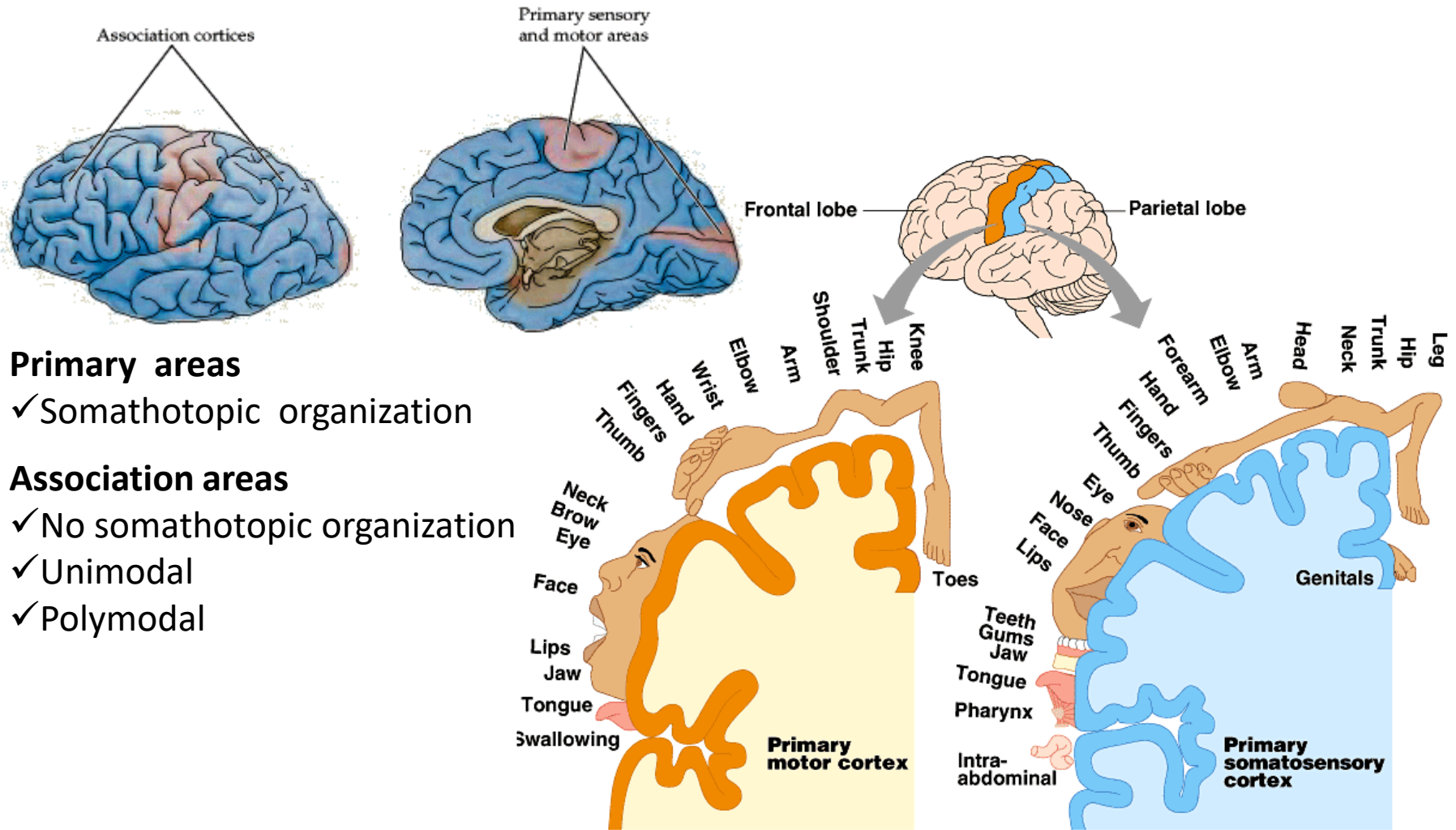


17

Neocortex I

Cerebral cortex



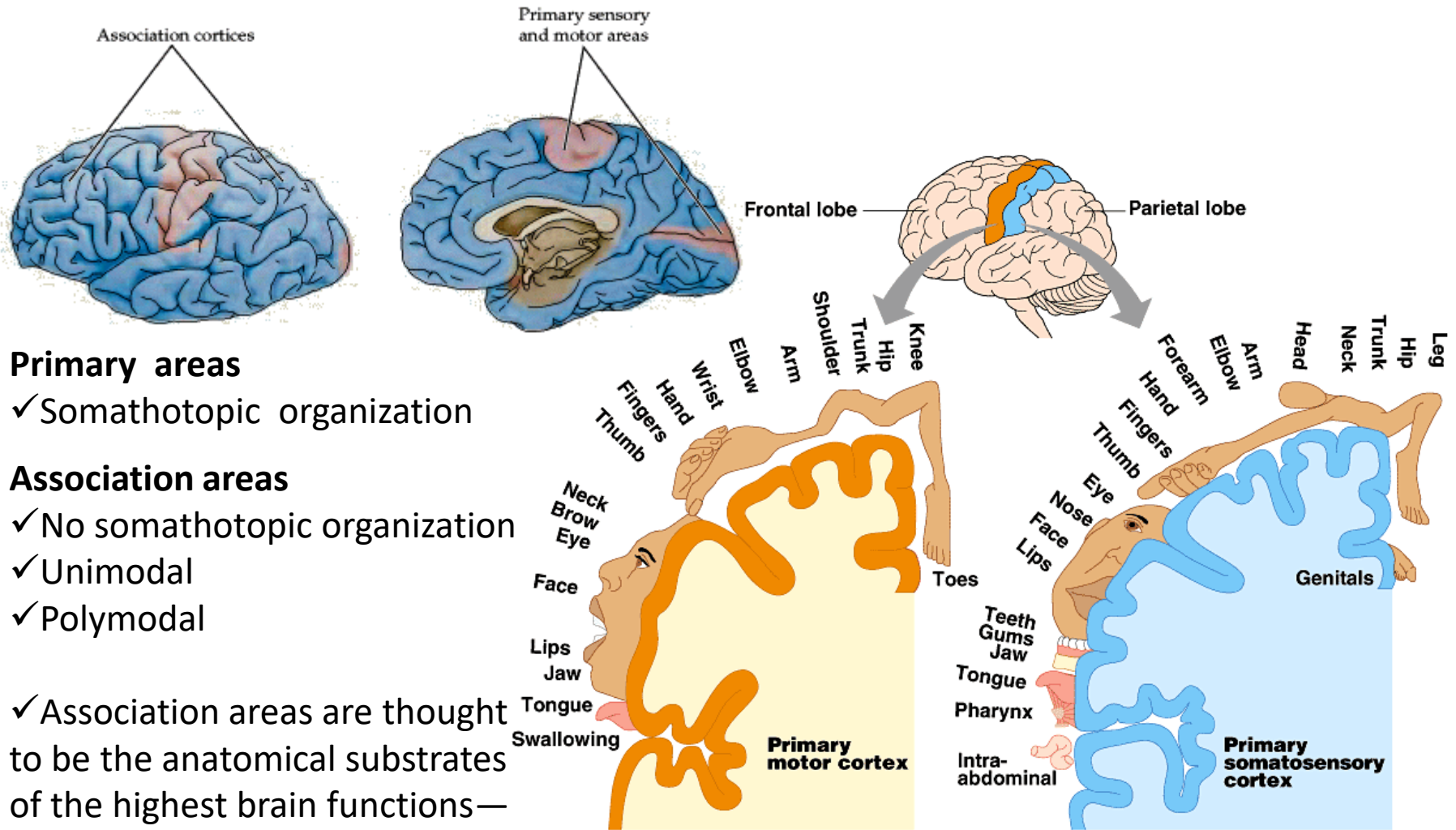
Primary areas

- ✓ Somatotopic organization

Association areas

- ✓ No somatotopic organization
- ✓ Unimodal
- ✓ Polymodal

Cerebral cortex



Primary areas

- ✓ Somatotopic organization

Association areas

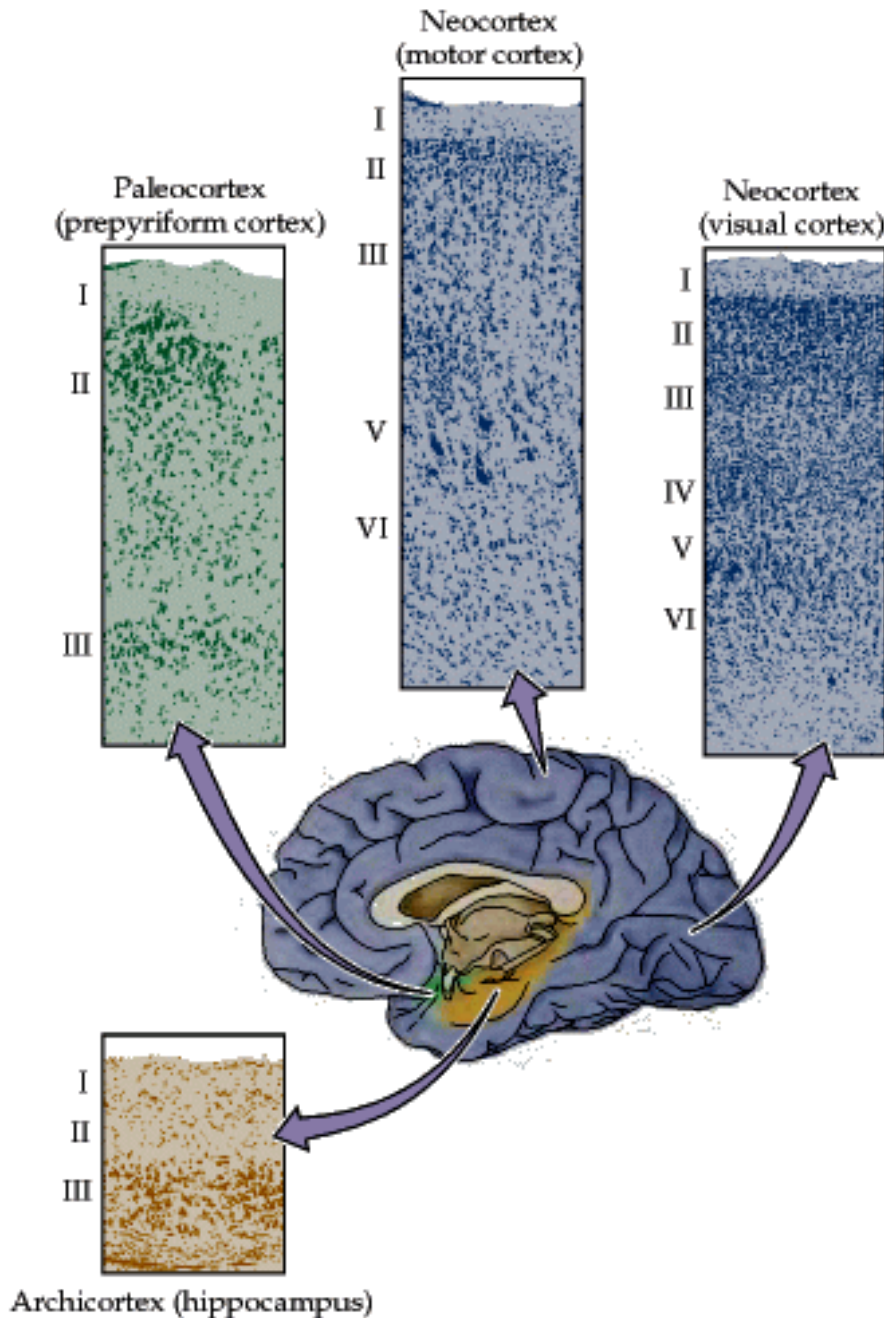
- ✓ No somatotopic organization
- ✓ Unimodal
- ✓ Polymodal

✓ Association areas are thought to be the anatomical substrates of the highest brain functions—conscious thought, perception, and goal-directed action

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<http://www.emunix.emich.edu>

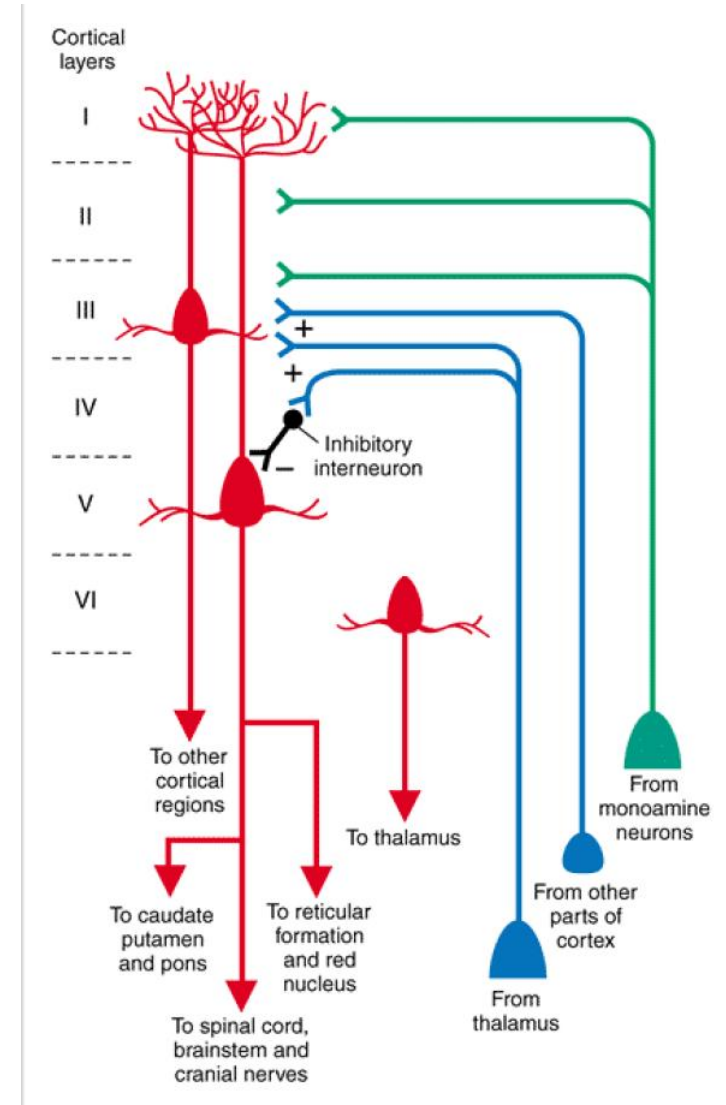
Cerebral cortex



- Paleocortex (1%)
 - 3 layers
 - rhinencephalon
- Archicortex (4%)
 - 3 layers
 - hippocampus
- Neocortex
 - 6 layers

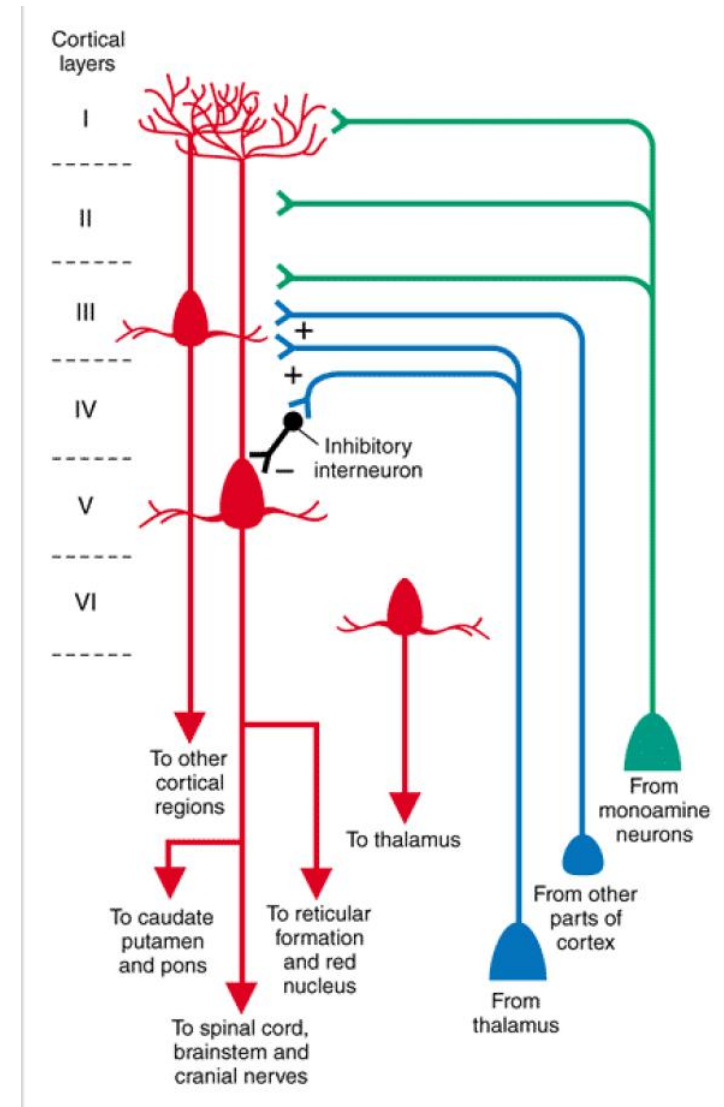
Organization of neocortex

- Specific inputs/outputs to/from each layer
- Vertical and horizontal connections in each layer
- Each layer usually contains cells with similar functions



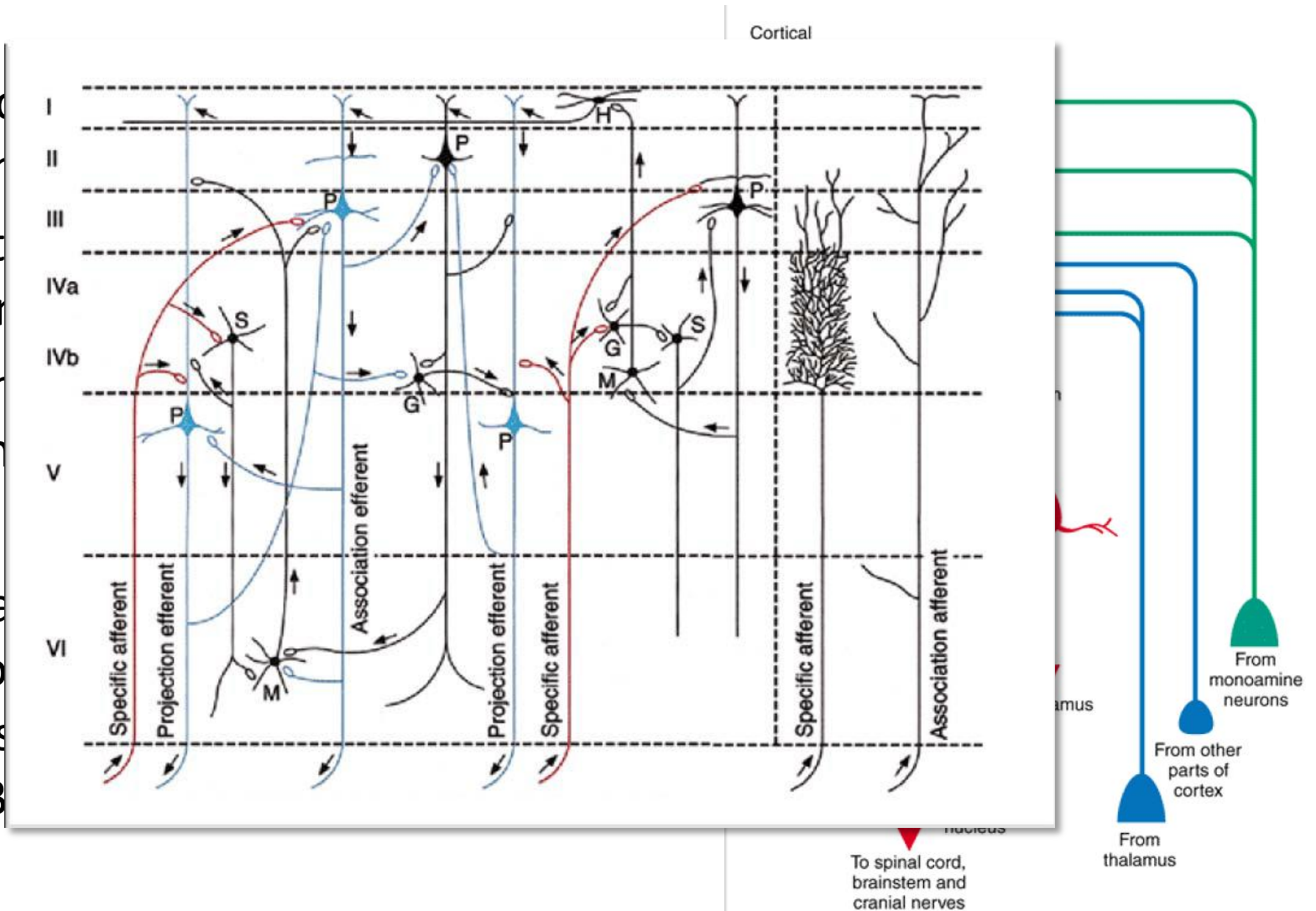
Organization of neocortex

- Specific inputs/outputs to/from each layer
- Vertical and horizontal connections in each layer
- Each layer usually contains cells with similar functions
- Local differences in cytoarchitecture were used by Brodmann for construction of the map of brain areas

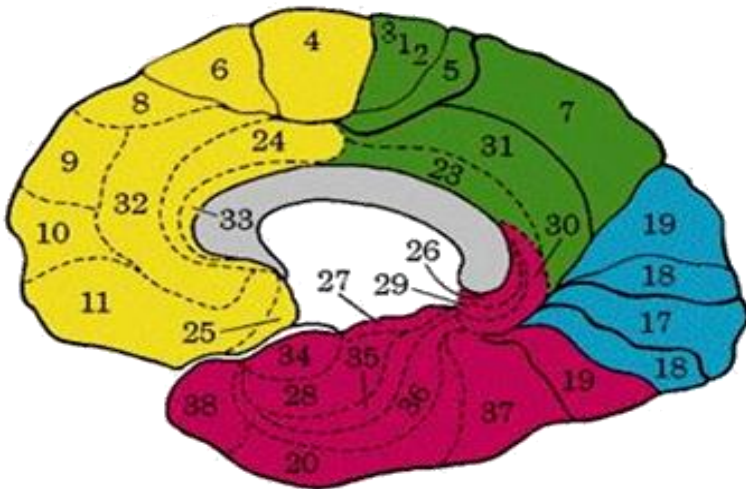
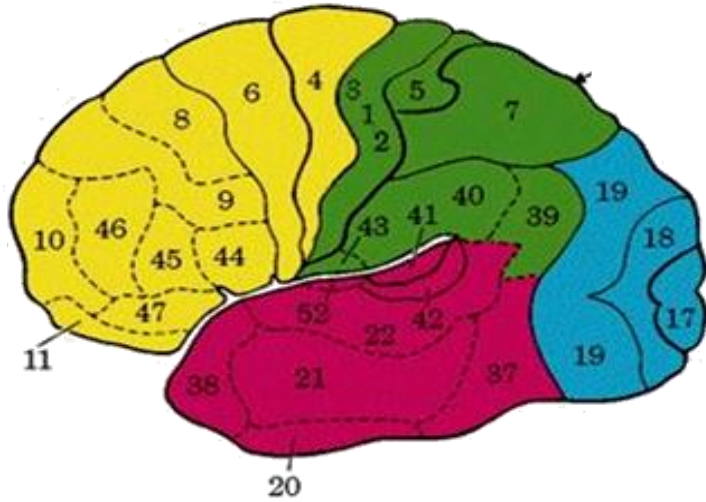


Organization of neocortex

- Specific afferents
- Each layer
- Vertical connections
- Each layer contains
- Each layer with
- Local circuitry
- cytochrome oxidase
- by B



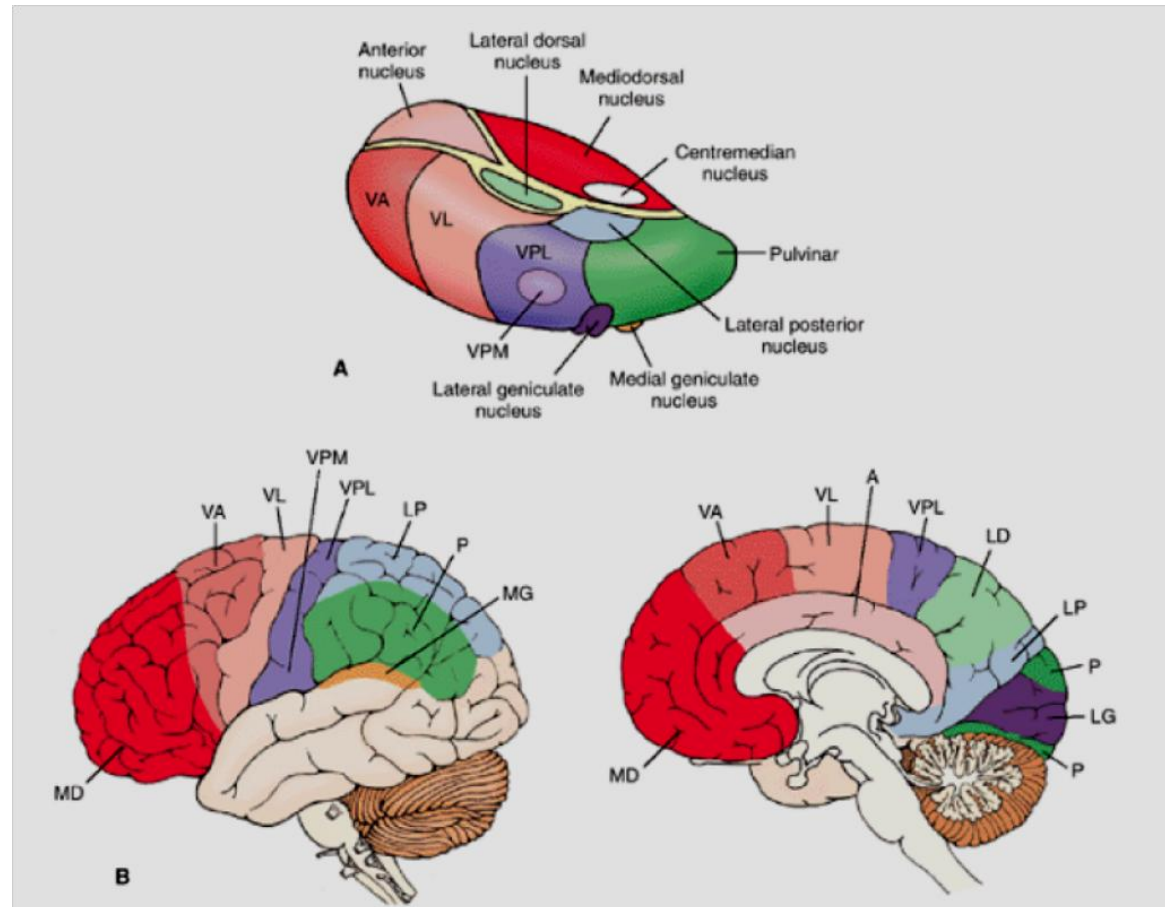
Brodman areas



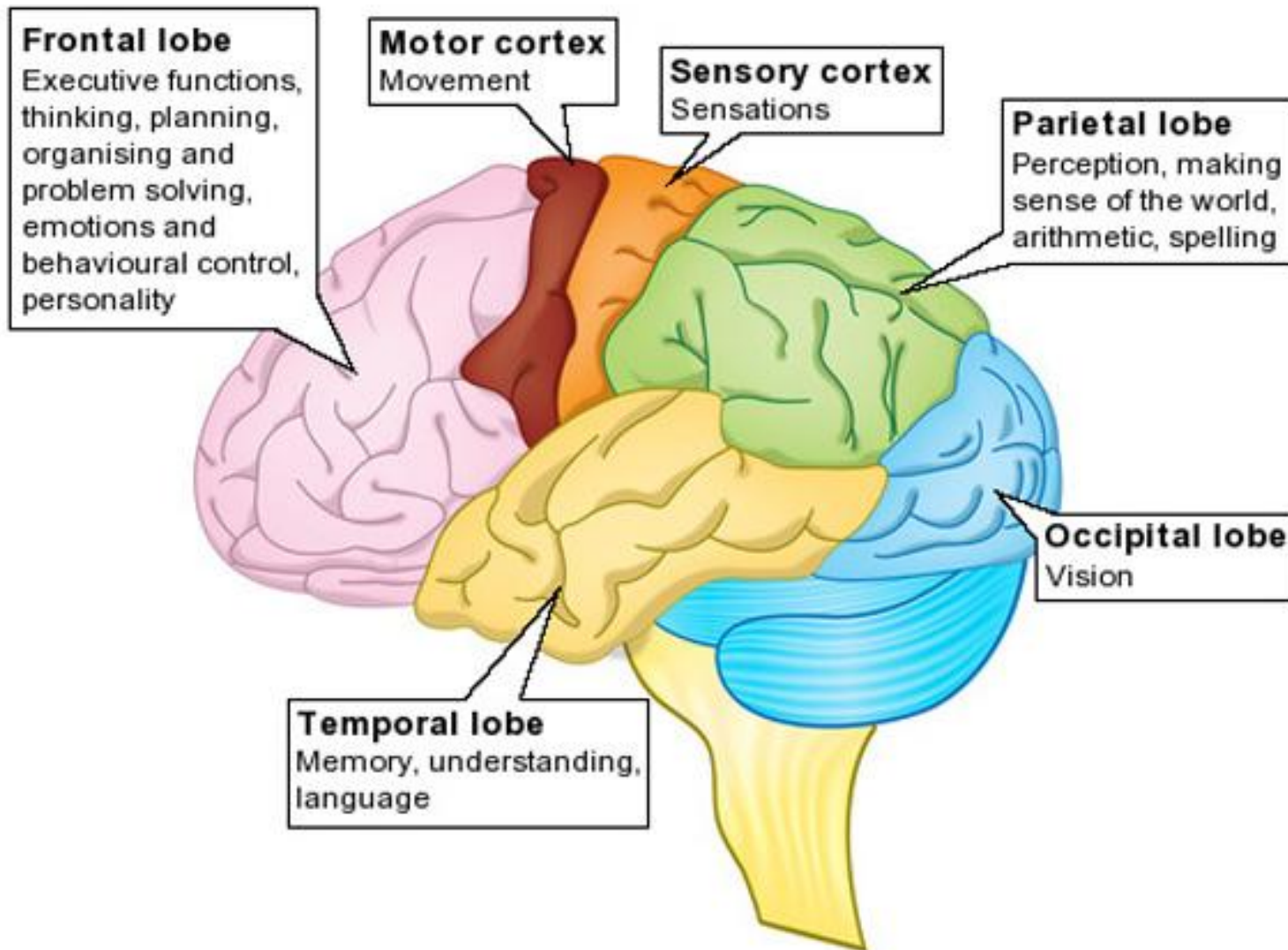
Broadman's #	NAME	FUNCTION
17	Occipital Lobe	Visual Projection Cortex
18		Visual Association Cortex
19	Posterior Parietal Lobe	Visual Association Cortex
37	Temporo-parietal-occipital area	General Sensory Association Cortex
39	Angular Gyrus	Word Recognition
40	Supramarginal Lobe	Somatosensory Association Cortex
1,2,3	Postcentral Gyrus	Somatosensory Projection Cortex
5, 7	Superior Parietal Lobule	General Sensory Association Cortex
41, 42	Middle 1/3 of Superior Temporal Cortex	Auditory Projection Cortex
22	Superior Temporal Gyrus	Auditory Association Cortex
21, 20, 38	Inferior Temporal Cortex	General Sensory Association Cortex
4	Precentral Gyrus	Primary Motor Cortex
1,2,3	Postcentral Gyrus	Somatosensory Projection Cortex
6,8,9	Premotor Cortex	Motor Association Cortex
41, 42	Middle 1/3 of Superior Temporal Cortex	Auditory Projection Cortex
44,45,46	Broca's Area	Motor Association Cortex - Specific to speech
10	Prefrontal Cortex	General Motor Association Cortex
11	Orbital Gyri	General Motor Association Cortex

Cerebral cortex and thalamus

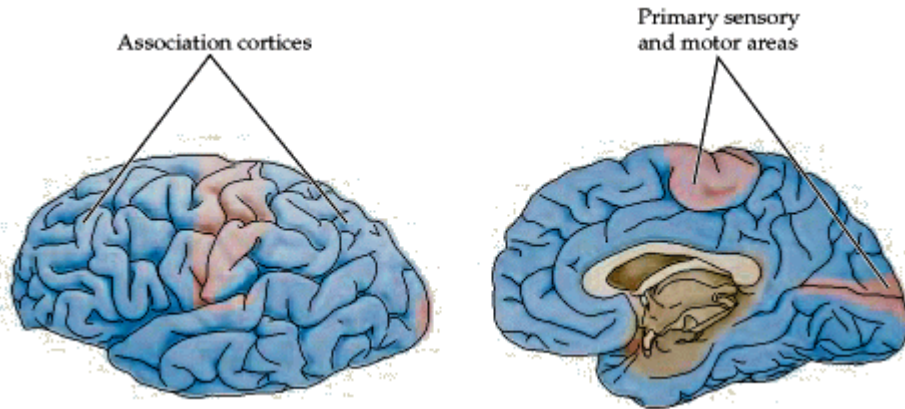
- Close cooperation between cerebral cortex and thalamus
- Bilateral connections
- Almost all sensory information reaching cerebral cortex is gated by thalamus
- Exception - olfaction



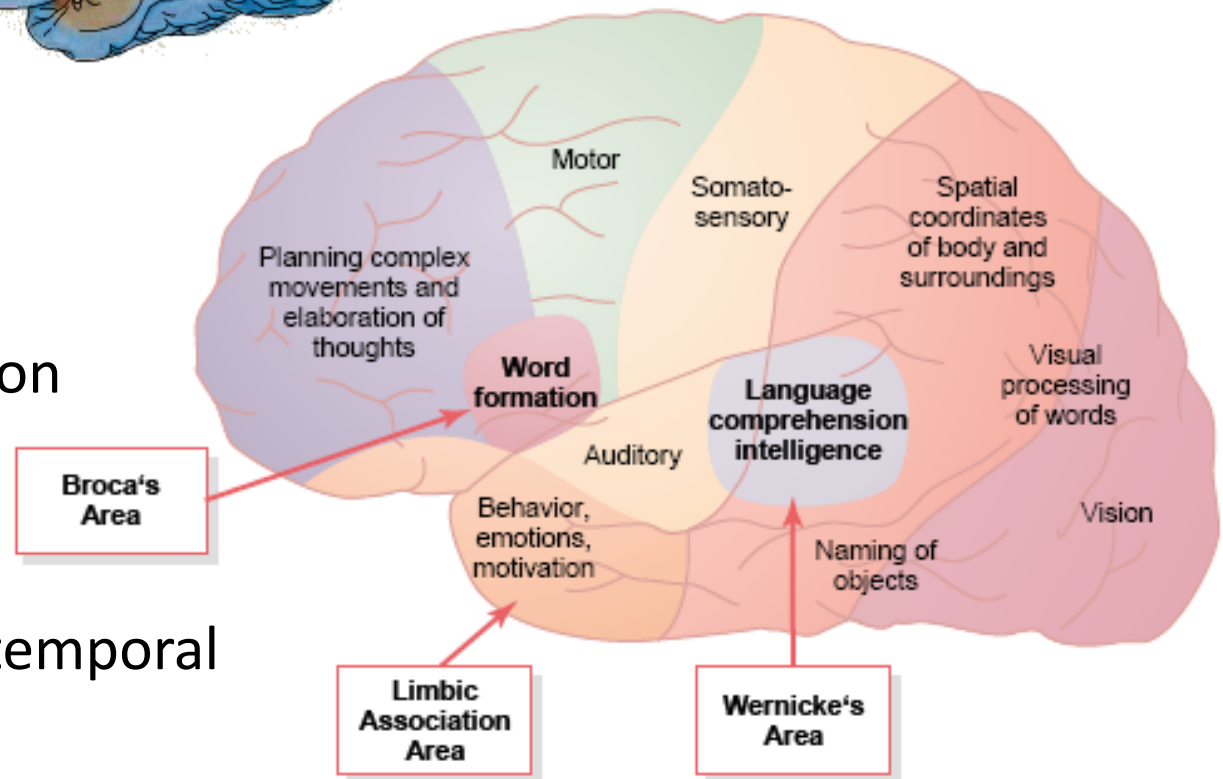
Cortical functions



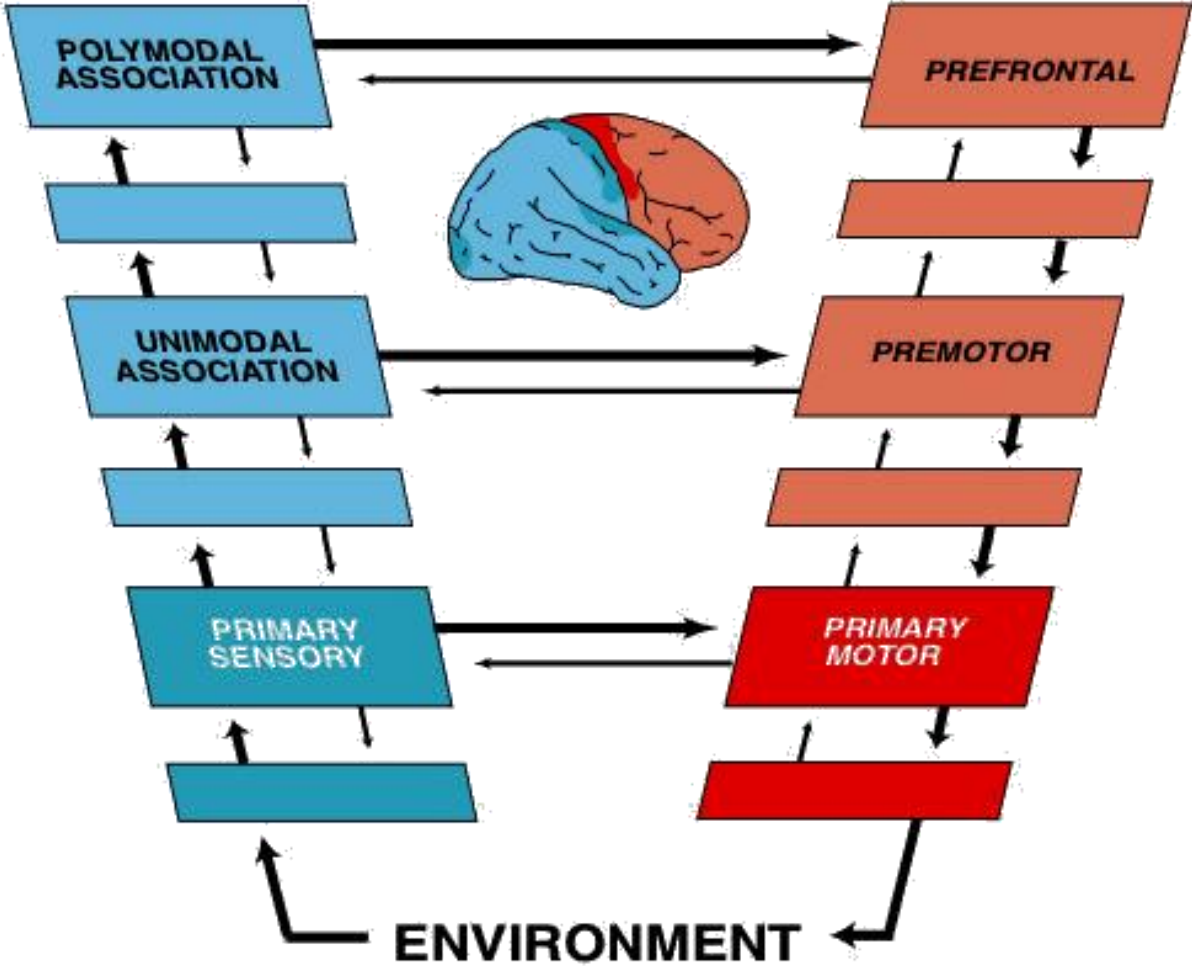
Association areas



- Neither receptive
- Nor effector
- Integrative function
- Limbic
- Parieto-occipito-temporal
- Frontal

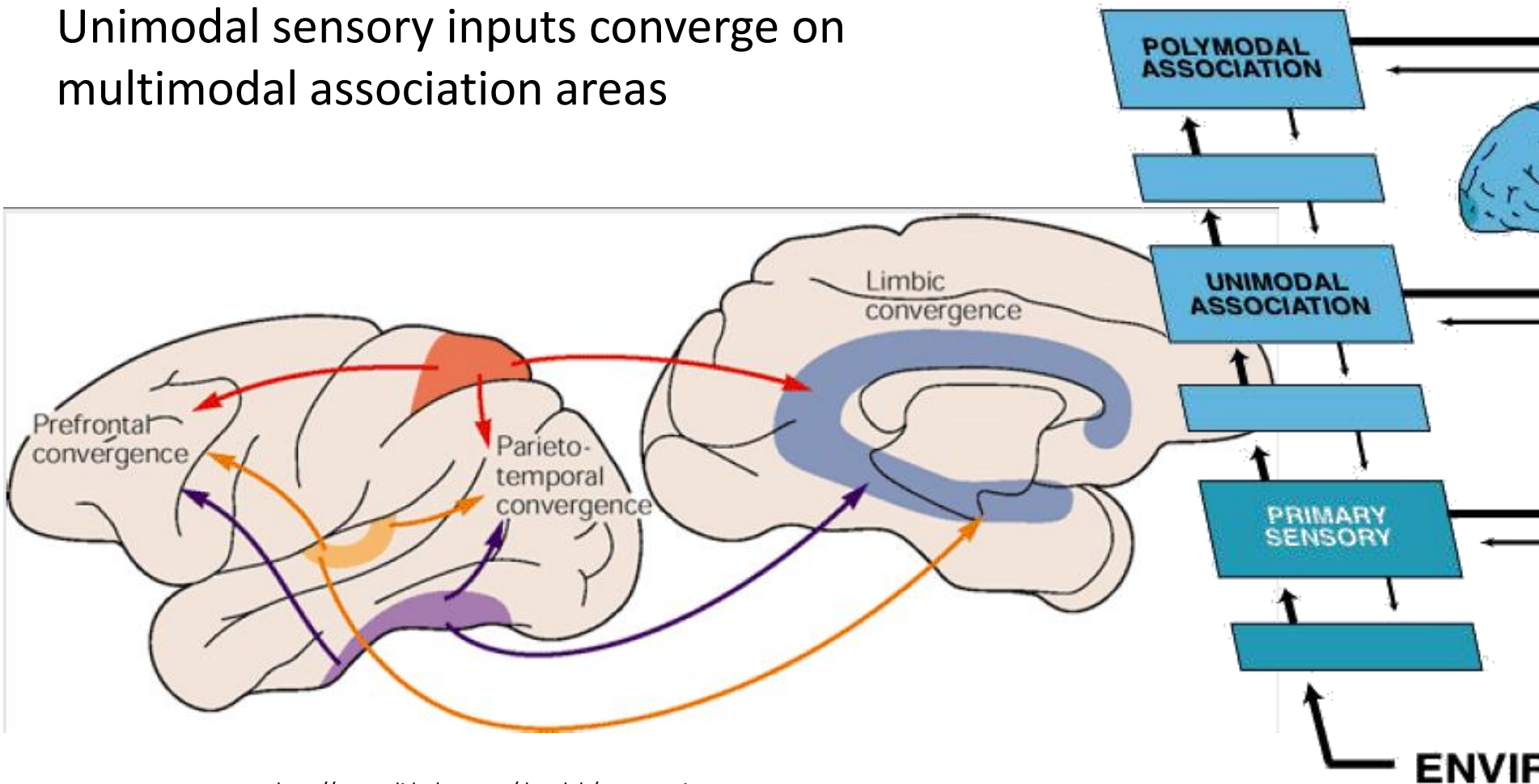


Signal processing algorithm



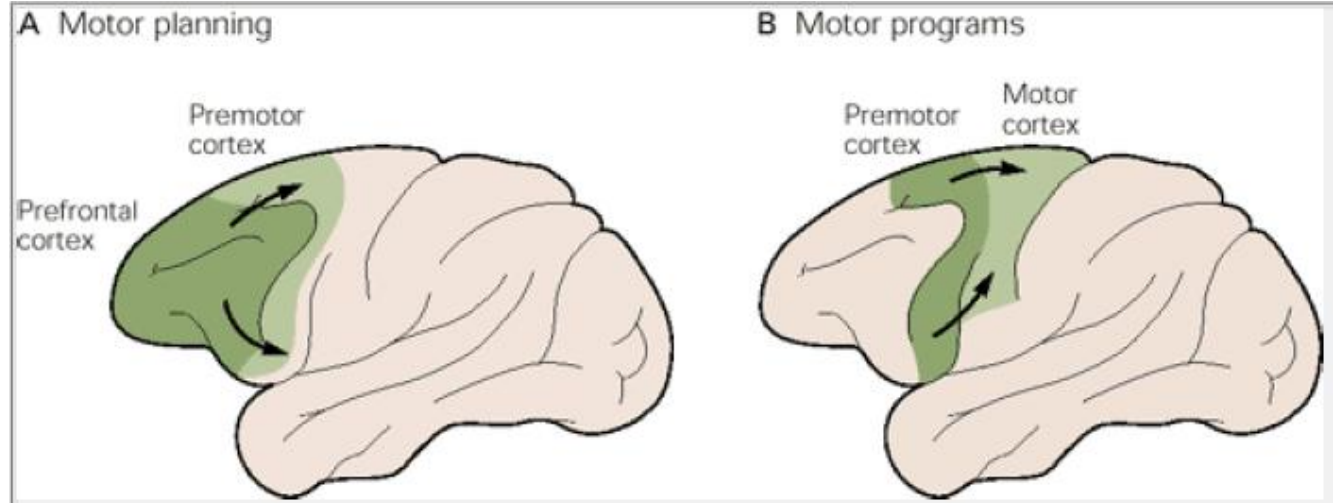
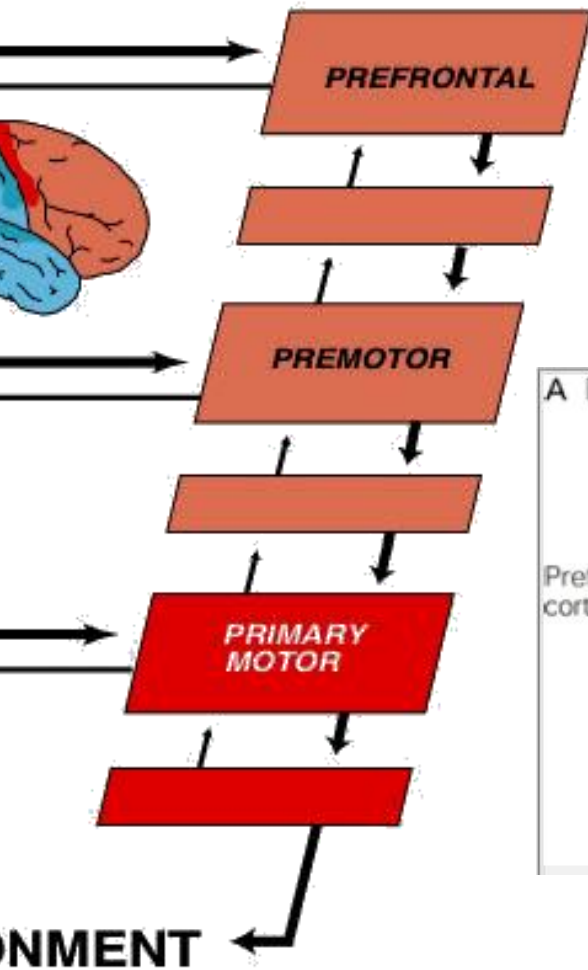
Aferentation

Unimodal sensory inputs converge on multimodal association areas



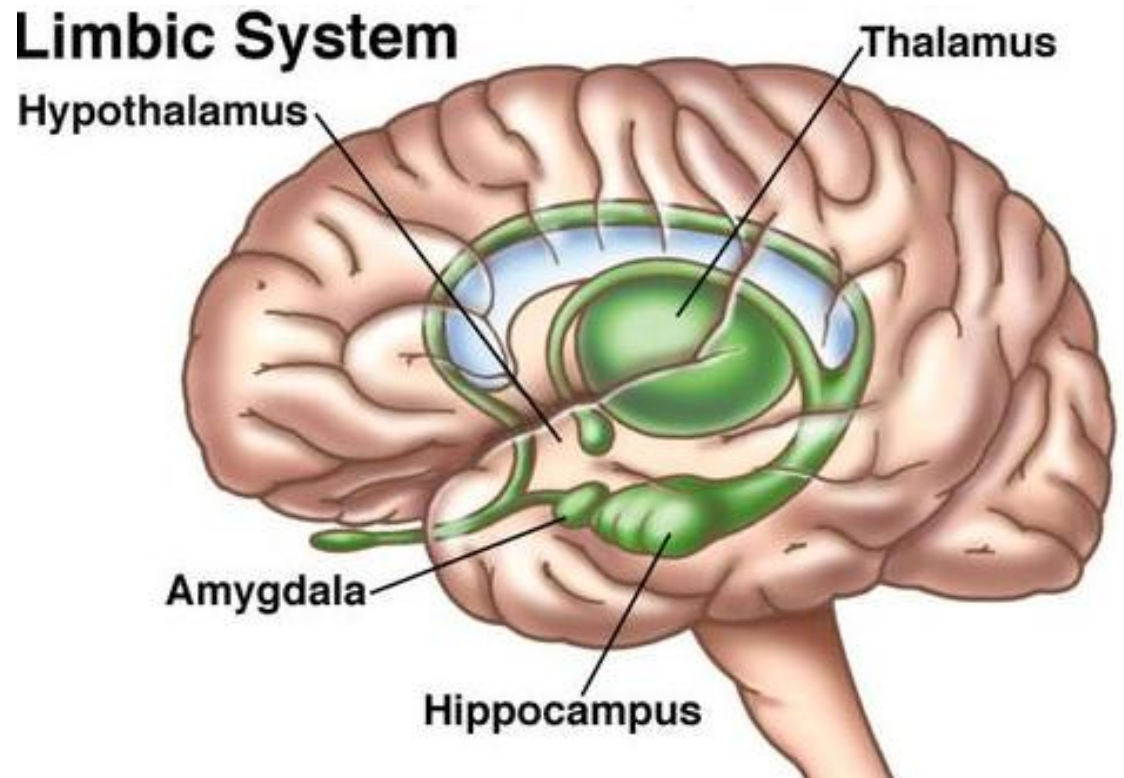
Eferentation

The Sequence of Information Processing Is Reversed in the Motor System



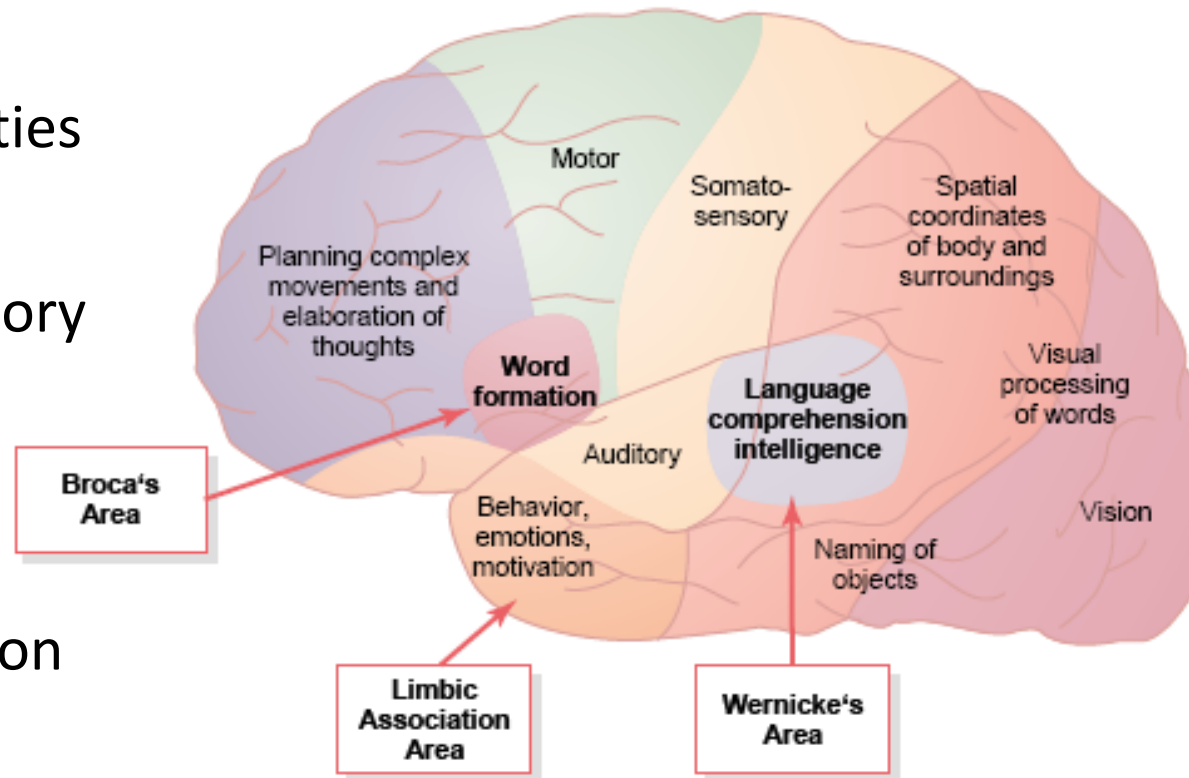
Limbic association area

- Integration of information from inner and outer environment
- Hypothalamus
- Emotions
- Motivation
- Instinct behavior

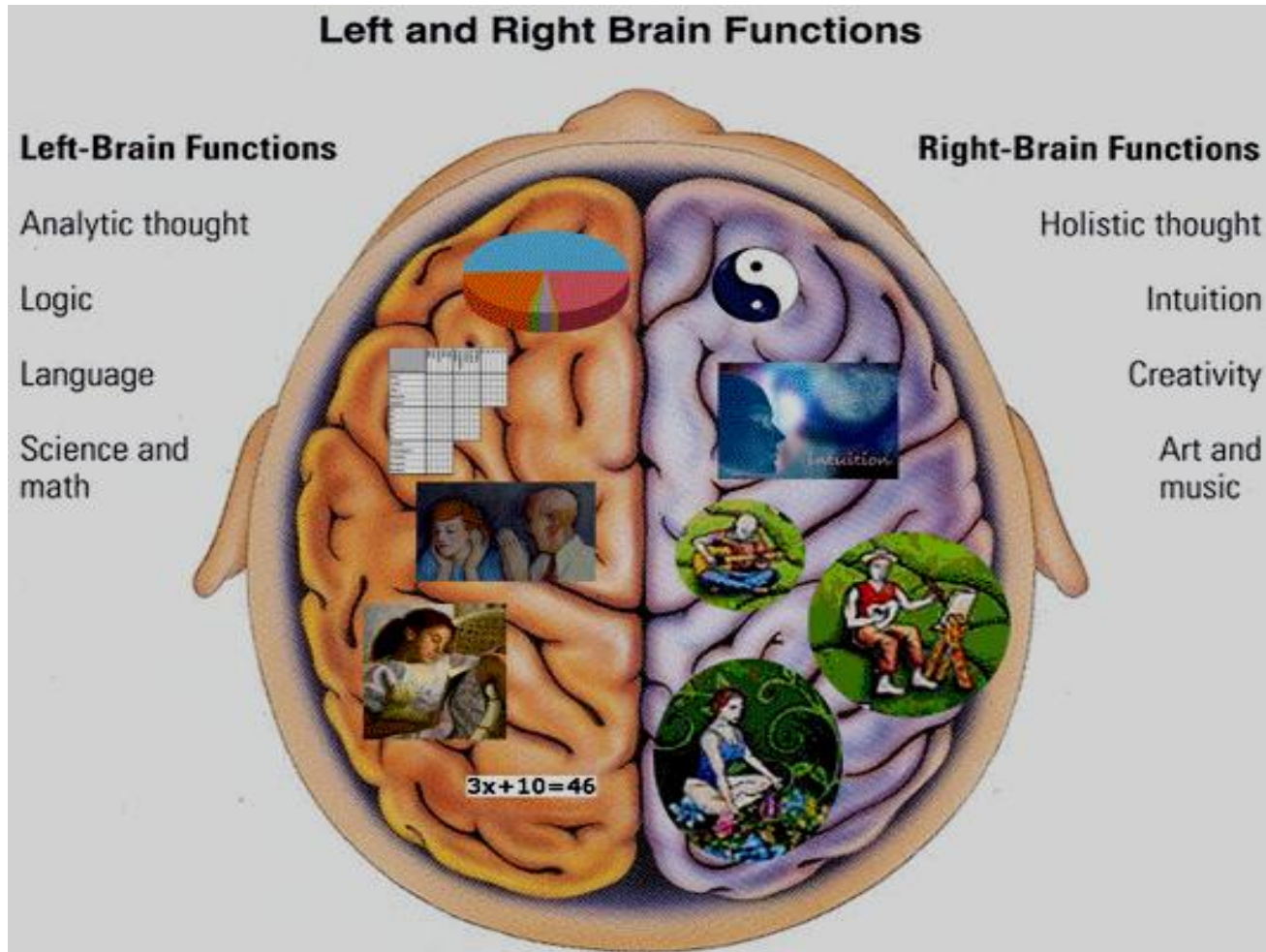


Parieto-occipito-temporal association area

- Linking and interpretation of information from several sensory modalities
- Visual – acoustic – sensory analysis
- Object recognition and categorization
- Language comprehension
- Attention



Lateralization of brain functions



Lateralization of brain functions

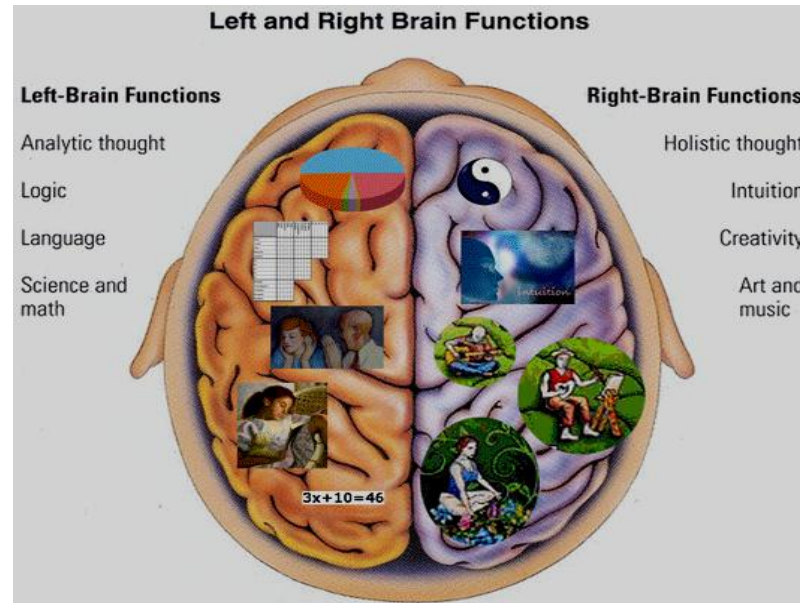
Aphasia

Acalculia

Tactile agnosia

Conceptual apraxia

Ideomotor apraxia



Orientation disorders

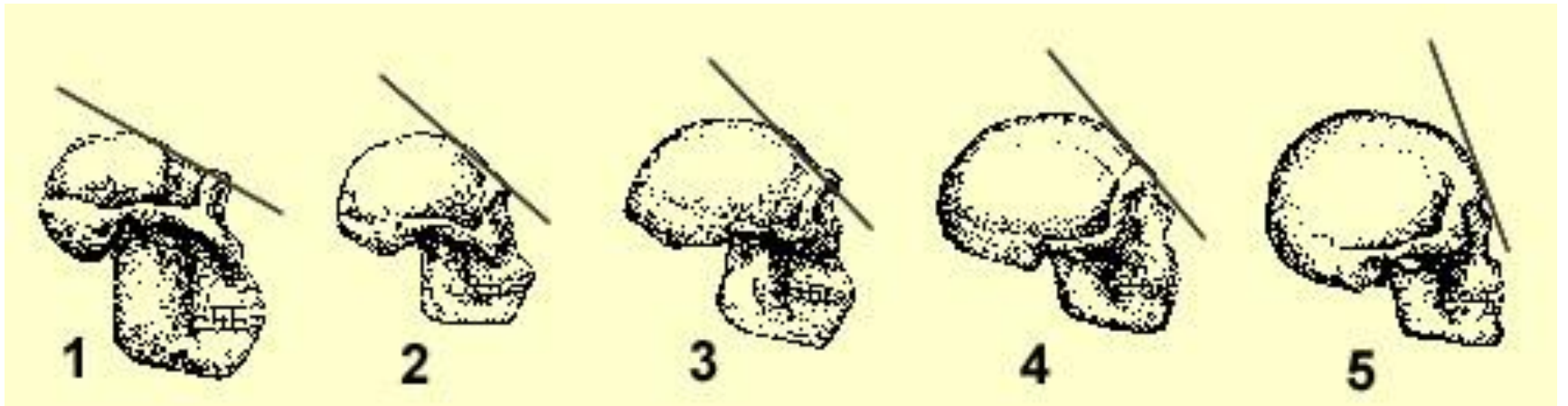
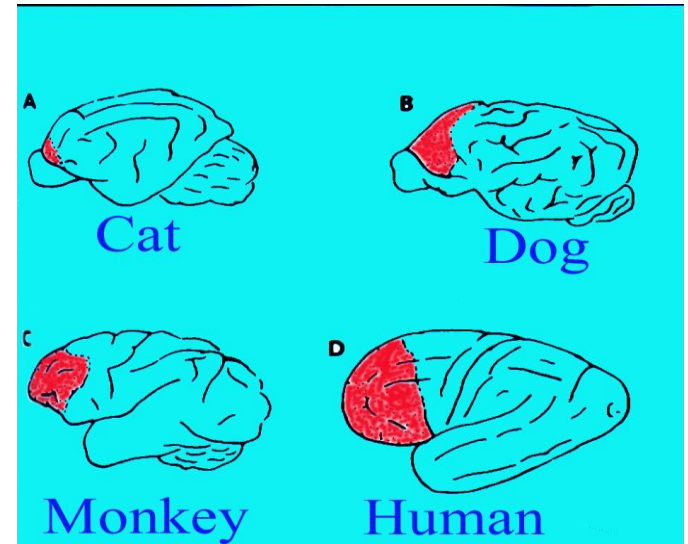
Constructional apraxia

Anosognosia

Neglect syndrome

Frontal association area

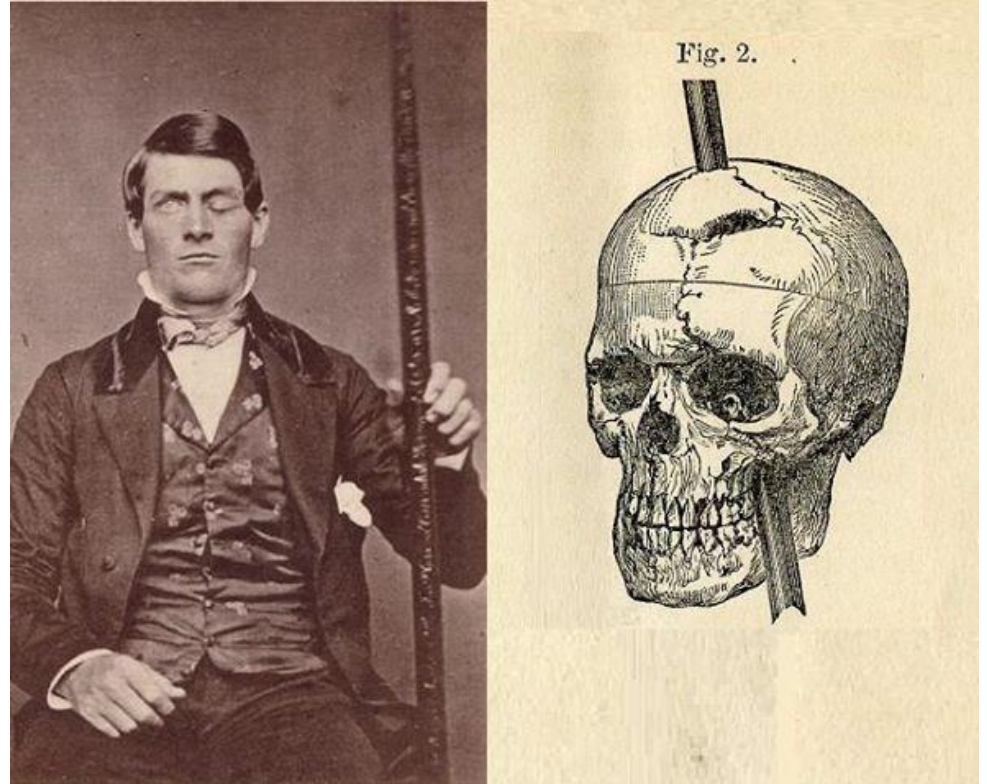
- Executive function
 - Motor / behavioral
 - Cognitive
- Mostly developed in human



- 1. *Australopithecus robustus* 2. *Homo habilis* 3. *Homo erectus*
- 4. *Homo sapiens neanderthalensis* 5. *Homo sapiens sapiens*

Phinease Gage (1823 – 1860)

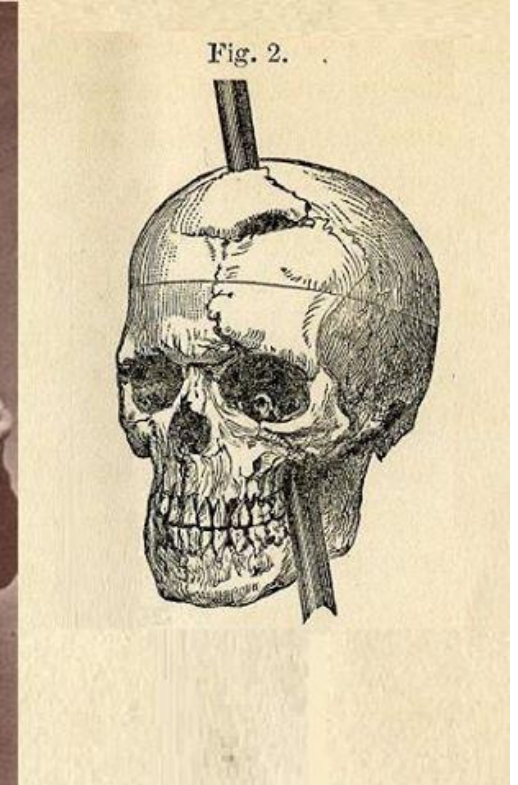
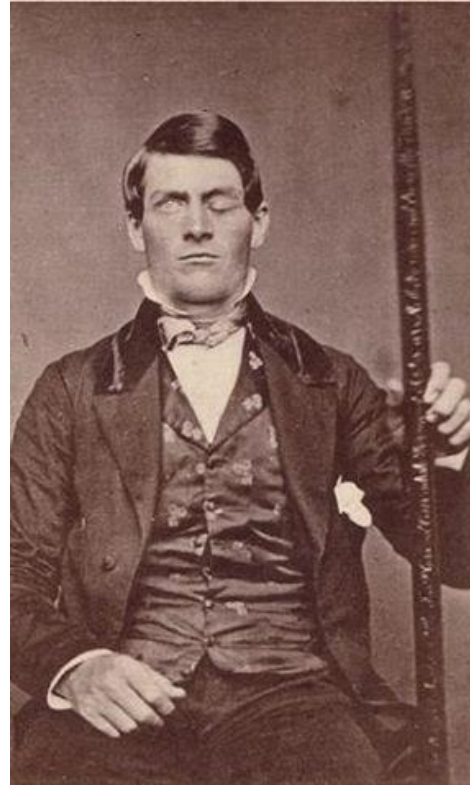
- 1848 – work injury
- Before injury
 - Reliable
 - Friendly
 - Responsible
 - Polite



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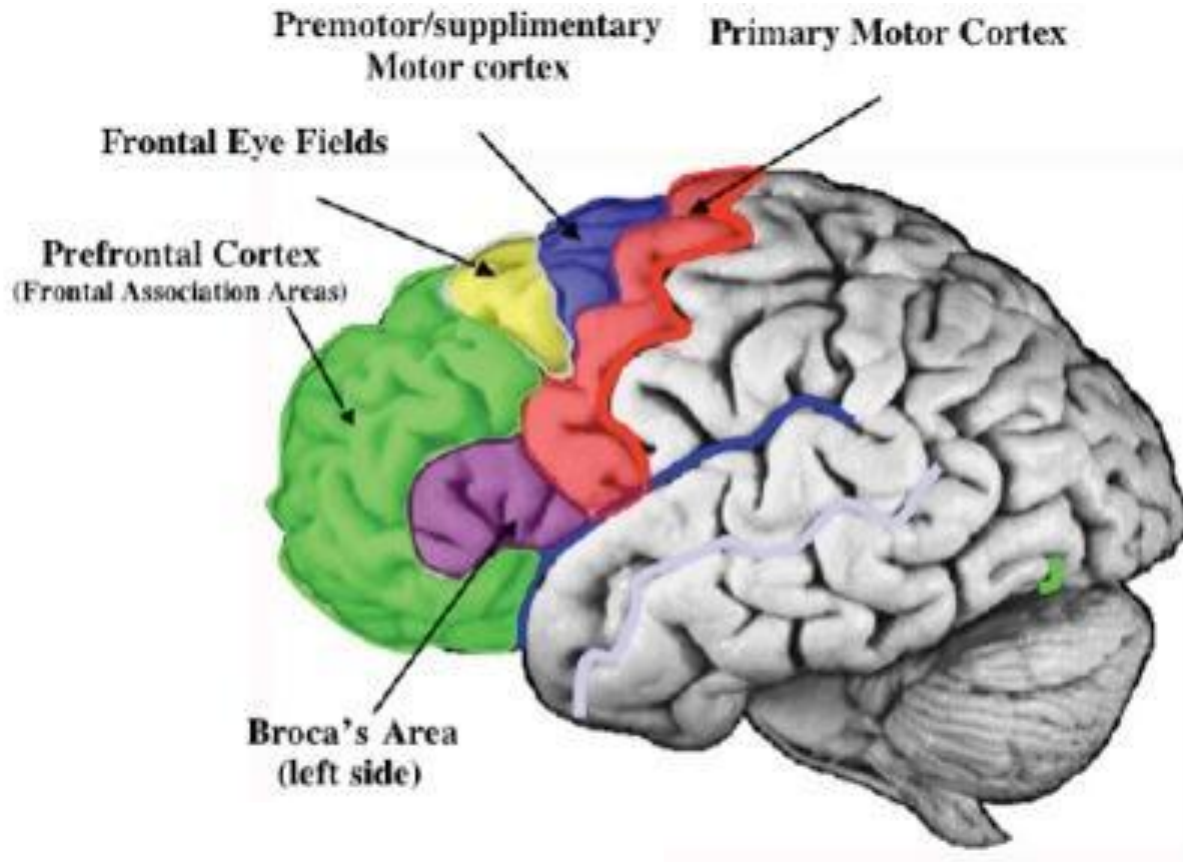
Phinease Gage (1823 – 1860)

- 1848 – work injury
- Before injury
 - Reliable
 - Friendly
 - Responsible
 - Polite
- After injury
 - Unreliable
 - Hostile
 - Irresponsible
 - Rude
- 1860 – died from status epilepticus



http://65.media.tumblr.com/553d3c3f3f579f57273b8598ec6739ab/tumblr_o11oqt0MUK1uaq7mqo1_1280.jpg

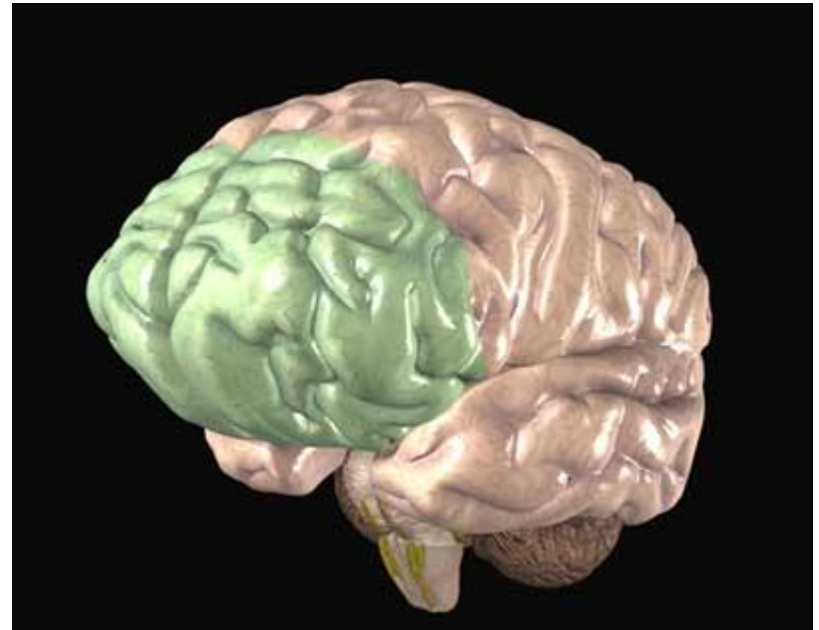
Frontal lobe



<https://d2gne97vdumgn3.cloudfront.net/api/file/edAV1gWAQ2uYSdYHSiPj>

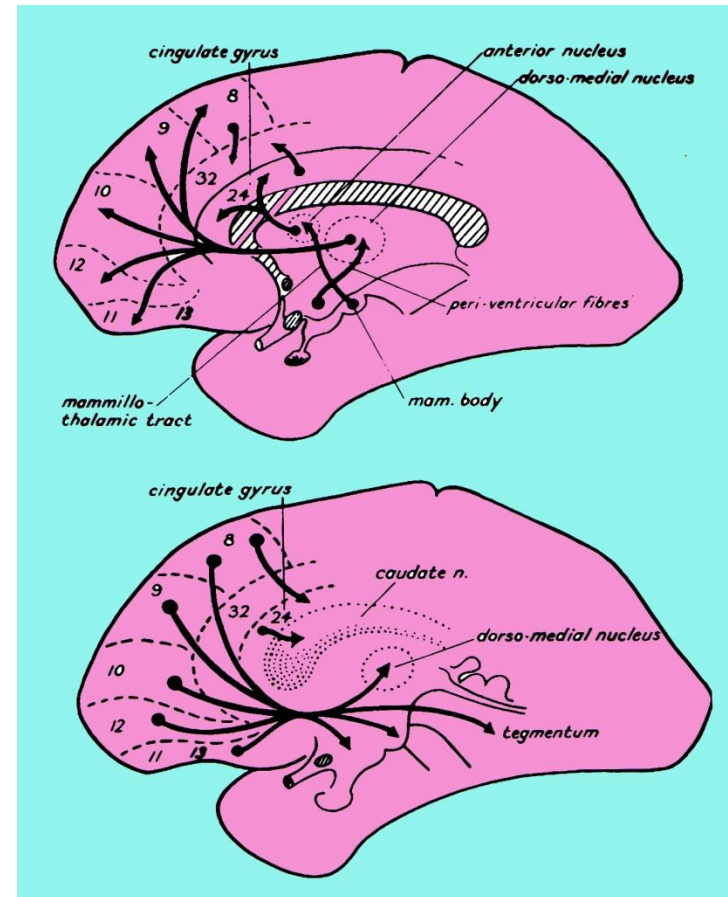
Frontal association area

- ~ 1/3 neocortex
- One of the evolutionary youngest cortical areas
- Late development in ontogeny
 - Differentiation during the 1st year of life
 - Mostly developed around the 6th year of life
 - ? End of maturation around the 20th year of life?



Frontal association area

- Input from association cortex
 - P-O-T association area
 - Limbic association area
- Reciprocal connections:
 - prefrontal processing modulates perceptual processing
 - „Loops“
- Input to premotor areas



Functions of frontal association area

- Motor/non-motor planning/organization - strategy - anticipation
 - Thinking – mental models processing

- Attention – „information filtering“

- Behavioral control
 - Facilitation of „wanted“
 - Inhibition of „unwanted“



1. Motor planning / organization

- Frontal association area
- Premotor area
- ✓ Close cooperation with motor cortex
- ✓ Planning and preparing of complex motor action (in cooperation with Basal ganglia)
- ✓ Close cooperation with P-O-T area which sends visual-acoustic-sensory-spatial information
- ✓ Voluntary motor control



2. Thinking skills

- Organization
 - The ability to arrange information in a meaningful system
- Planning
 - The ability to create a strategy for reaching goals
- Time management
 - The ability to estimate time needed for reaching goals
- Working memory
 - The ability to hold information in awareness while performing a mental operation



3. Attention

- Selective attention
 - The ability to filter information
- Sustained attention
 - The ability to actively attend to a task
- Divided attention
 - The ability to attend to two tasks at once
- Shifting attention
 - The ability to shift attention between two or more tasks



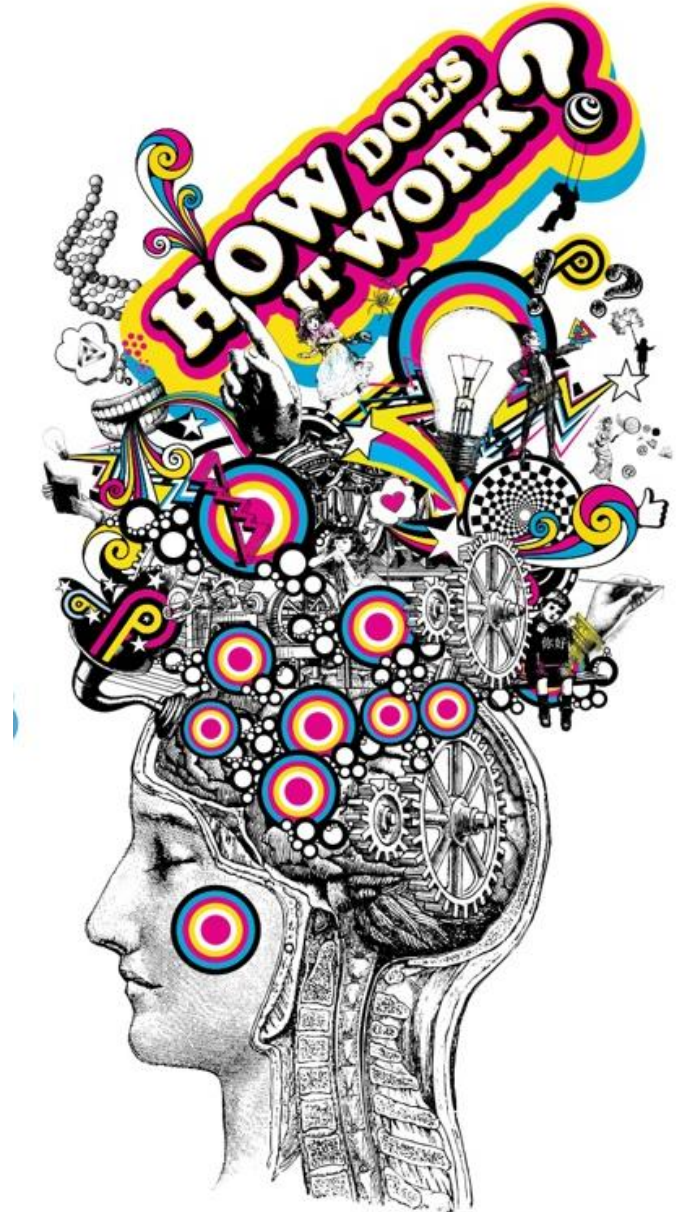
4. Behavioral control

- Facilitation/ initiation of „wanted“ (re)action
- Inhibition of „unwanted“ (re)action
 - Anticipation
 - Self-regulation x procrastination
- Flexibility
 - The ability to revise plans when it is needed
- Goal-directed persistence
 - The ability to self-motivate
- Social brain
 - Mentalization
 - Empathy
 - Social behavior - frontal association area
 - Instinct behavior - limbic association area



Frontal lobe and mental arousal

- Right frontal lobe
 - Bilateral influence
 - Inhibition
- Left frontal lobe
 - Unilateral influence
 - Activation
- Left frontal lobe damage
 - Reduced spontaneous activity
 - Reduced self-control; impulsive instinct behavior



Frontal lobe functions

Motor	Cognitive	Behavior	Arousal
Voluntary movements	Memory	Personality	Attention
Language Expression	Problem solving	Social and sexual	
Eye movements	Judgment	Impulse control	
Initiation	Abstract thinking	Mood and affect	
Spontaneity			