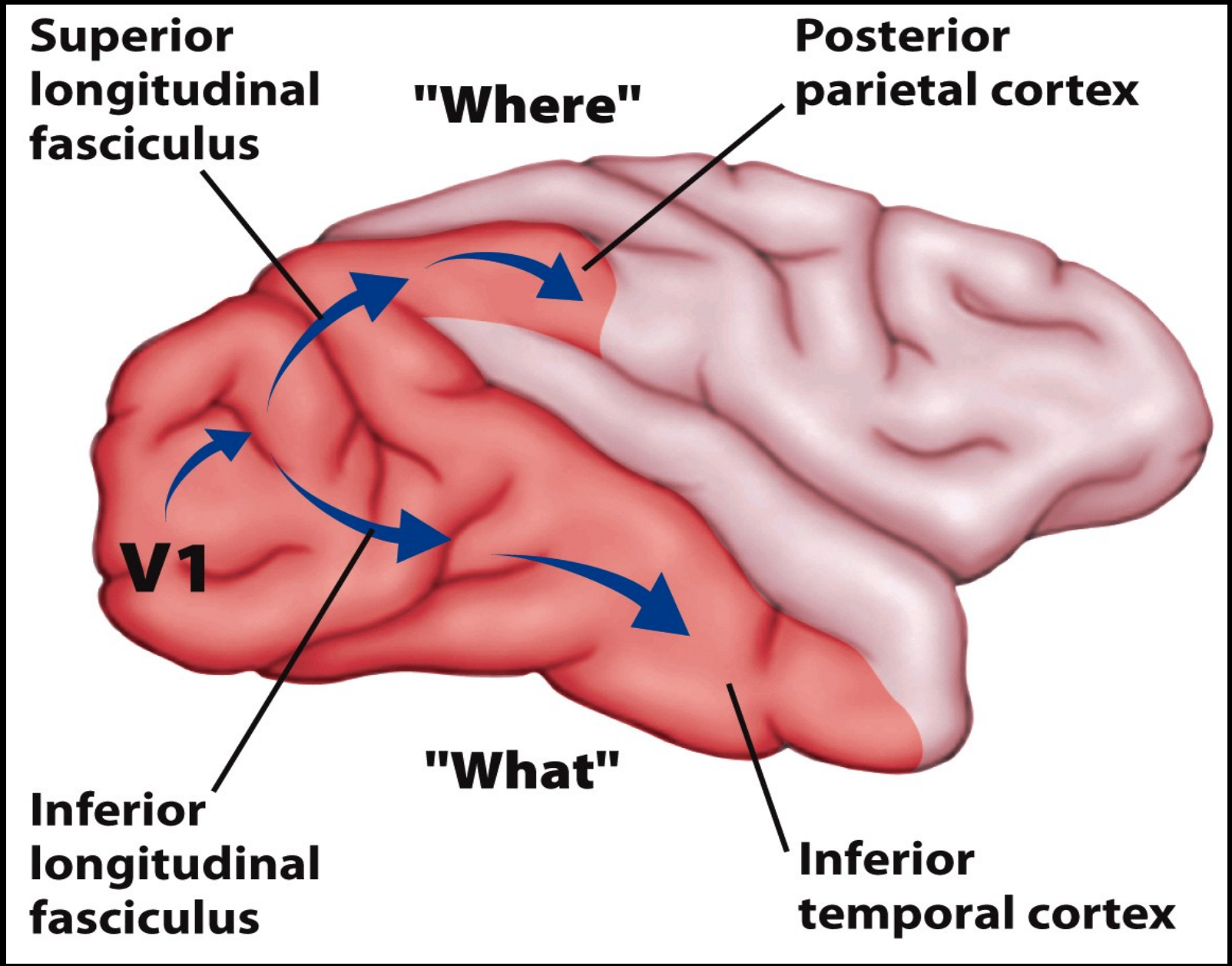
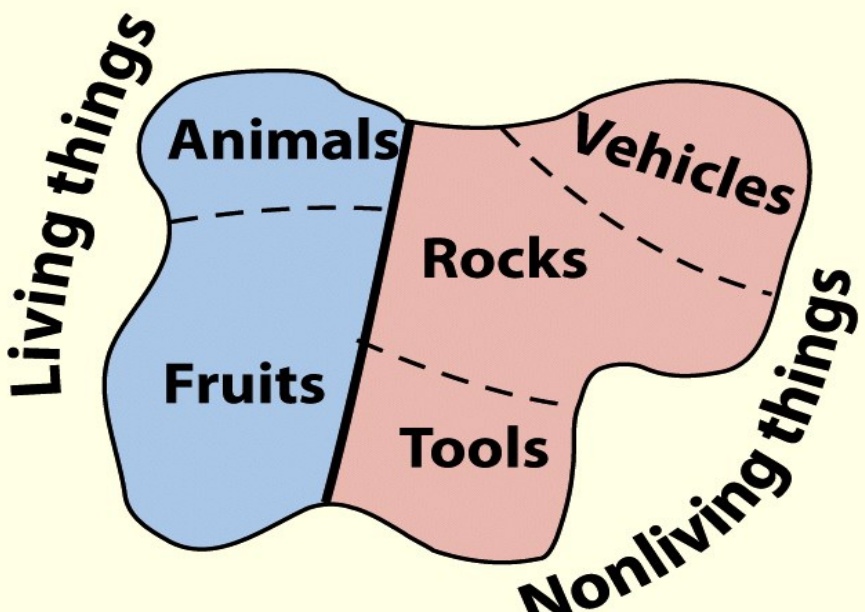
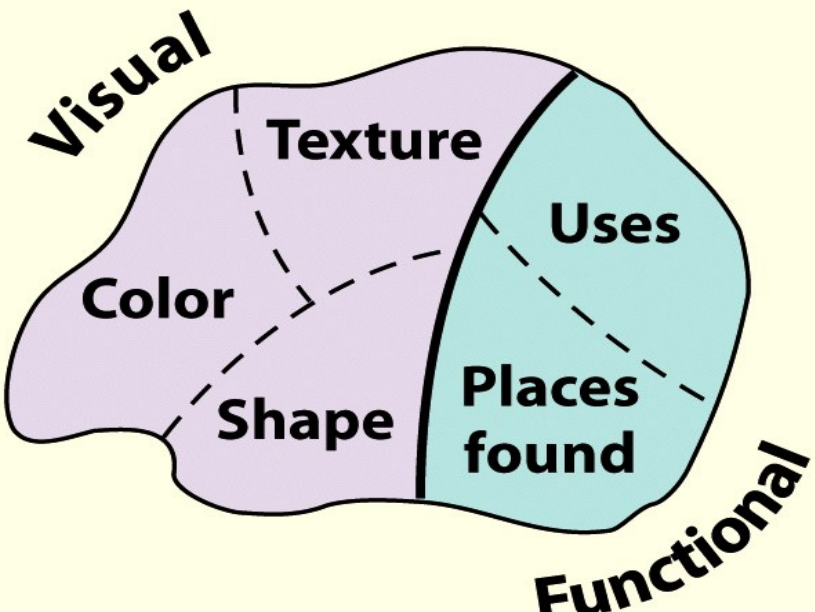



Superior
longitudinal
fasciculus
"Where"
Posterior
parietal cortex
V1
"What"
Inferior
longitudinal
fasciculus
Inferior
temporal cortex

Category-based organization



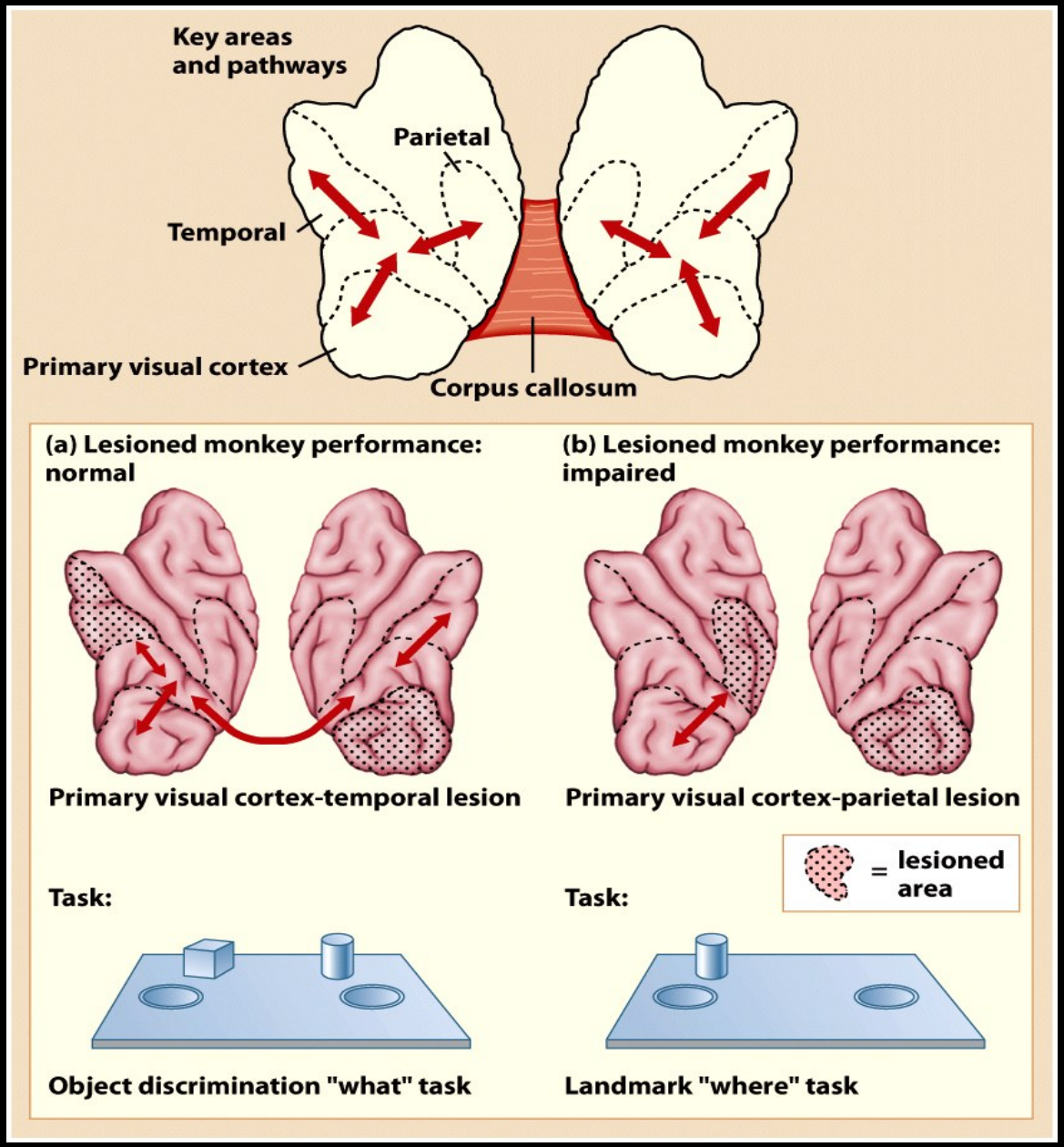
Property-based organization

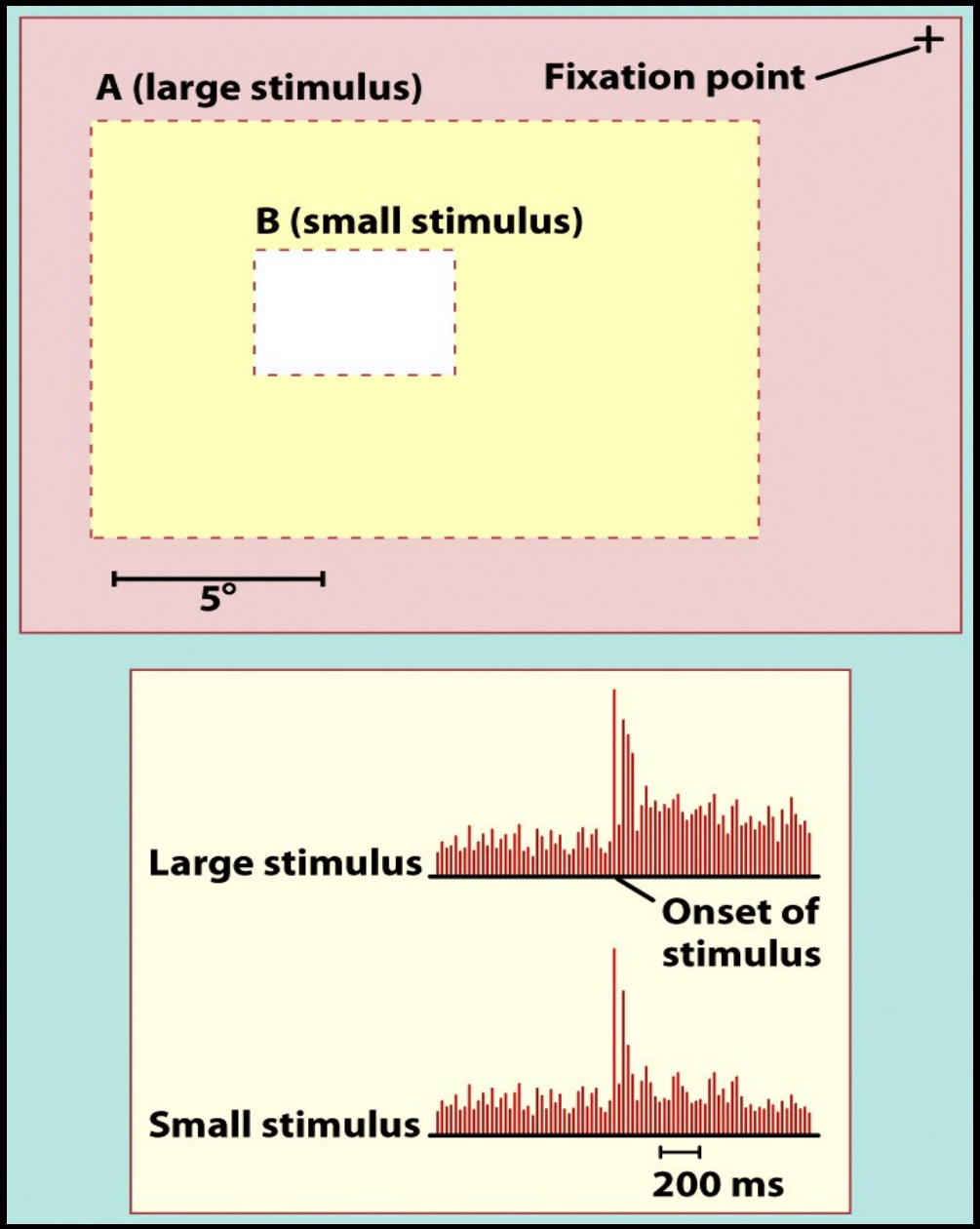


It's a telephone ?
60
5
10
15
20
25
30
35
40
45
50
55

GENUINE HICKORY

GS
GENUINE HICKORY


Key areas and pathways
Parietal
Temporal
Primary visual cortex
Corpus callosum
(a) Lesioned monkey performance: normal
(b) Lesioned monkey performance: impaired
Primary visual cortex-temporal lesion
Primary visual cortex-parietal lesion
= lesioned area
Task:
Task:
Object discrimination "what" task
Landmark "where" task


A (large stimulus)
Fixation point
B (small stimulus)
5°
Large stimulus
Onset of stimulus
Small stimulus
200 ms

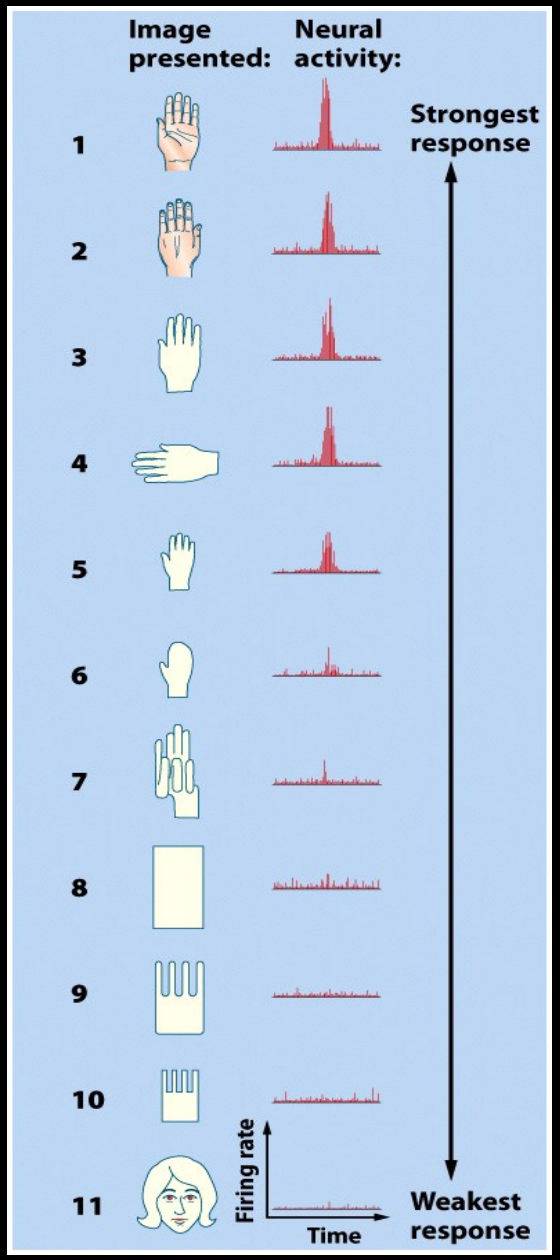
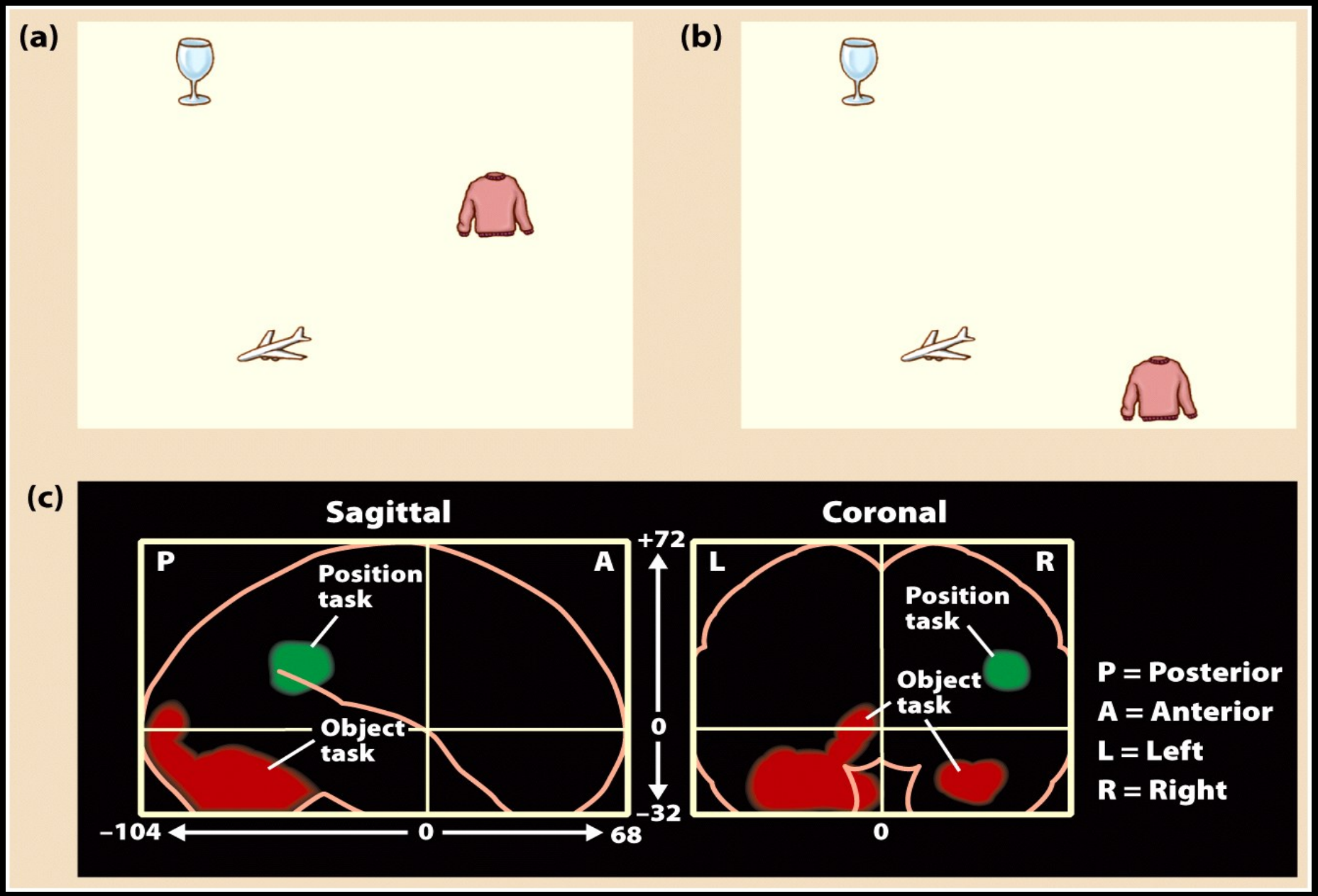
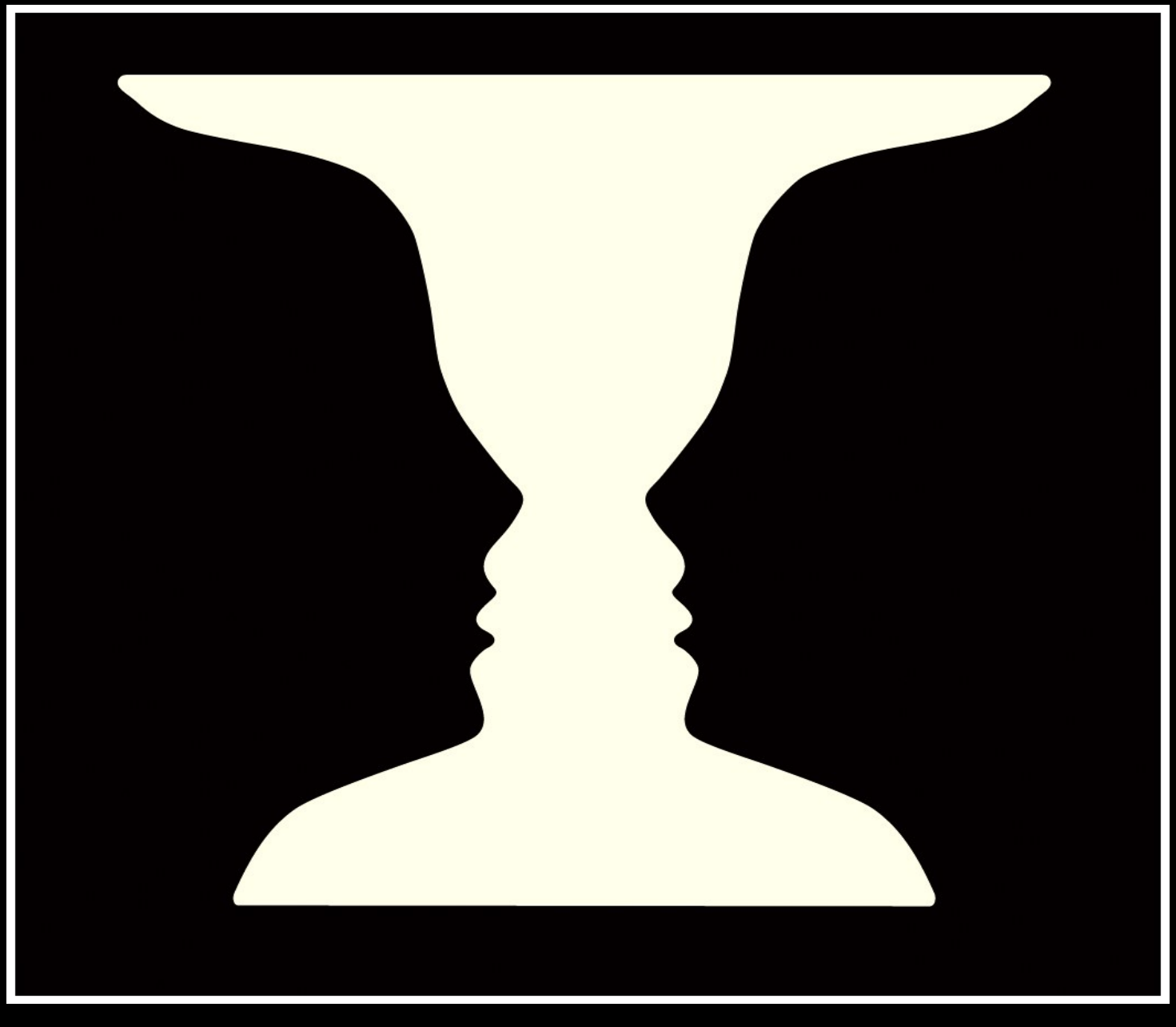
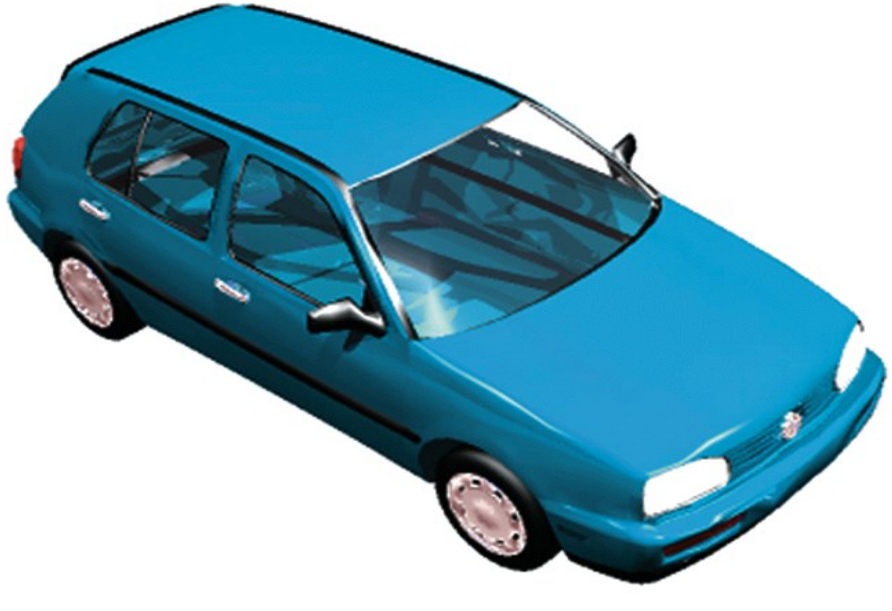
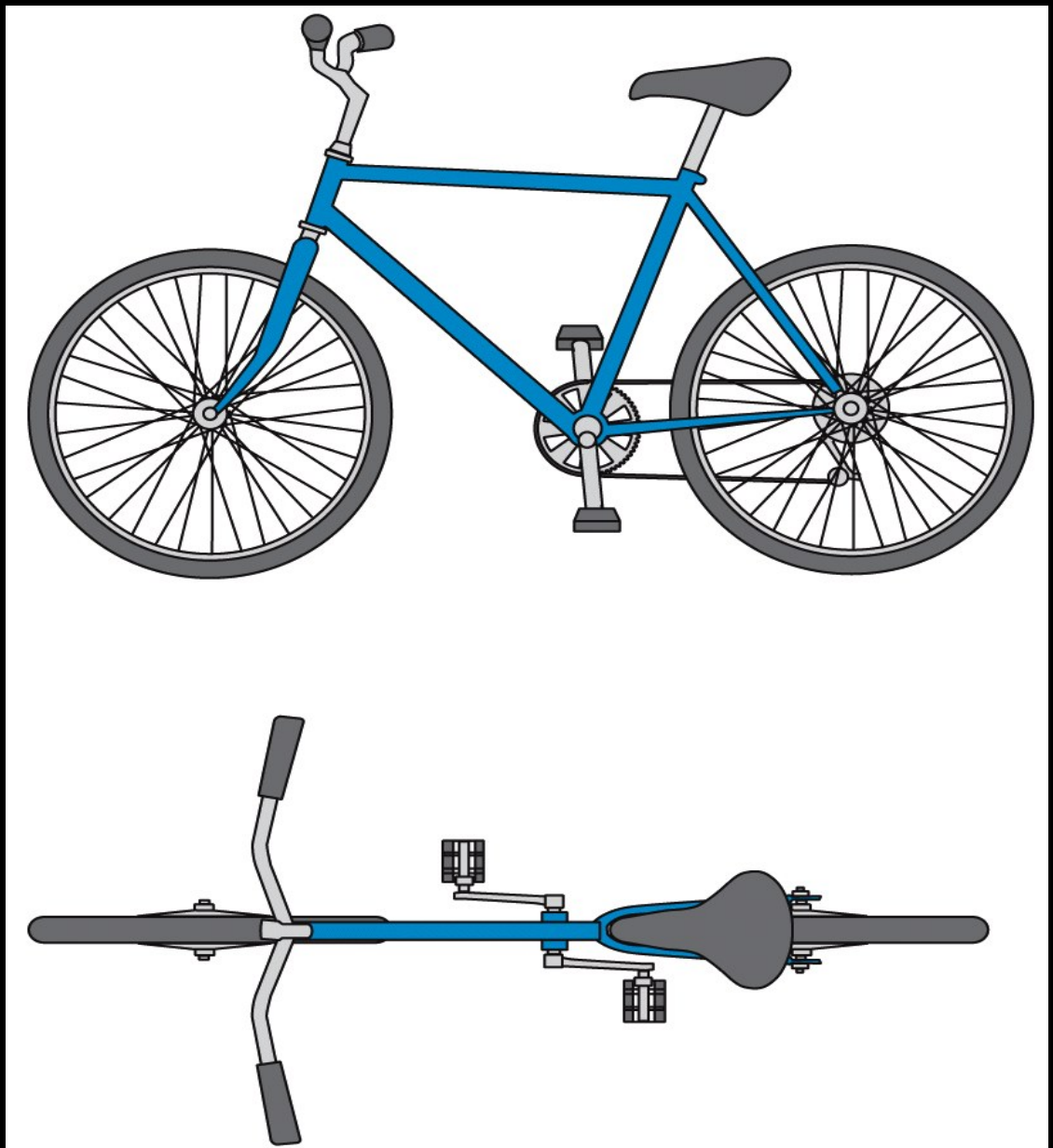


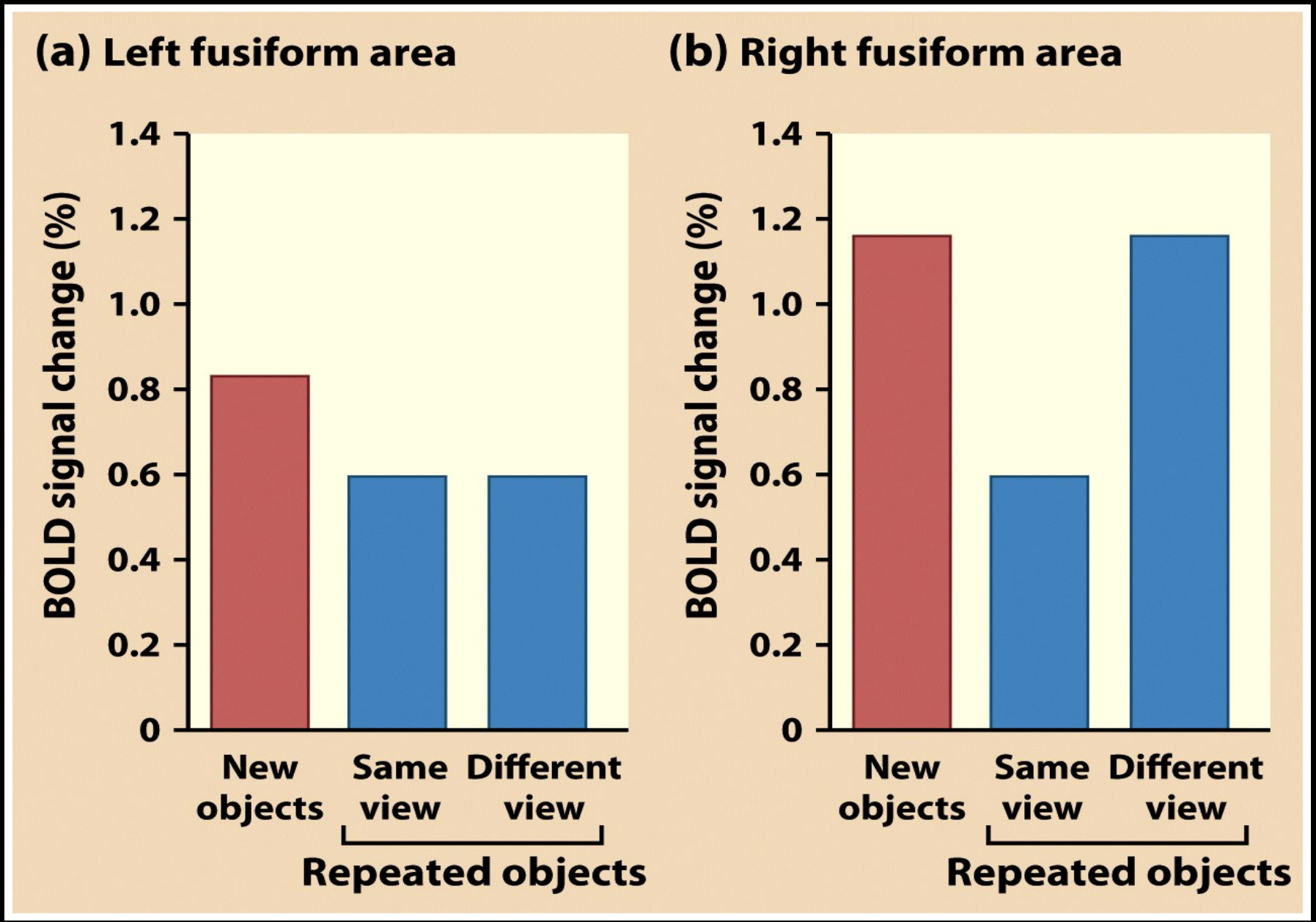
Image presented:
Neural activity:
1
2
3
4
5
6
7
8
9
10
11
Strongest response
Weakest response
Firing rate
Time

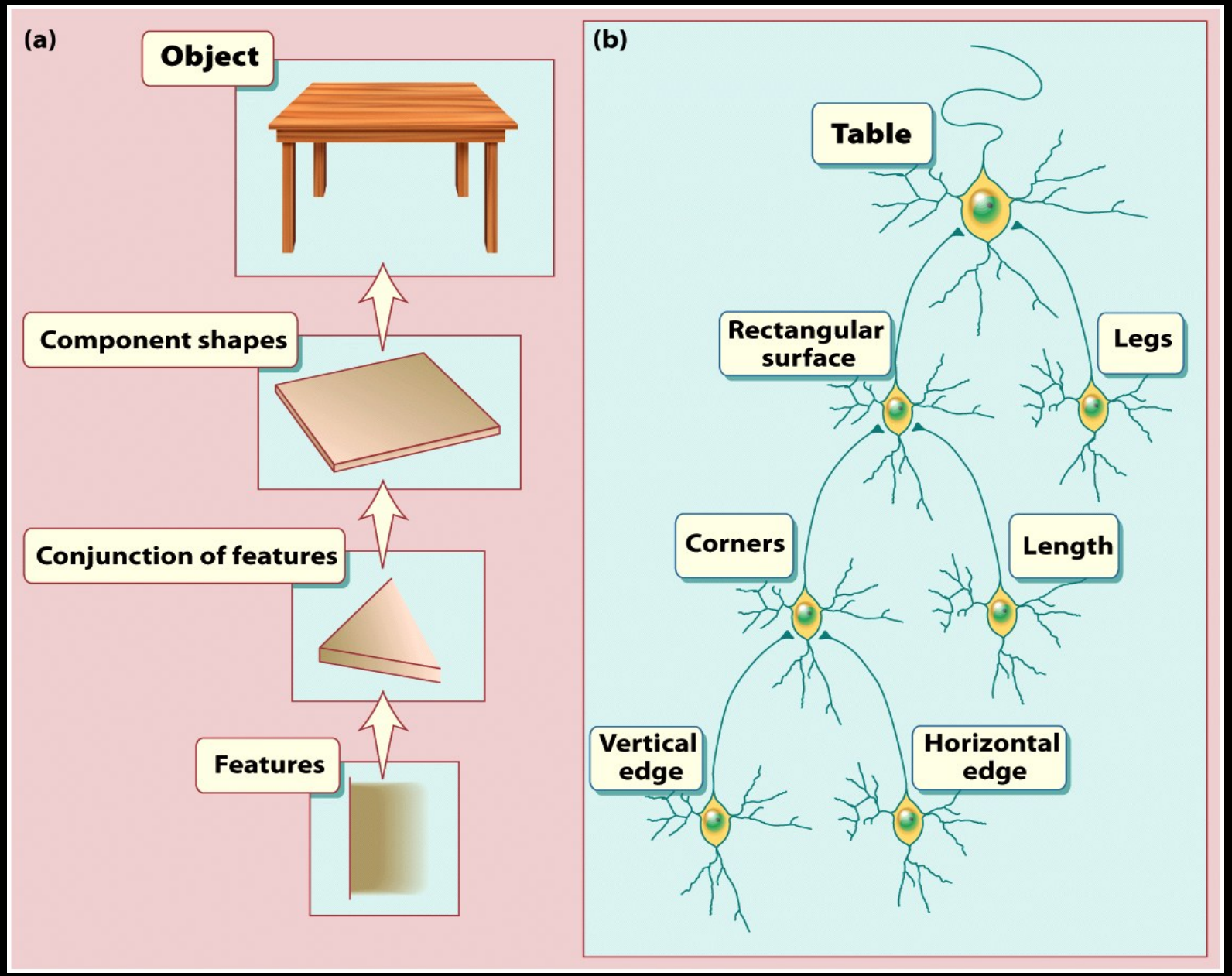

(a)
(b)
(c)
Sagittal
Coronal
P
A
L
R
Position task
Object task
+72
0
−32
−104
0
68
0
P = Posterior
A = Anterior
L = Left
R = Right

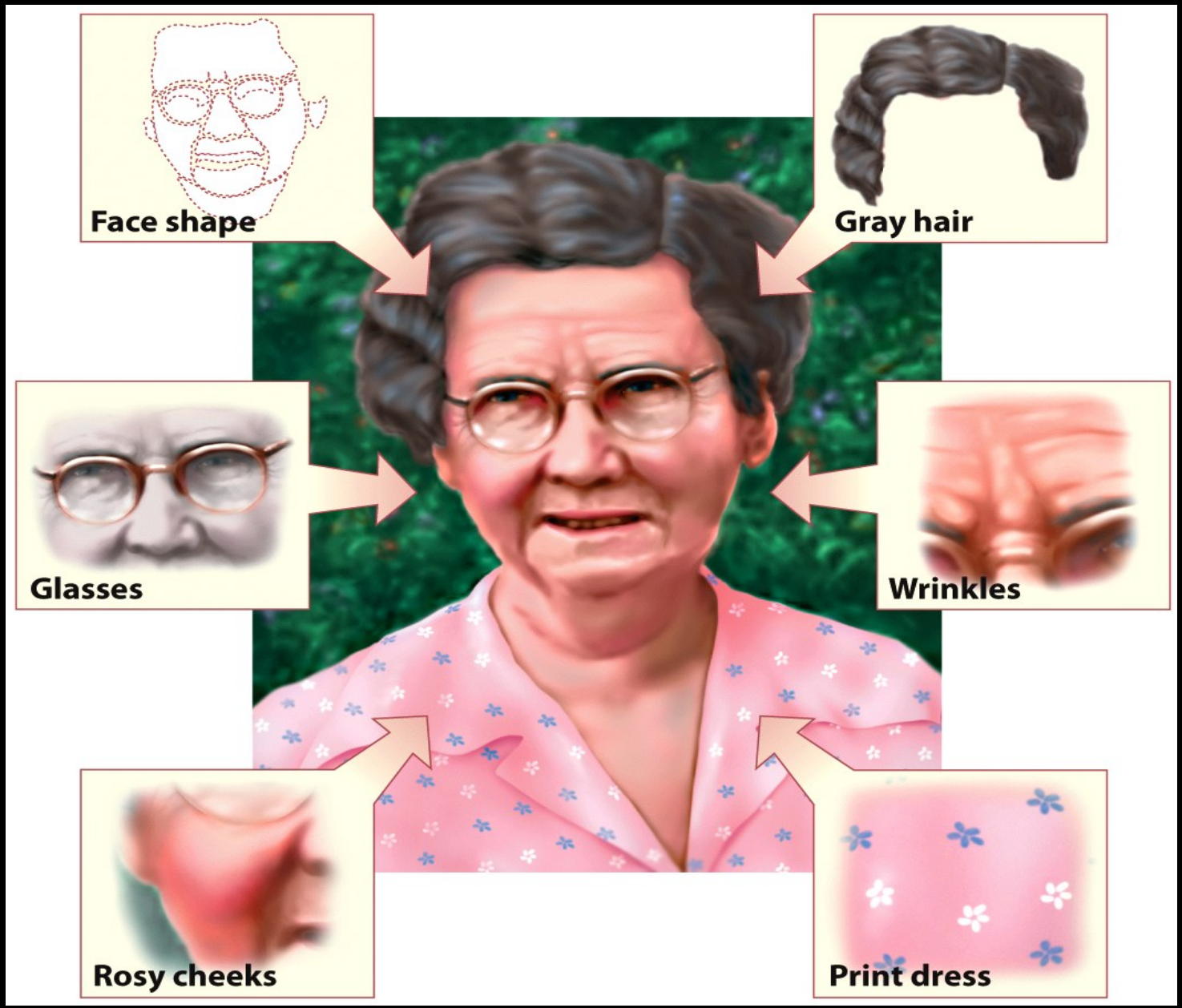


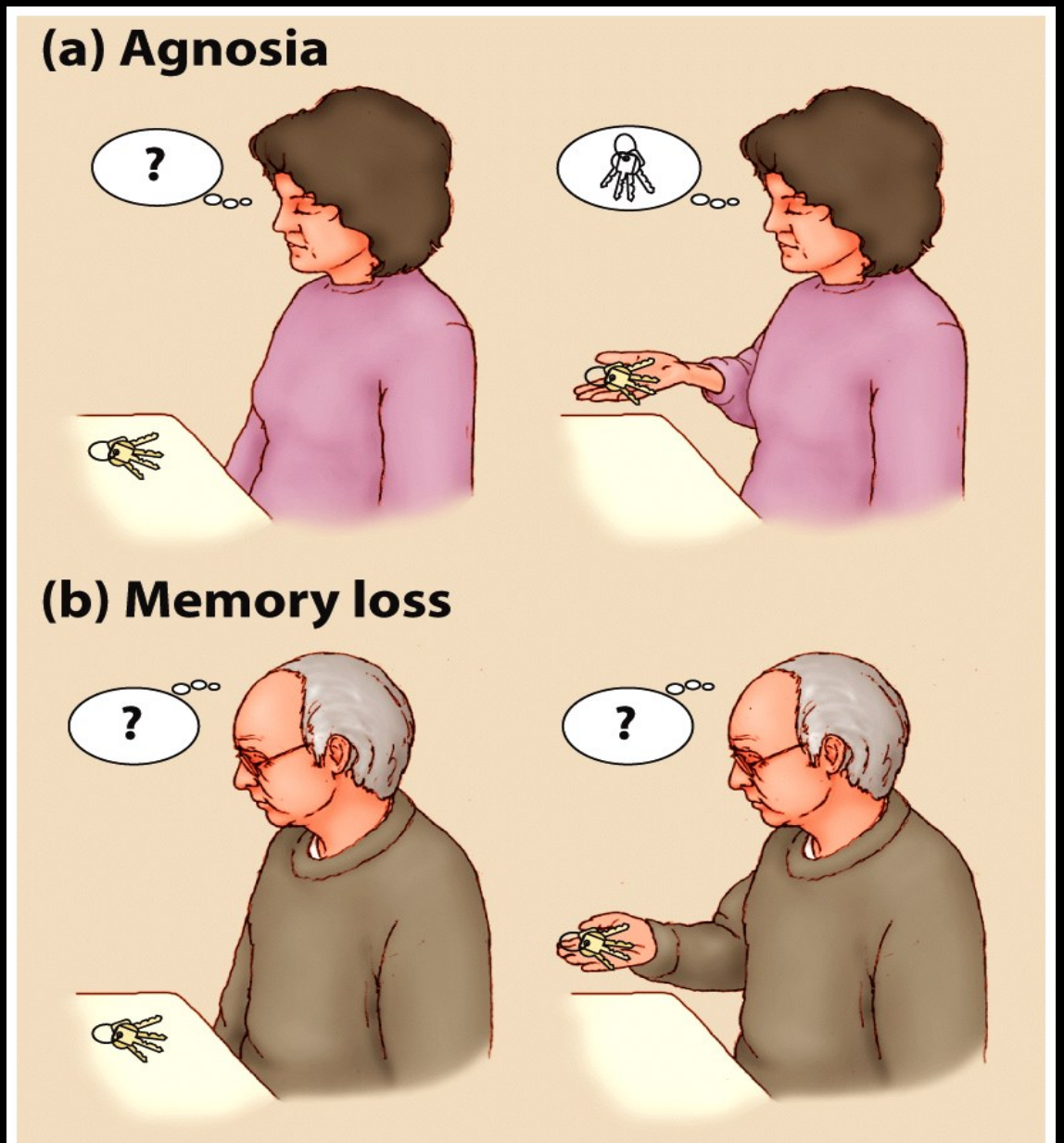


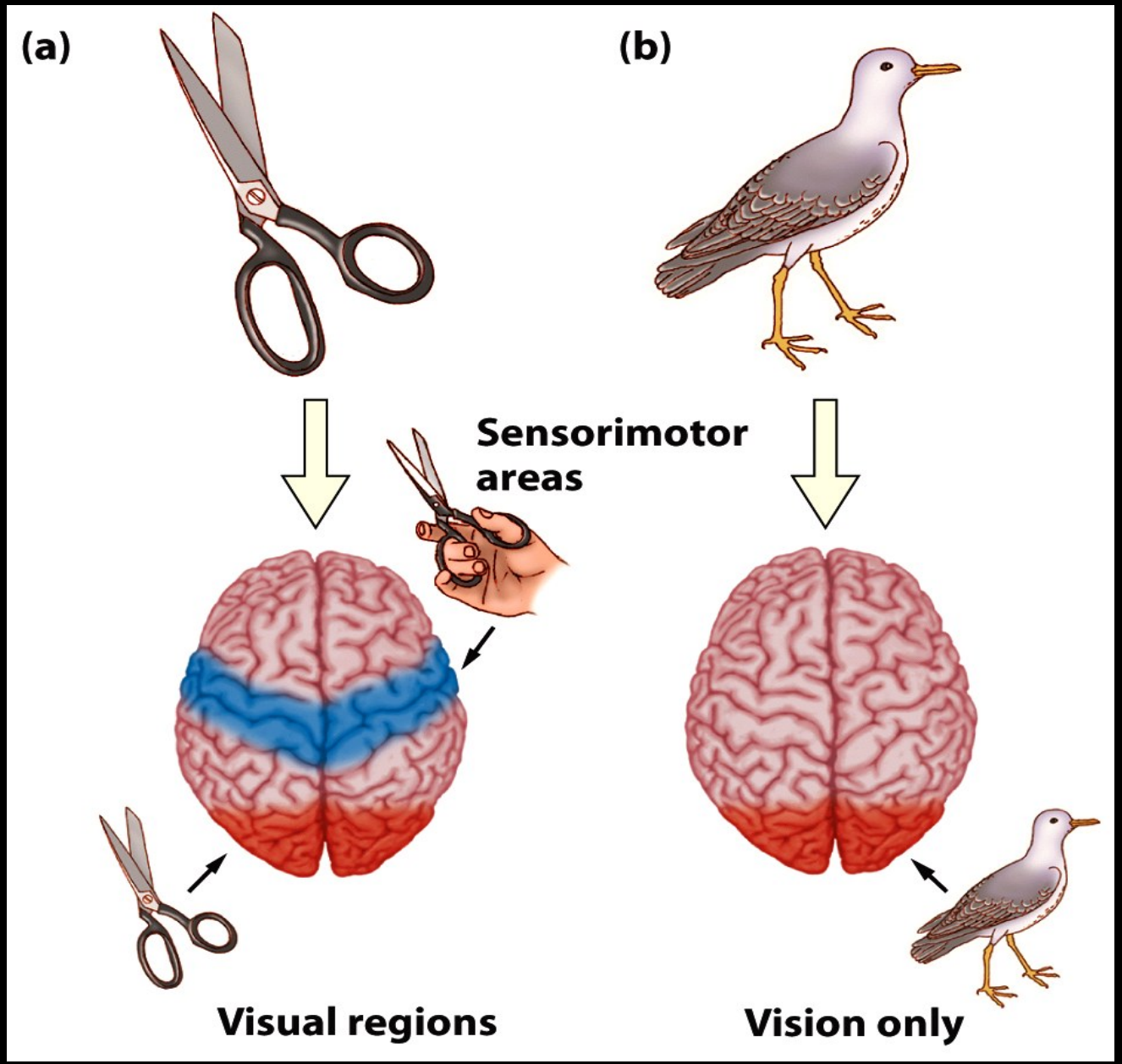


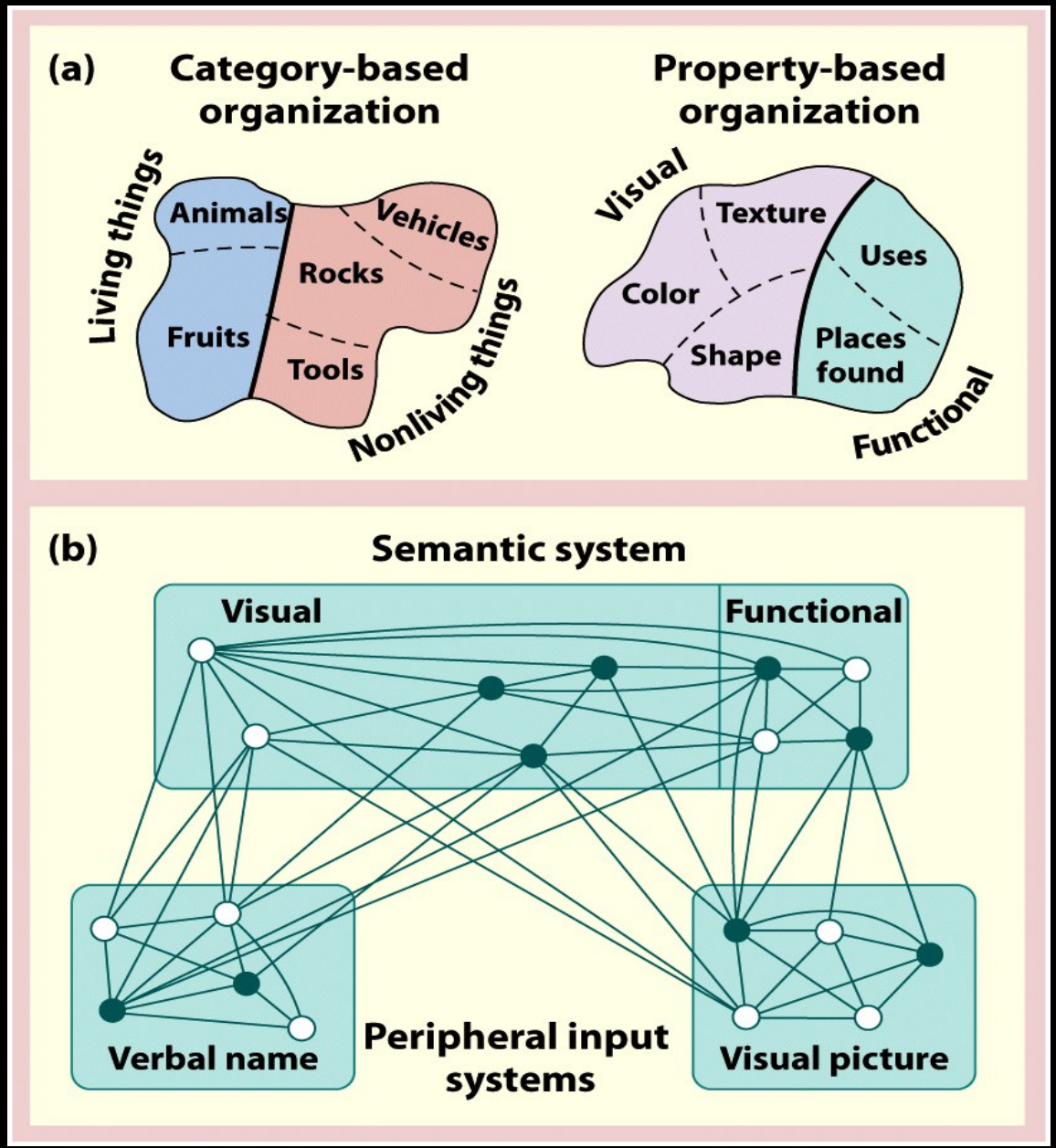

(a) Left fusiform area
BOLD signal change (%)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
New objects
Same view
Different view
Repeated objects
(b) Right fusiform area
BOLD signal change (%)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
New objects
Same view
Different view
Repeated objects


(a)
Object
Component shapes
Conjunction of features
Features
(b)
Table
Rectangular surface
Legs
Corners
Length
Vertical edge
Horizontal edge

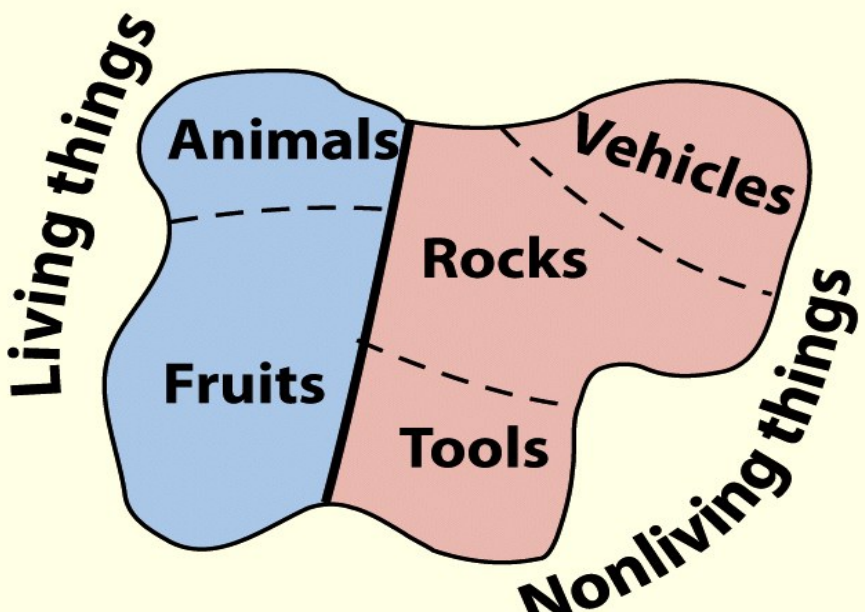

Face shape
Gray hair
Glasses
Wrinkles
Rosy cheeks
Print dress


(a) Agnosia
?
(b) Memory loss
?
?

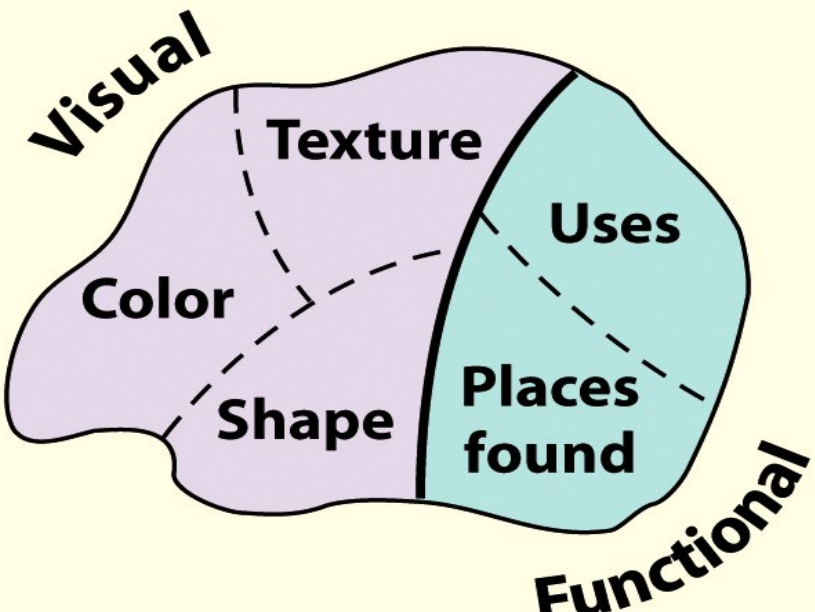

(a)
(b)
Sensorimotor areas
Visual regions
Vision only

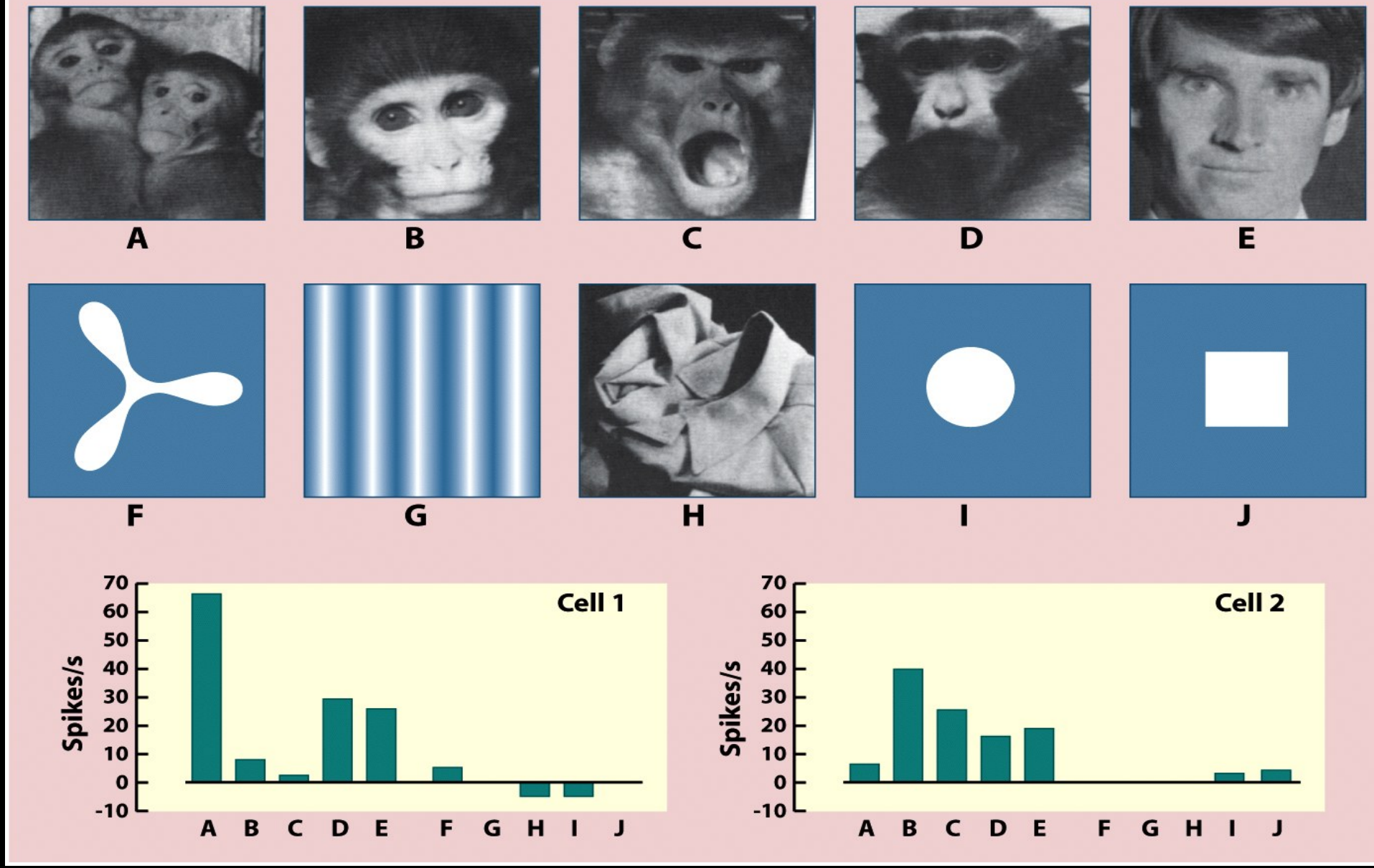

(a)
Category-based organization
Property-based organization
Living things
Animals
Vehicles
Rocks
Fruits
Tools
Nonliving things
Visual
Texture
Uses
Color
Shape
Places found
Functional
(b)
Semantic system
Visual
Functional
Verbal name
Peripheral input systems
Visual picture

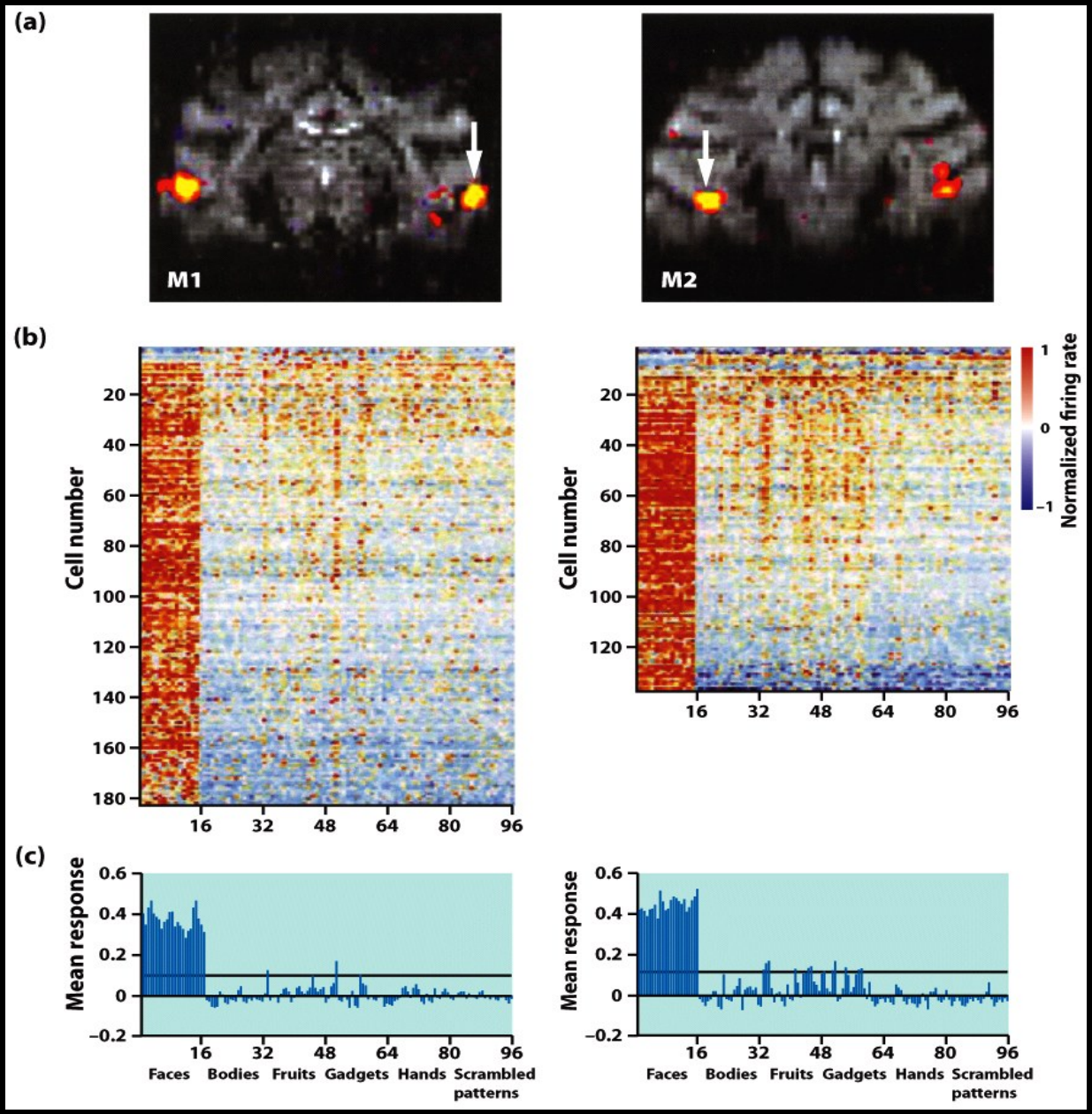
Category-based organization

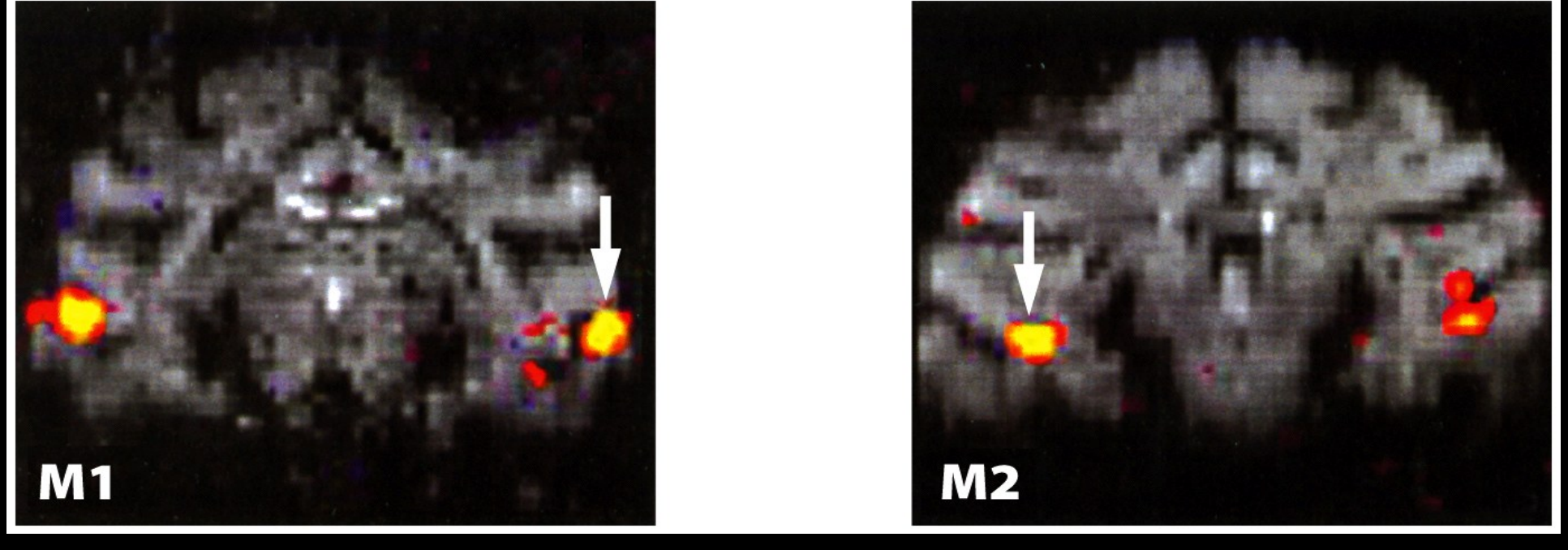


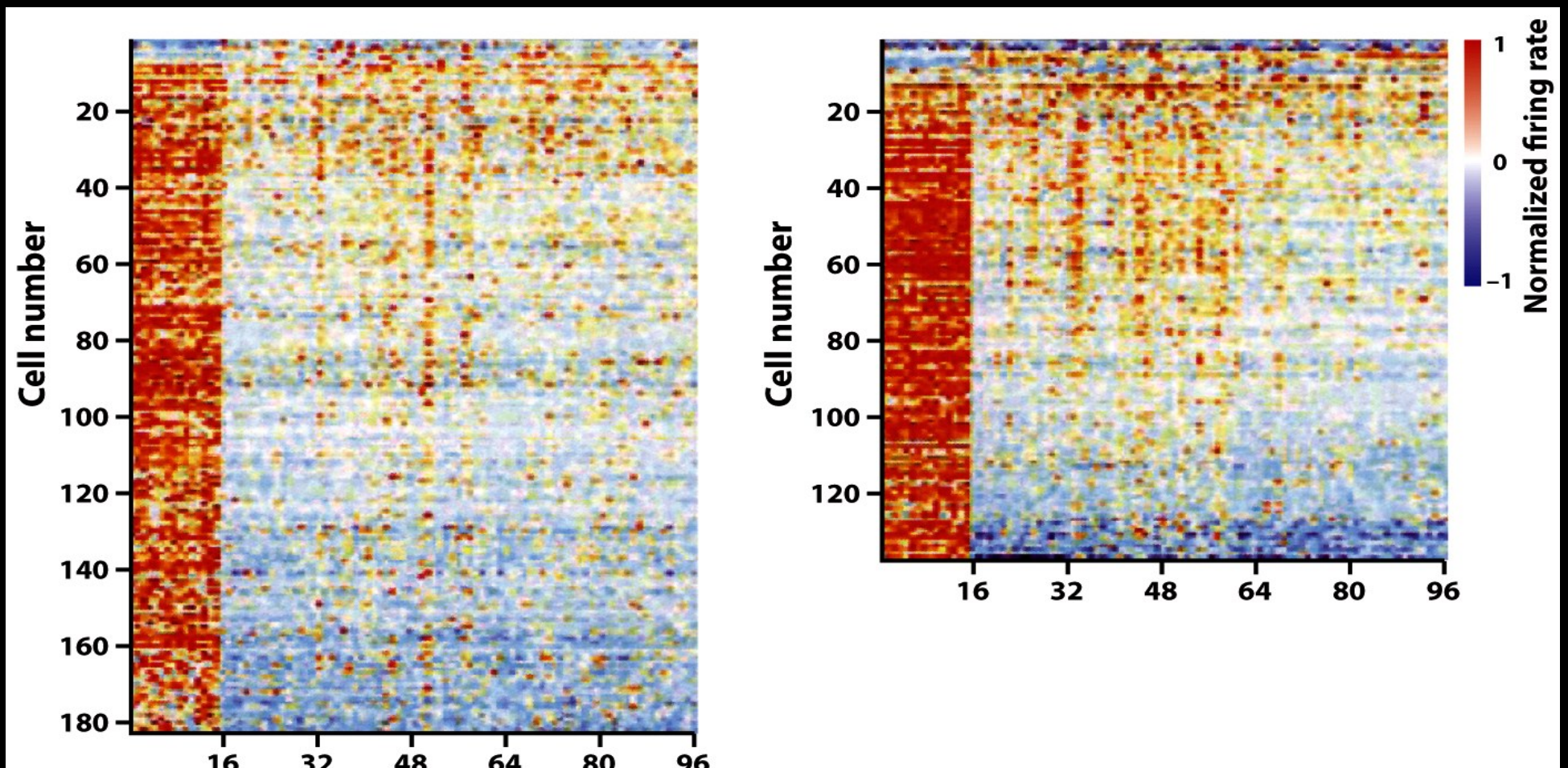
Property-based organization

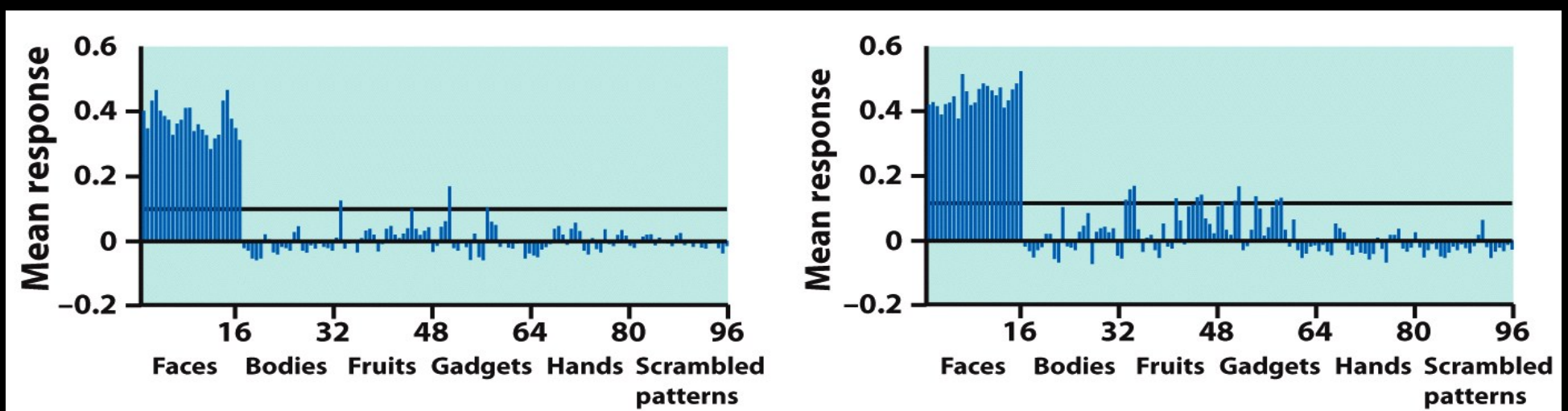



A
B
C
D
E
F
G
H
I
J
Cell 1
Spikes/s
70
60
50
40
30
20
10
0
-10
A B C D E F G H I J
Cell 2
Spikes/s
70
60
50
40
30
20
10
0
-10
A B C D E F G H I J


(a)
M1
M2
(b)
Cell number
20
40
60
80
100
120
140
160
180
16
32
48
64
80
96
Normalized firing rate
1
0
−1
(c)
Mean response
0.6
0.4
0.2
0
−0.2
Faces
Bodies
Fruits
Gadgets
Hands
Scrambled patterns


M1
M2


Cell number
20
40
60
80
100
120
140
160
180
16
32
48
64
80
96
Cell number
20
40
60
80
100
120
16
32
48
64
80
96
1
0
−1
Normalized firing rate


Mean response
0.6
0.4
0.2
0
−0.2
16
32
48
64
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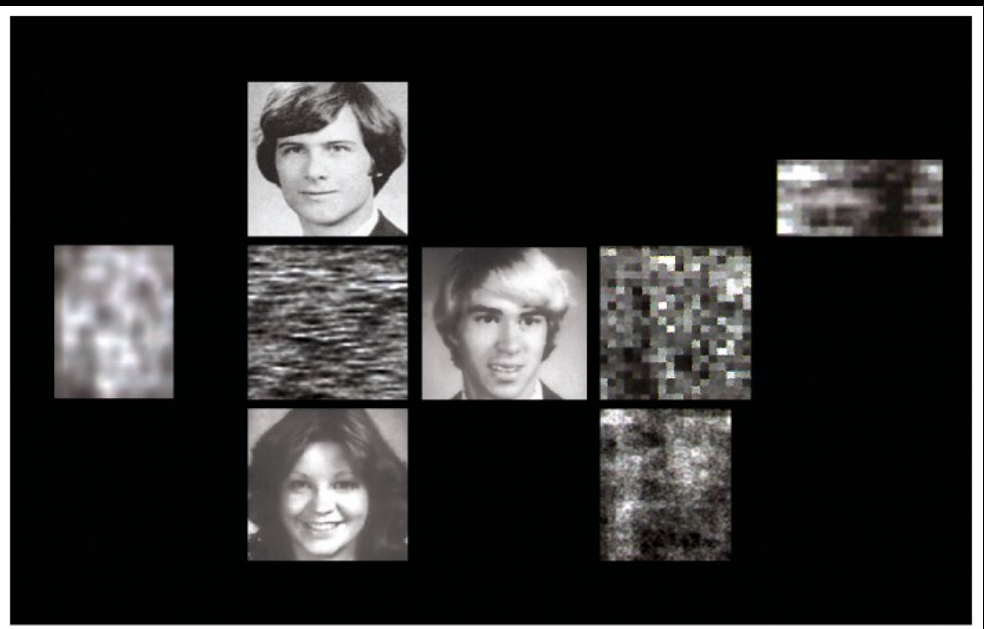
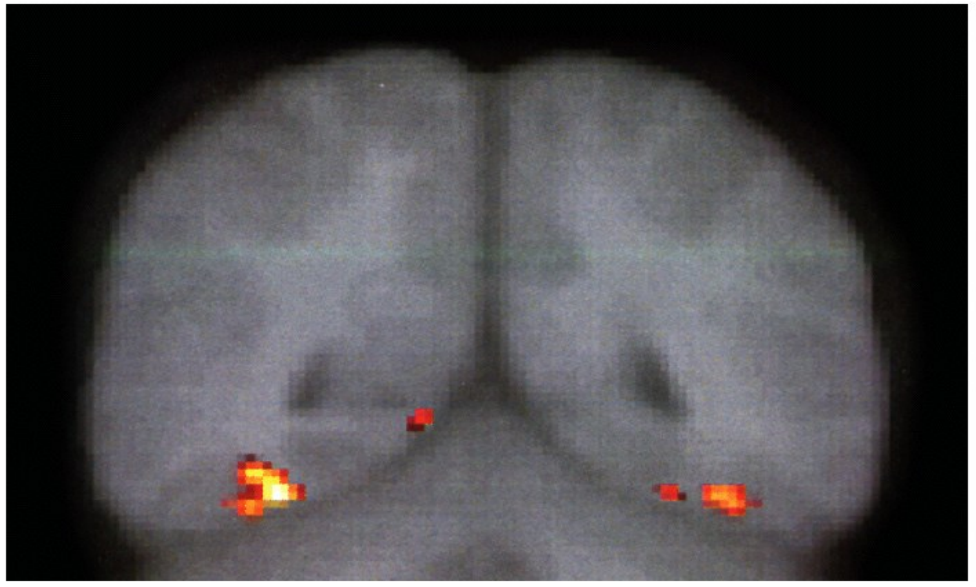
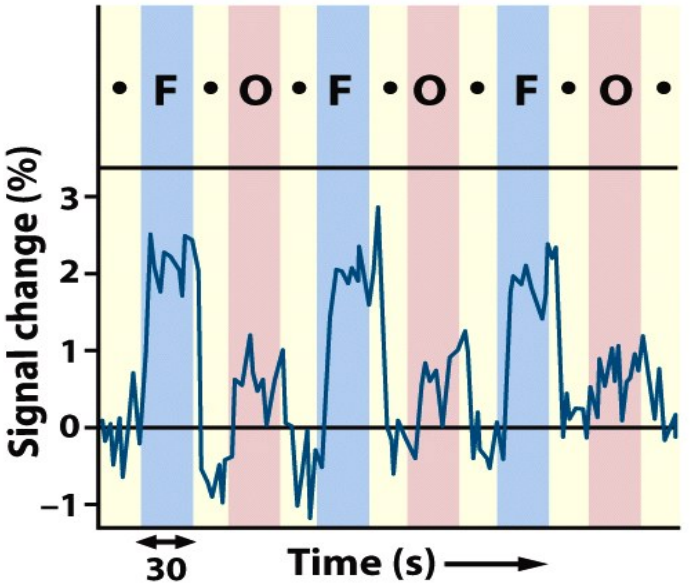
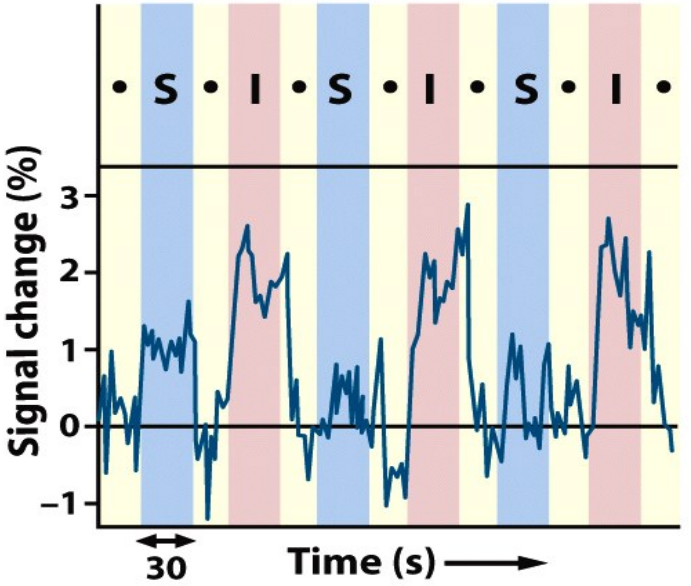




Faces > Objects



Intact faces > Scrambled faces