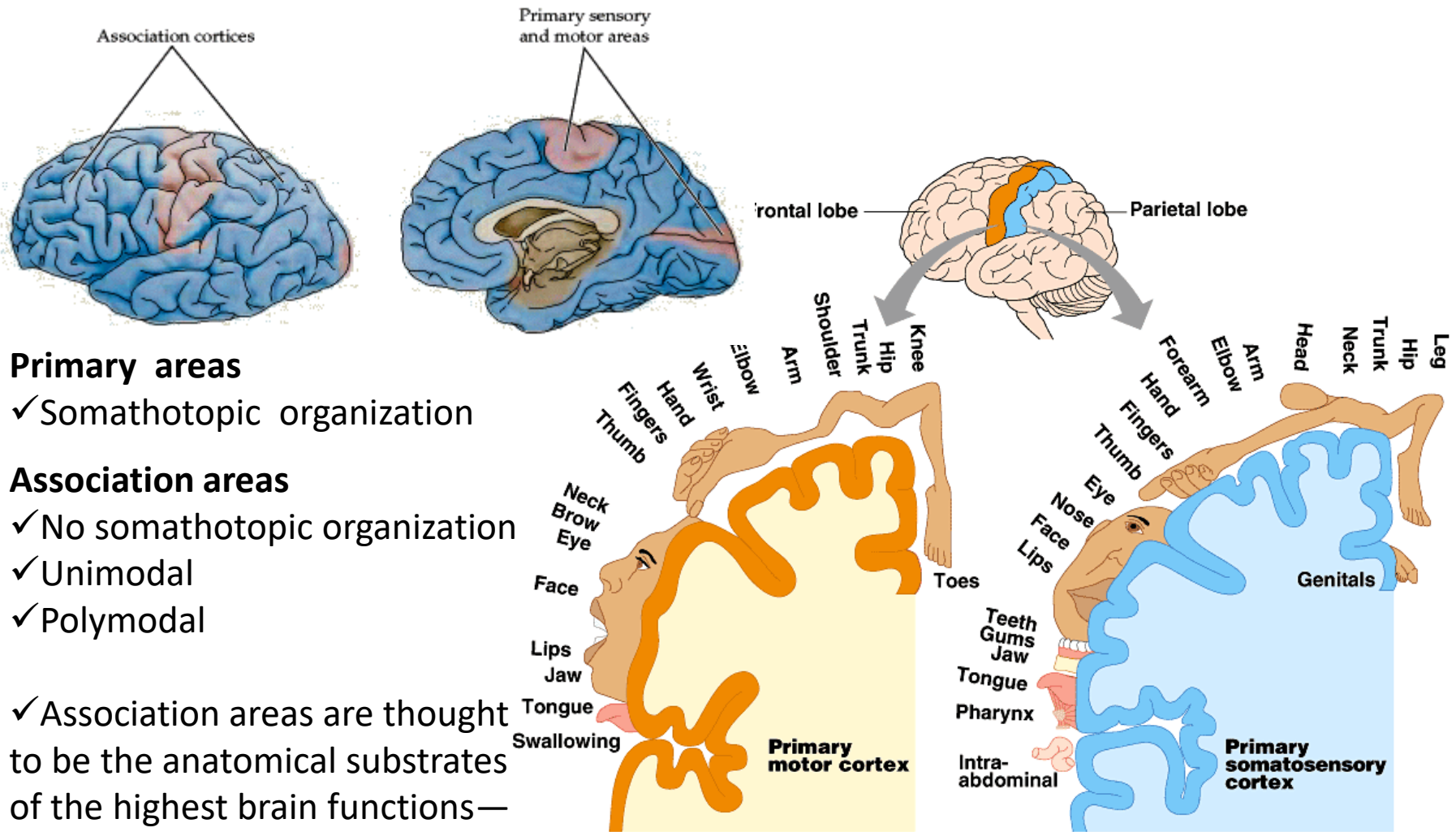


**15**

**Neocortex I**



# Cerebral cortex



## Primary areas

- ✓ Somatotopic organization

## Association areas

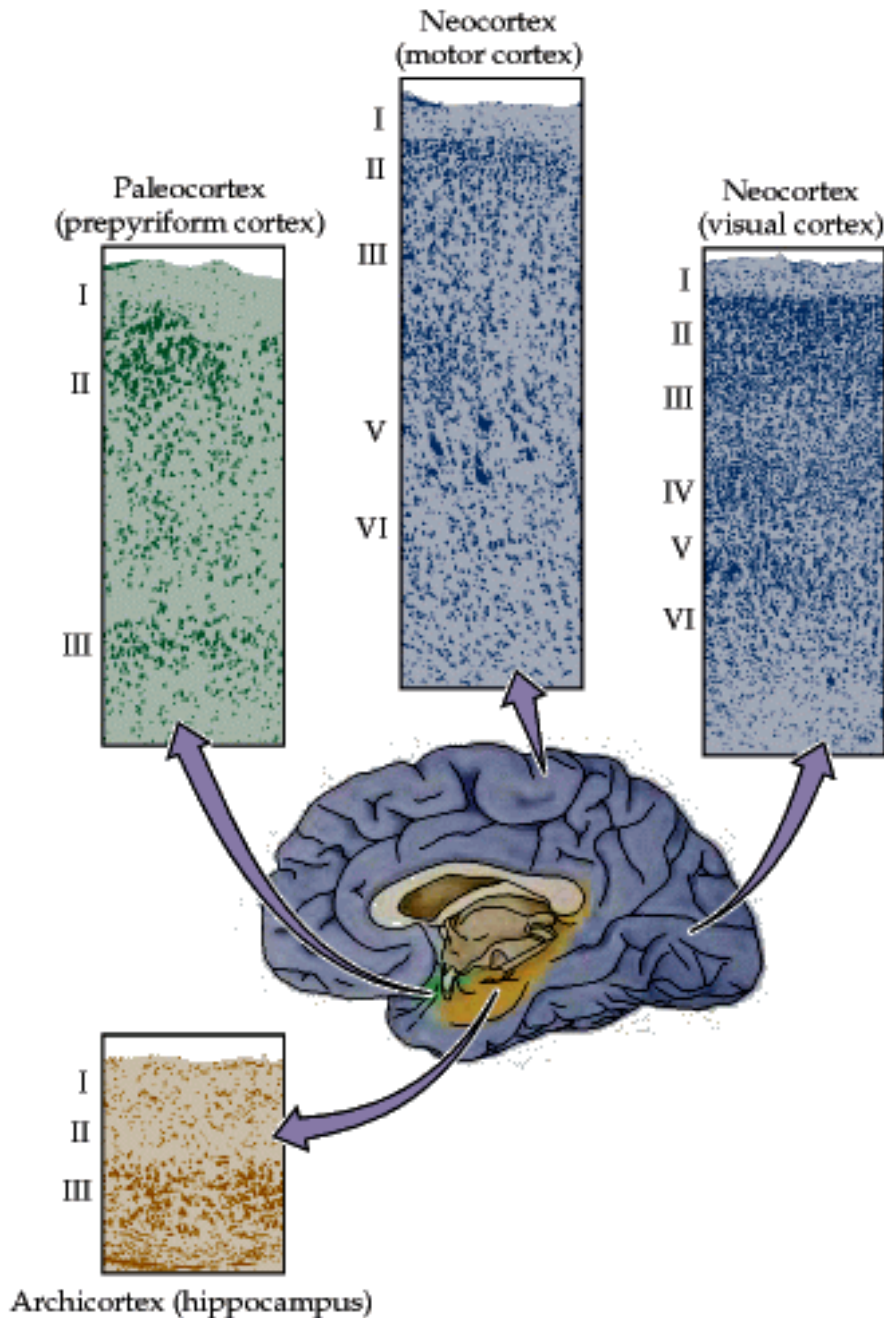
- ✓ No somatotopic organization
- ✓ Unimodal
- ✓ Polymodal

✓ 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>

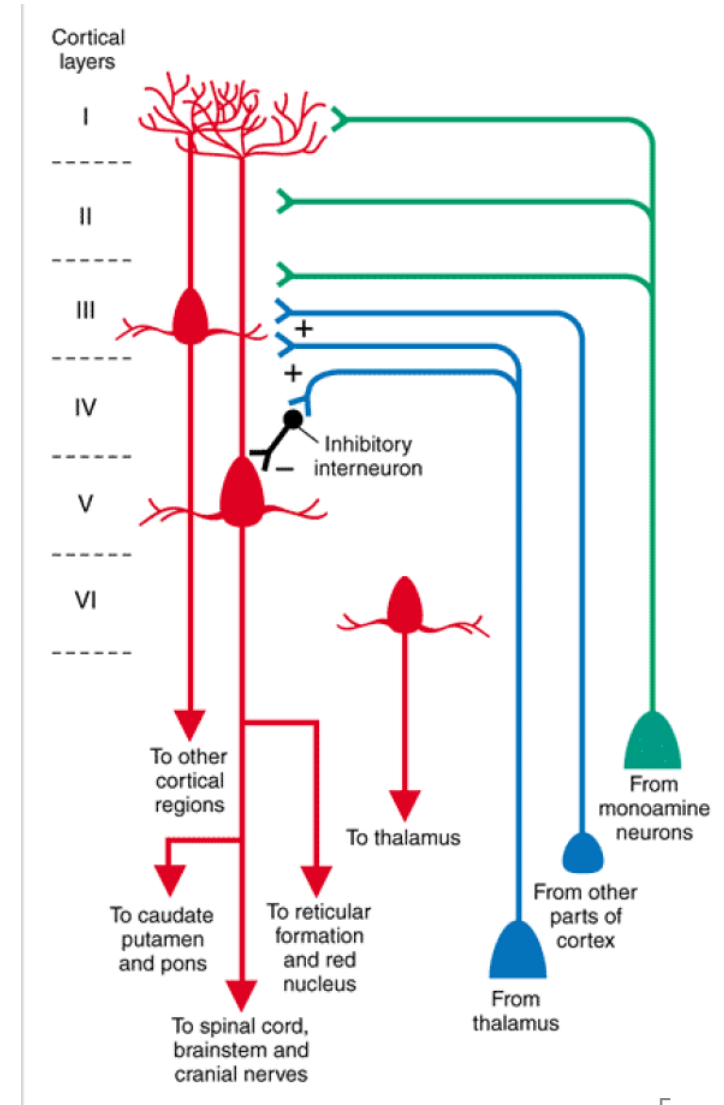
# Cerebral cortex



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

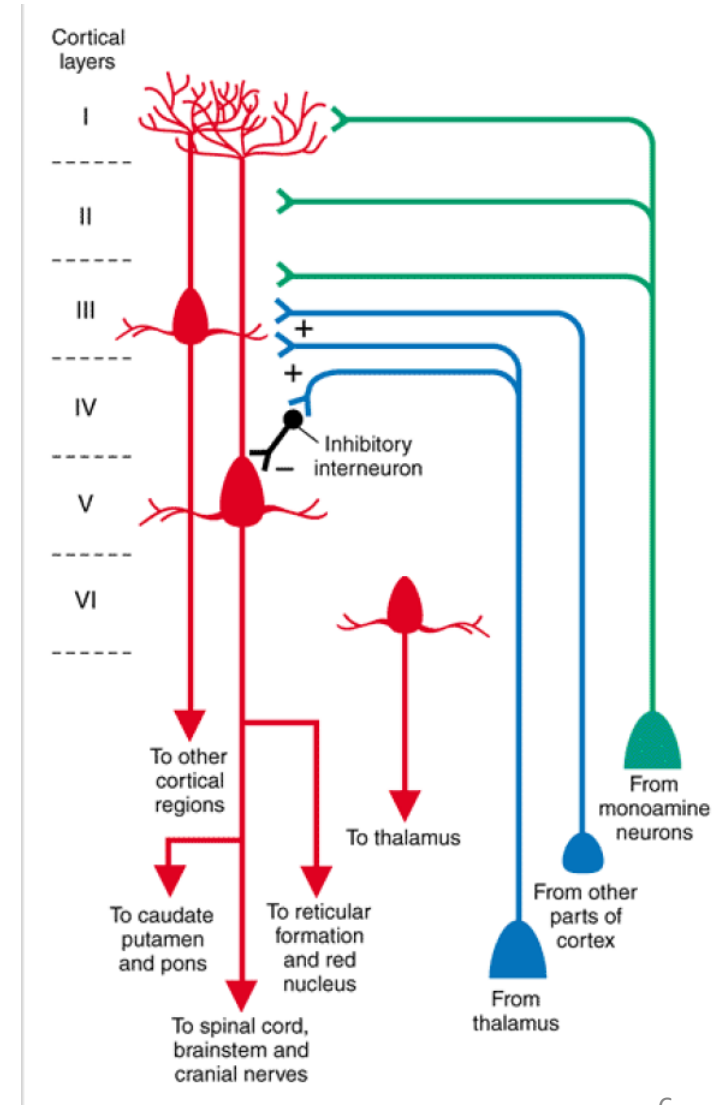
# Organization of neocortex

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



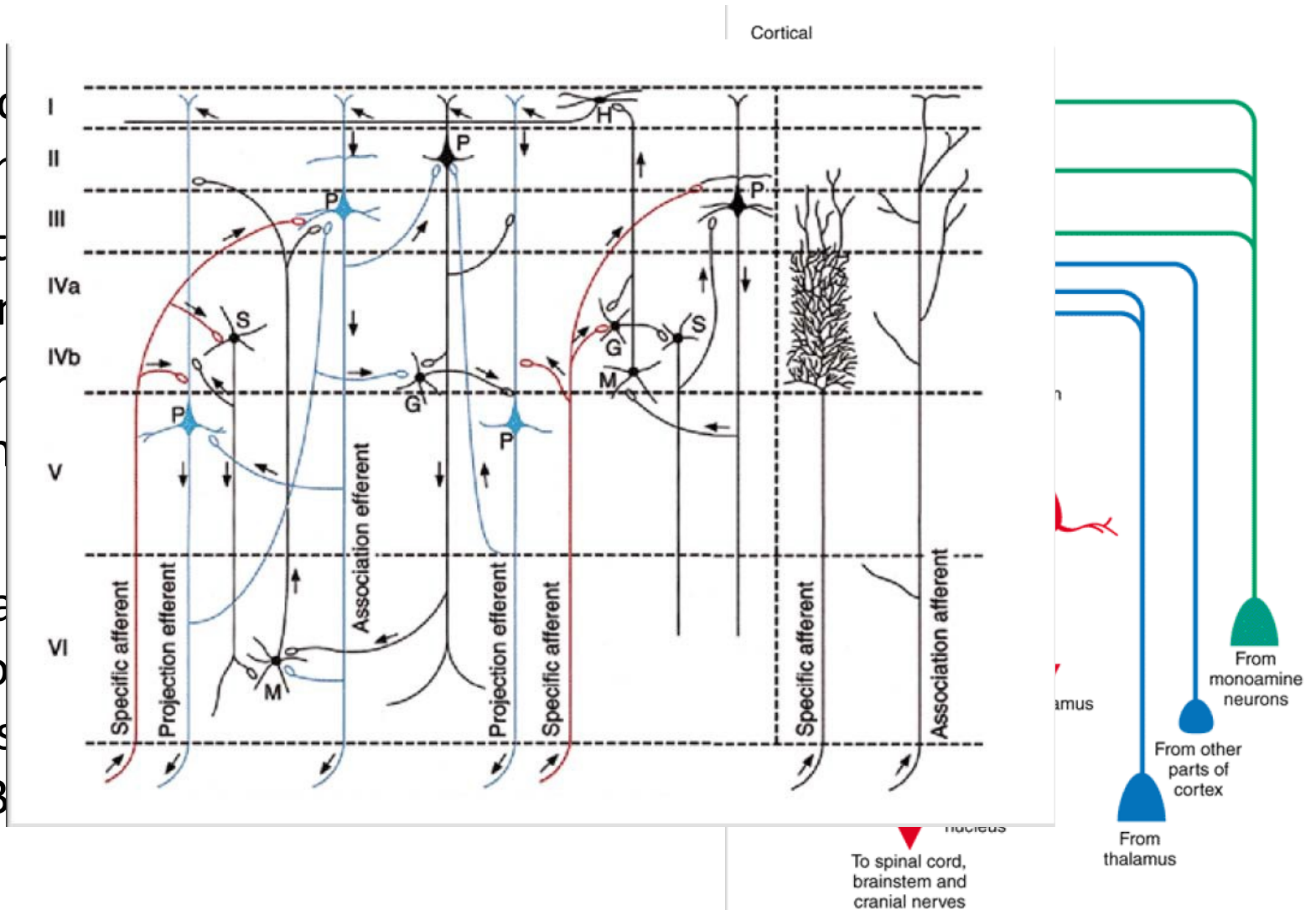
# Organization of neocortex

- 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

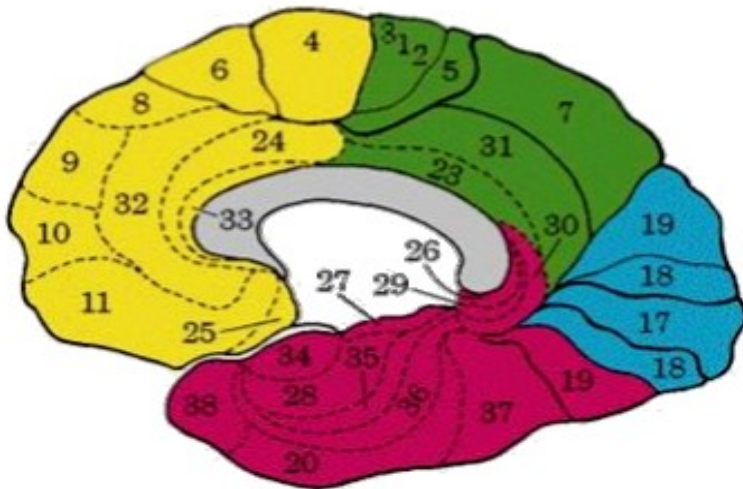
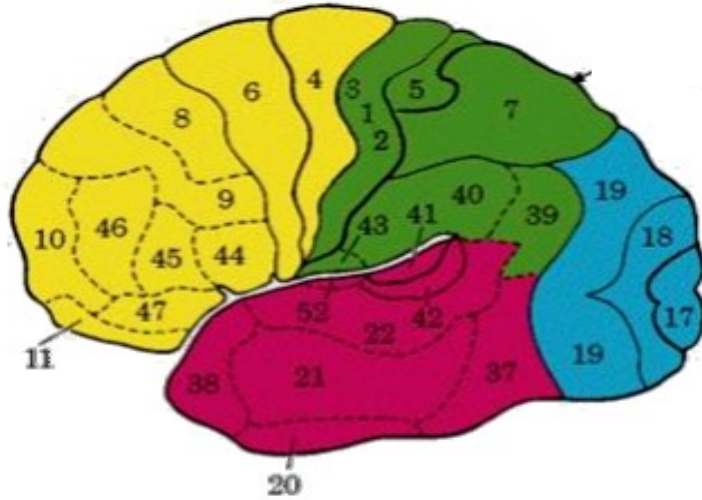


# Organization of neocortex

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



# Brodman areas

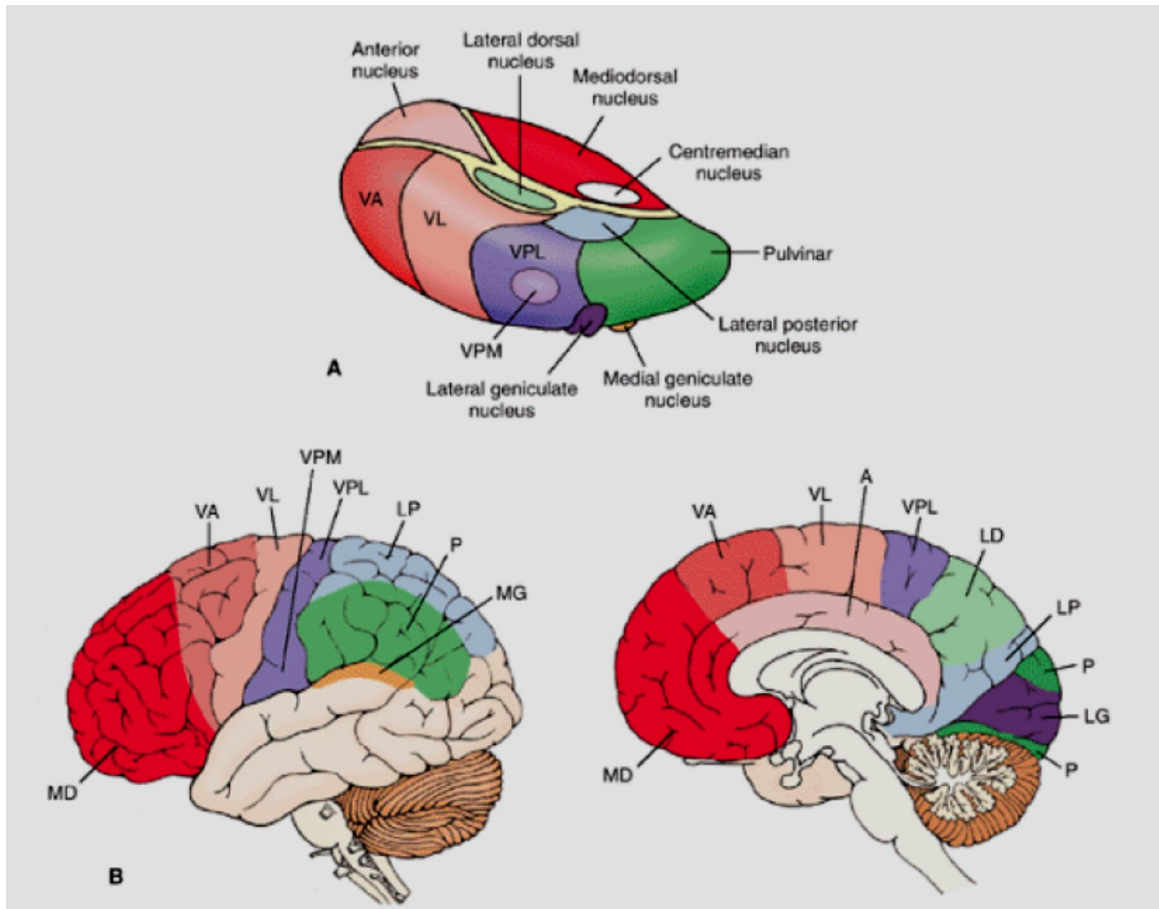


Broadman's #	NAME	FUNCTION
17	Occipital Lobe	Visual Projection Cortex
18		Visual Association Cortex
19	Posterior Parietal Lobe	Visual Association Cortex
37	Temporo-parietal-occipital area	General Sensory Association Cortex
39	Angular Gyrus	Word Recognition
40	Supramarginal Lobe	Somatosensory Association 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

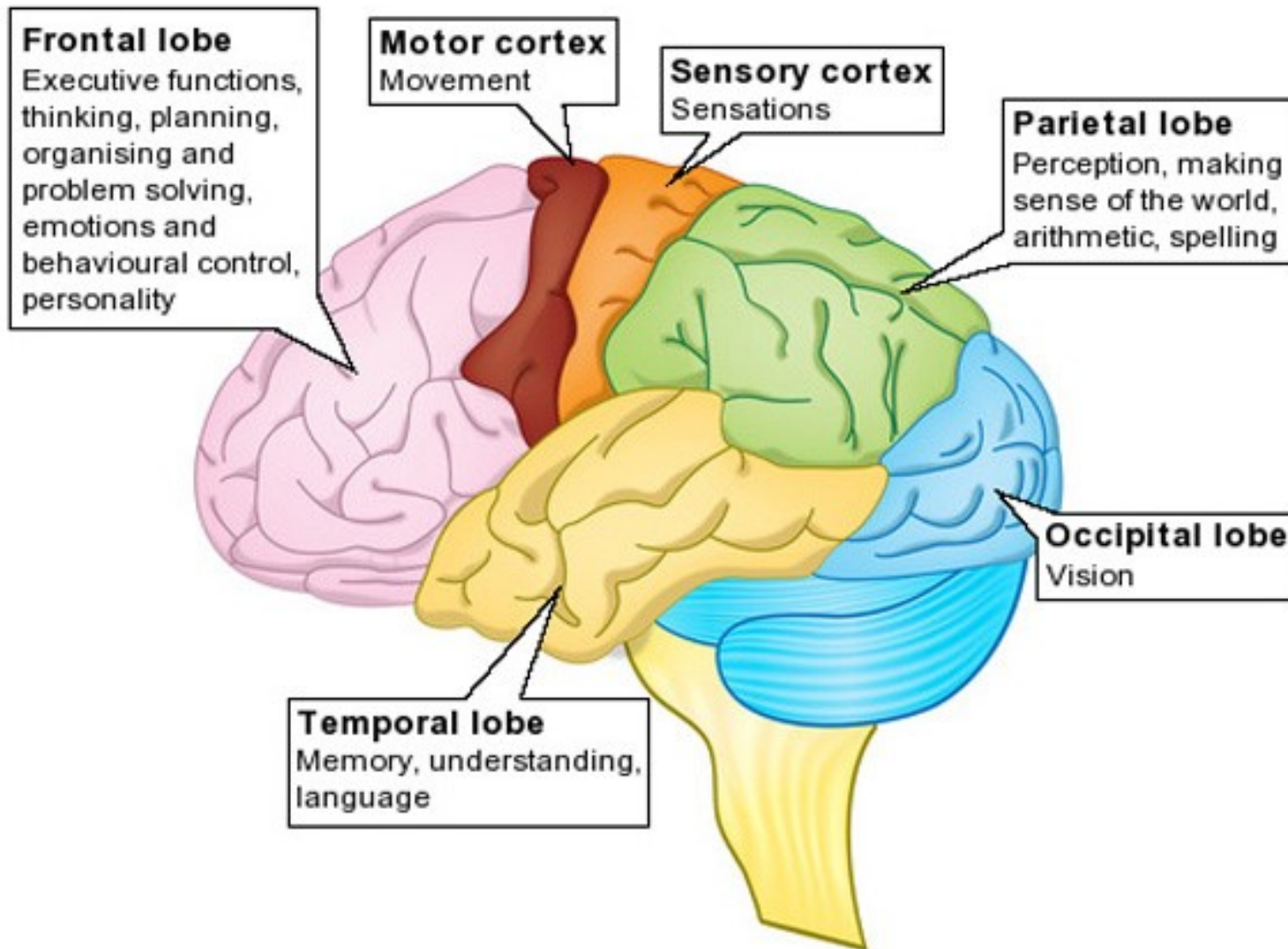


# Cerebral cortex and thalamus

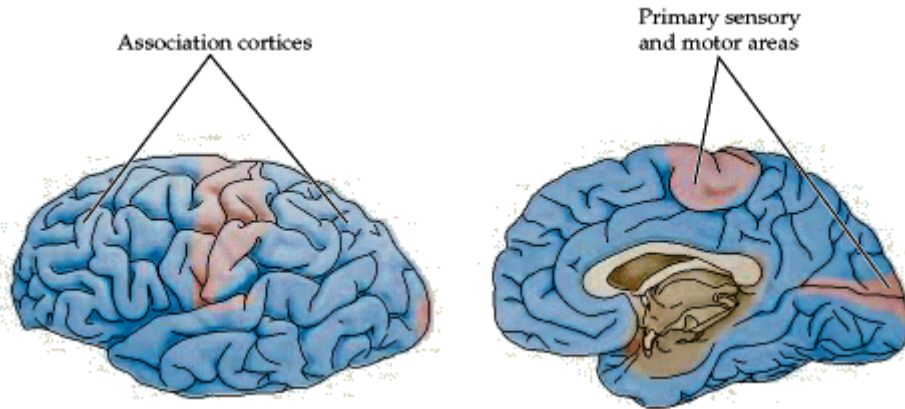
- Close cooperation between cerebral cortex and thalamus
- Bilateral connections
- Almost all sensory information reaching cerebral cortex is gated by thalamus
- Exception - olfaction



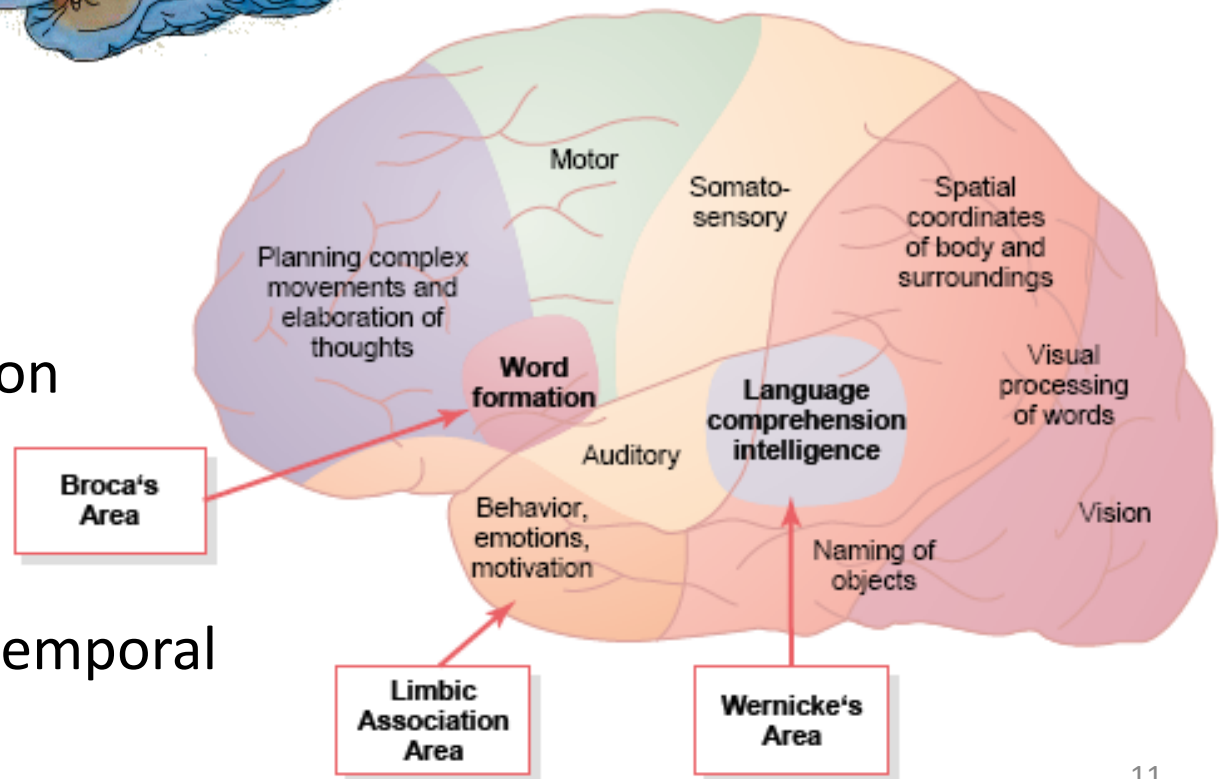
# Cortical functions



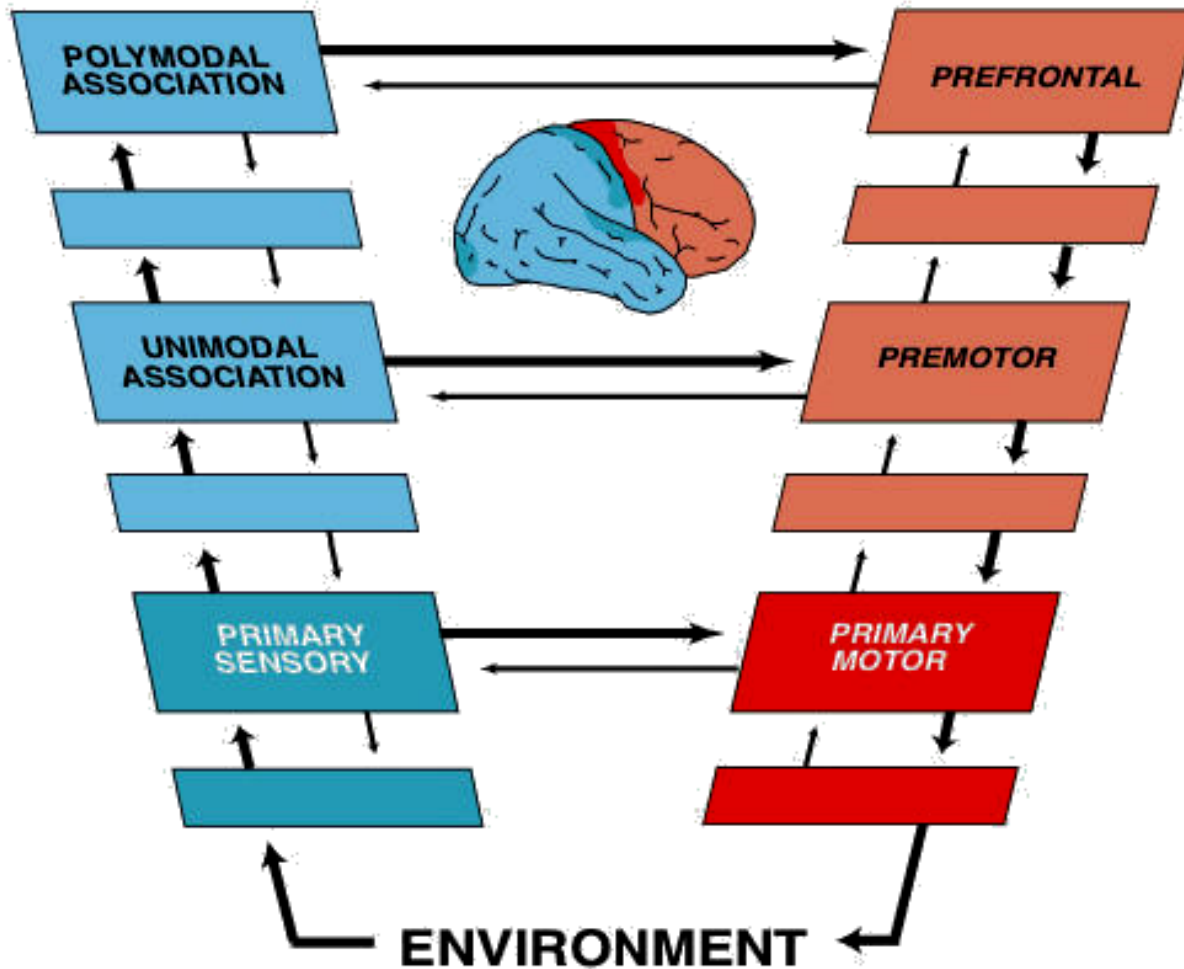
# Association areas



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

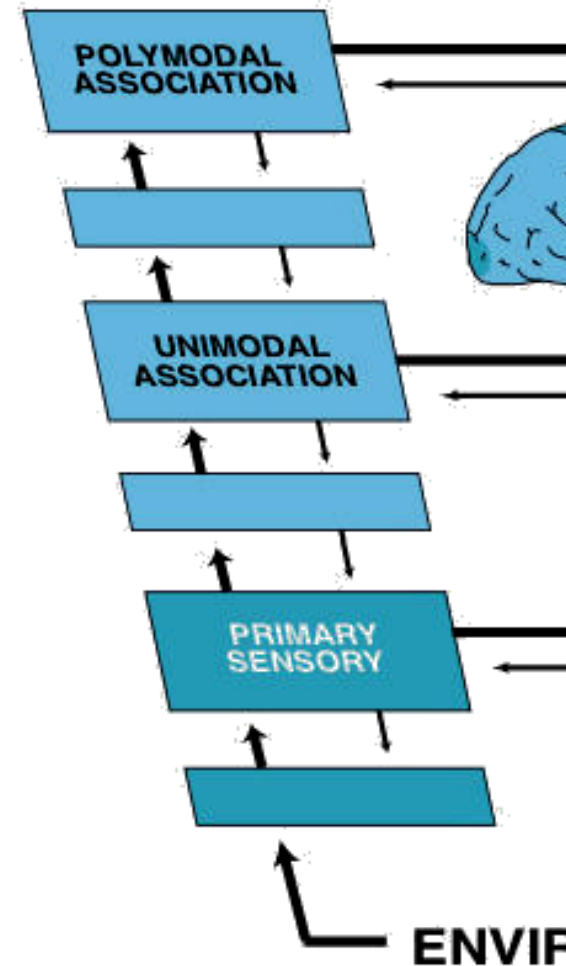
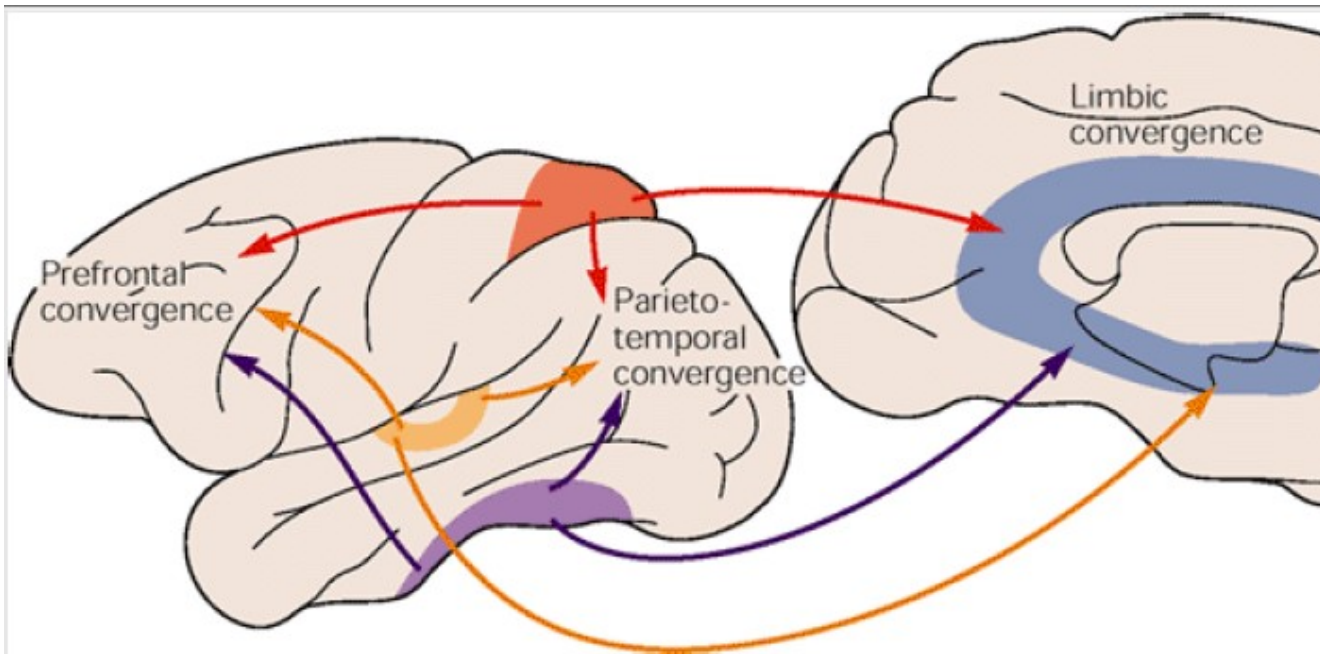


# Signal processing algorithm



# Aferentation

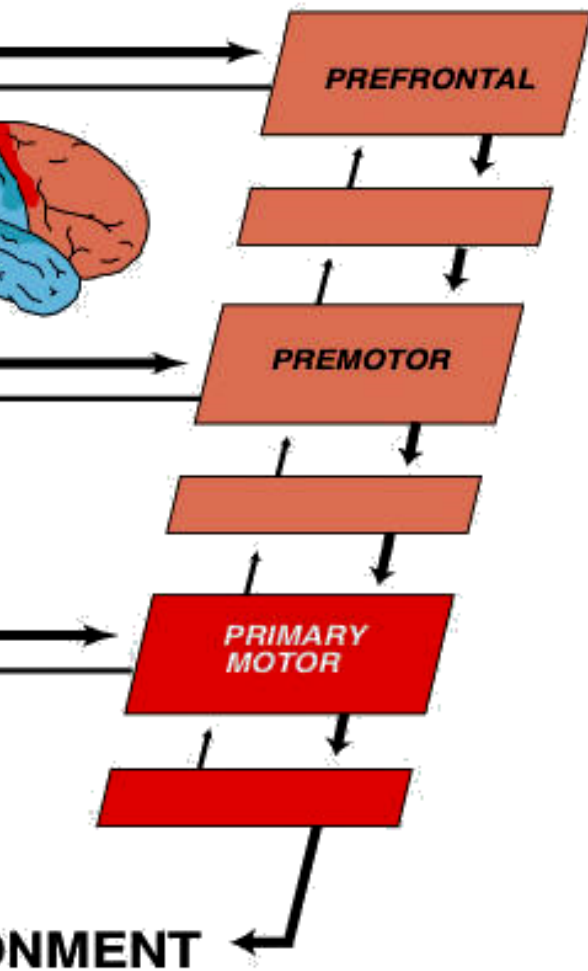
Unimodal sensory inputs converge on multimodal association areas



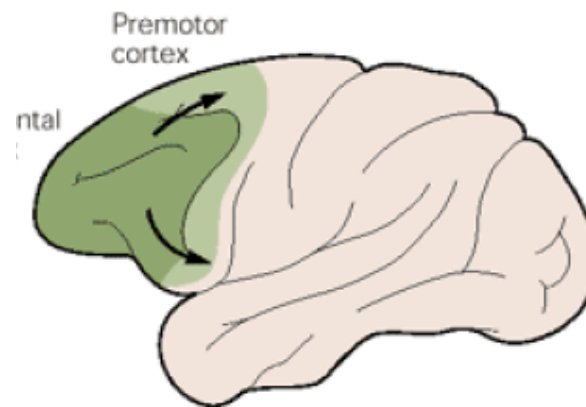
<http://www.slideshare.net/drpsdeb/presentations>

# Eferentation

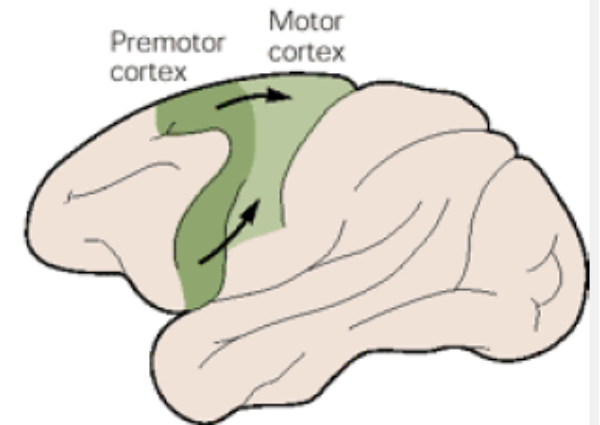
The Sequence of Information Processing Is Reversed in the Motor System



Motor planning



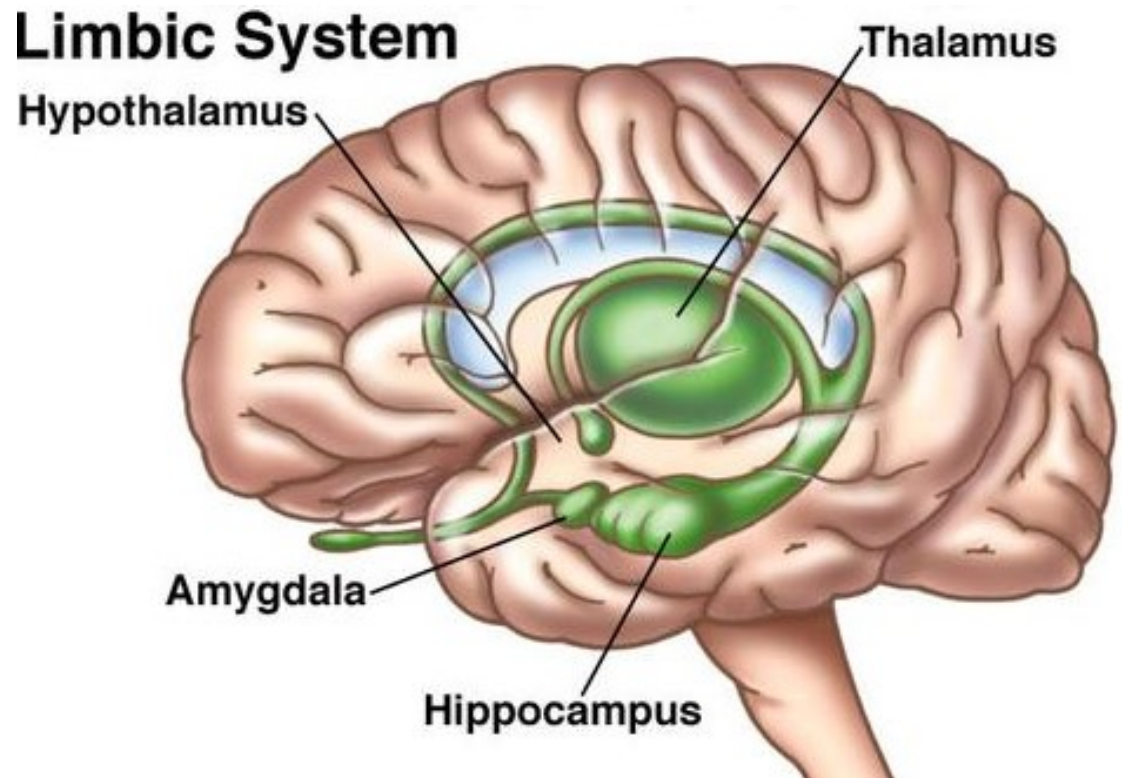
B Motor programs



<http://www.slideshare.net/drpsdeb/presentations>

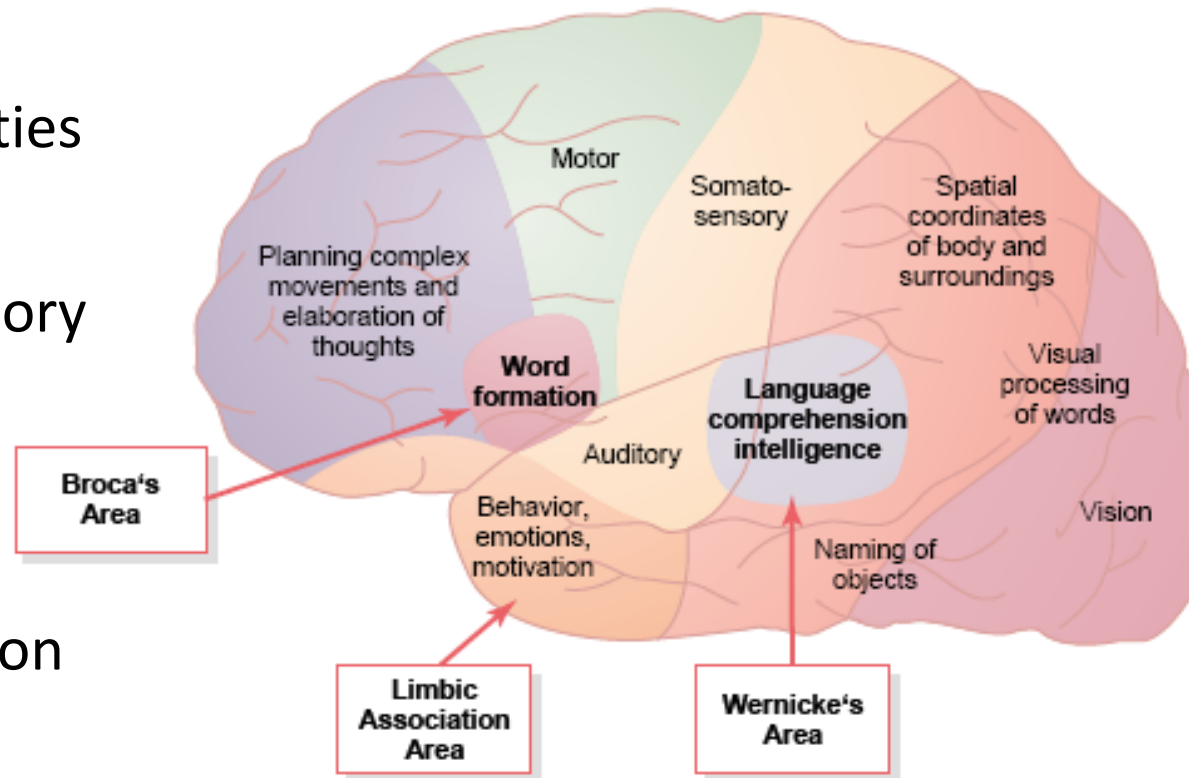
# Limbic association area

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



# Parieto-occipito-temporal association area

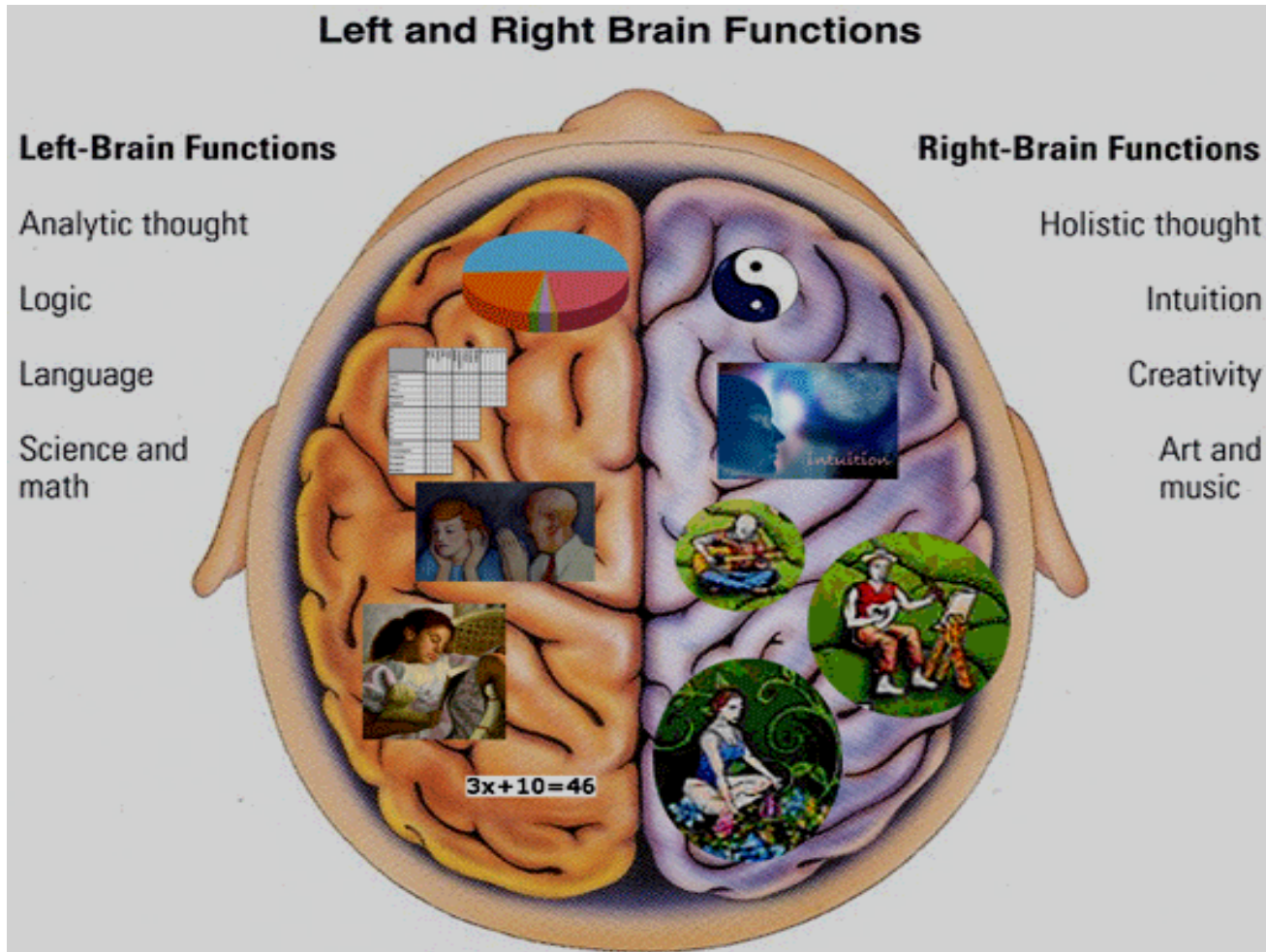
- Linking and interpretation of information from several sensory modalities
- Visual – acoustic – sensory analysis
- Object recognition and categorization
- Language comprehension
- Attention



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# Lateralization of brain functions



# Lateralization of brain functions

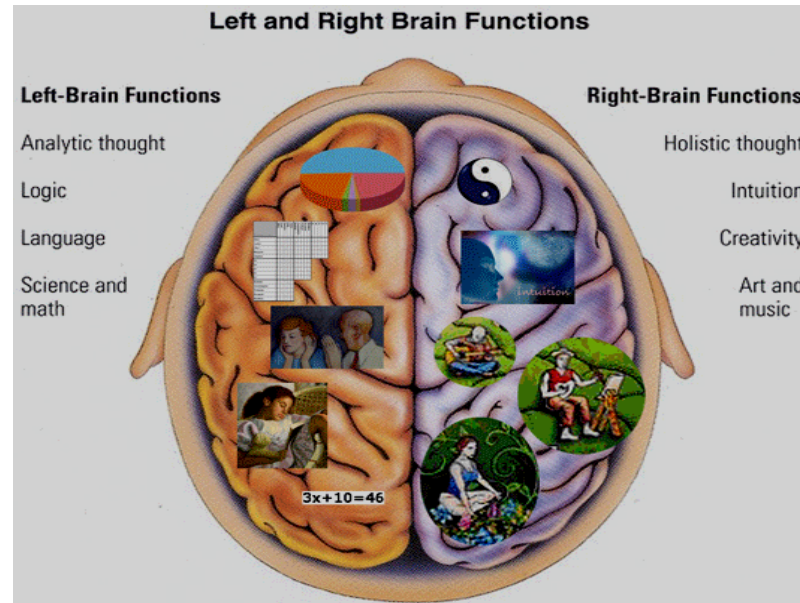
Aphasia

Acalculia

Tactile agnosia

Conceptual apraxia

Ideomotor apraxia



Orientation disorders

Constructional apraxia

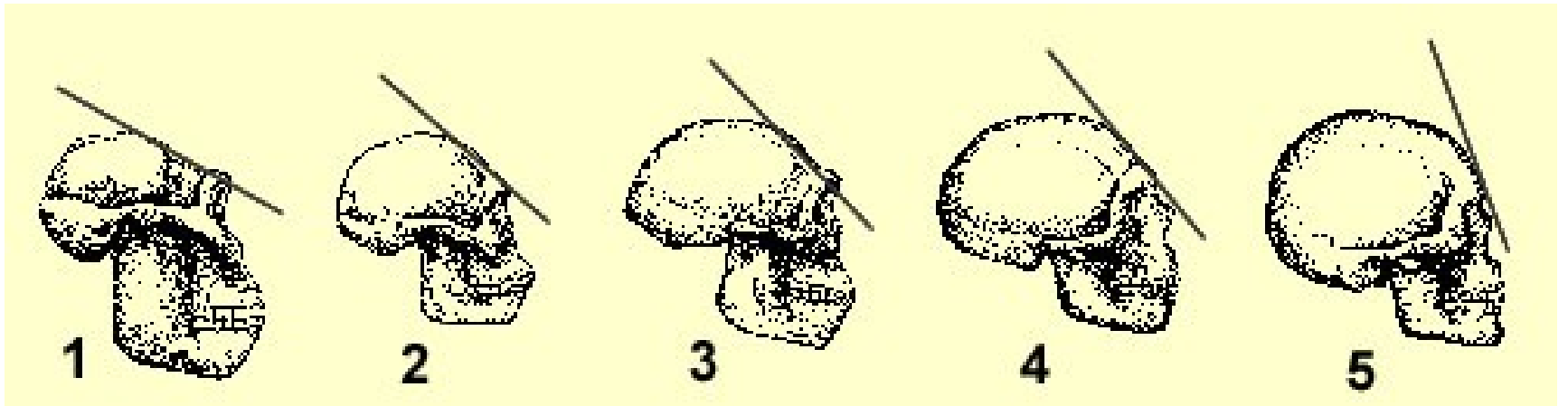
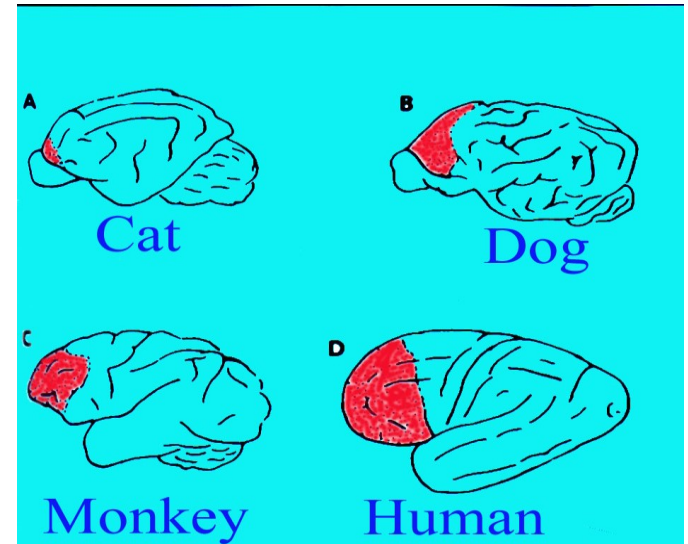
Anosognosia

Neglect syndrome

<http://www.slideshare.net/drpsdeb/presentations>

# Frontal association area

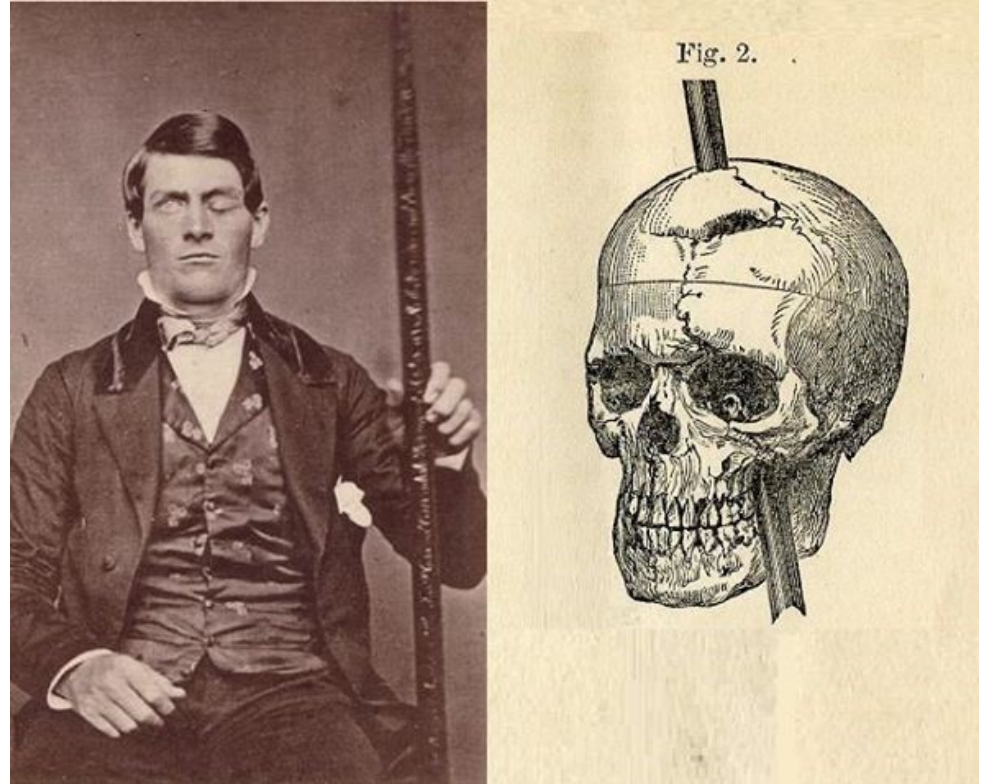
- Executive function
  - Motor / behavioral
  - Cognitive
- Mostly developed in human



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

# Phinease Gage (1823 – 1860)

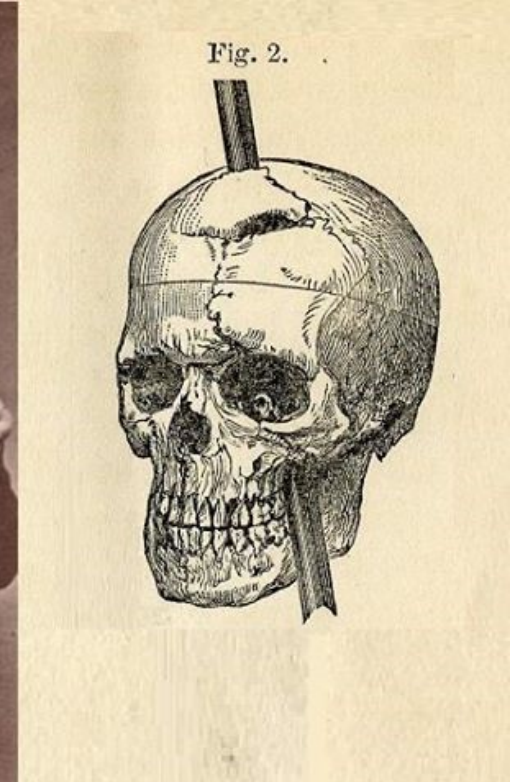
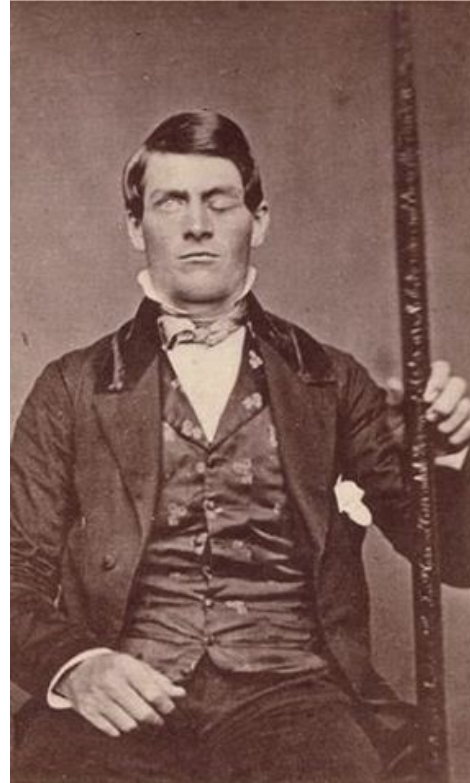
- 1848 – work injury
- Before injury
  - Reliable
  - Friendly
  - Responsible
  - Polite



[http://65.media.tumblr.com/553d3c3f3f579f57273b8598ec6739ab/tumblr\\_o11oqt0MUK1uaq7mqo1\\_1280.jpg](http://65.media.tumblr.com/553d3c3f3f579f57273b8598ec6739ab/tumblr_o11oqt0MUK1uaq7mqo1_1280.jpg)

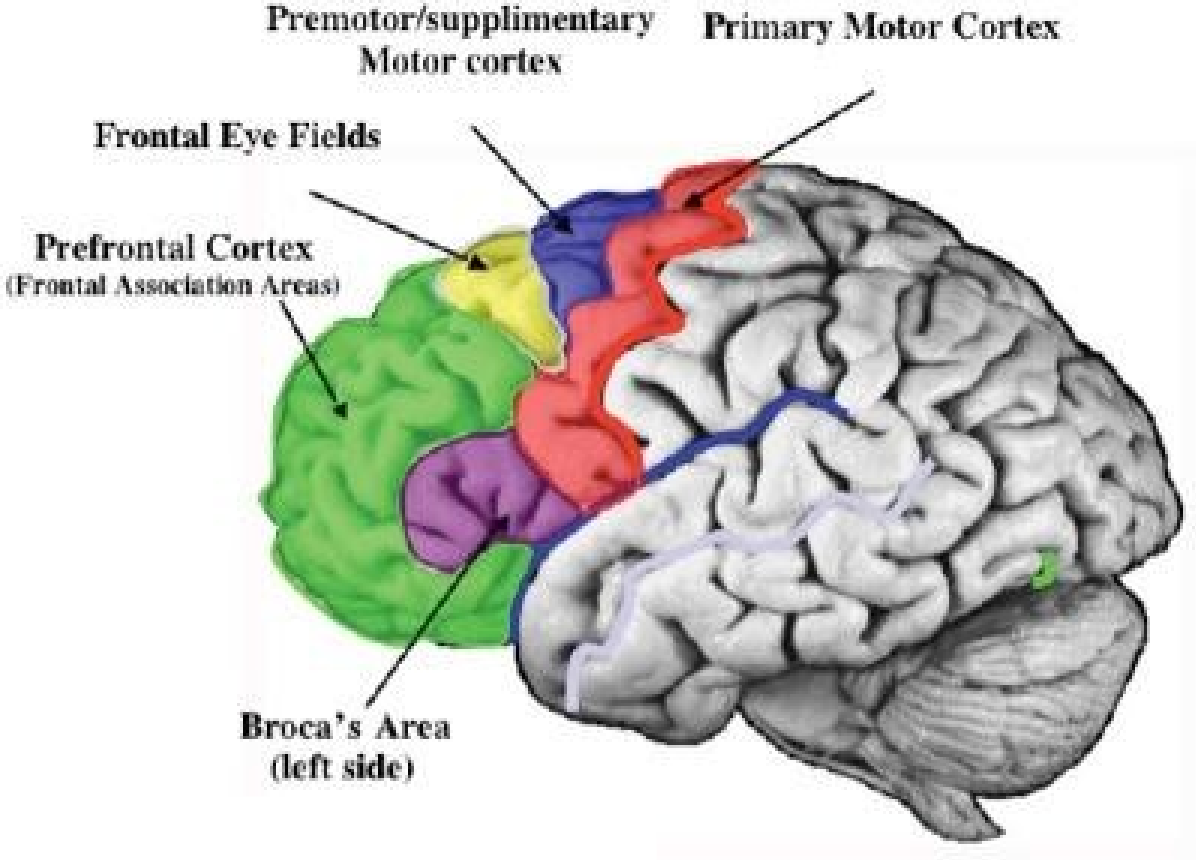
# Phinease Gage (1823 – 1860)

- 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](http://65.media.tumblr.com/553d3c3f3f579f57273b8598ec6739ab/tumblr_o11oqt0MUK1uaq7mqo1_1280.jpg)

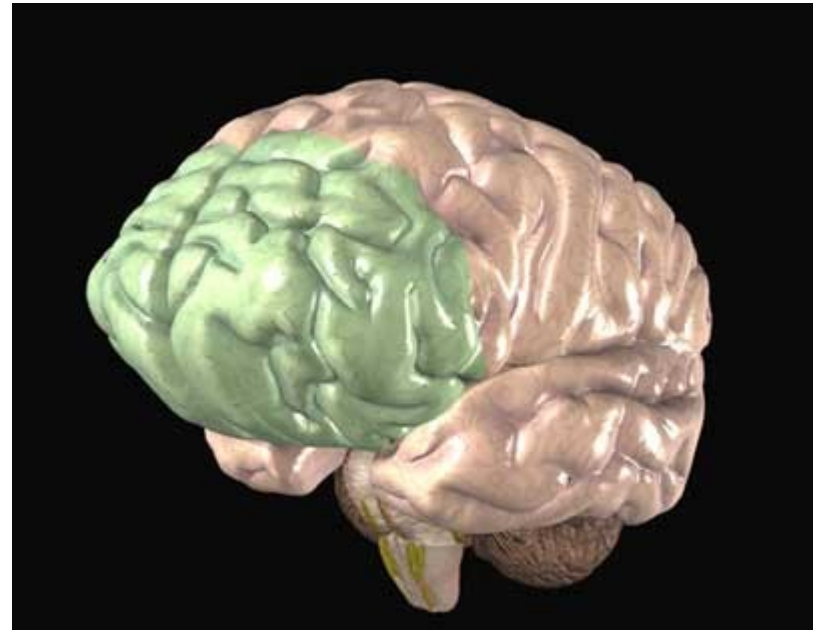
# Frontal lobe



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

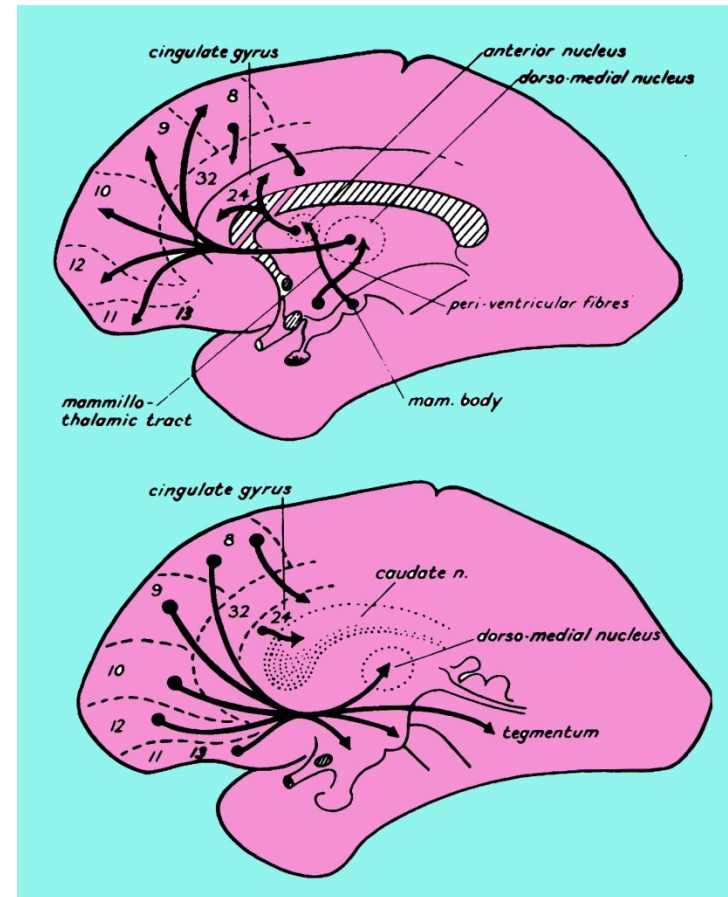
# Frontal association area

- ~ 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



<http://www.slideshare.net/drpsdeb/presentations>



# 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



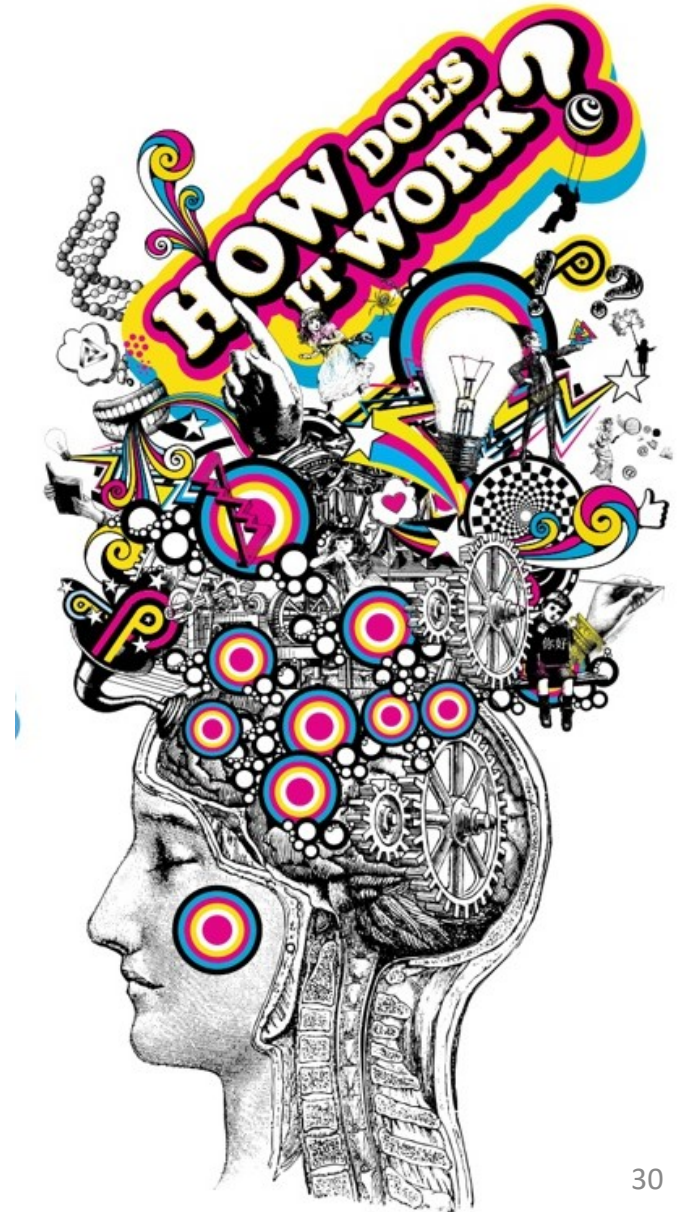
# 4. Behavioral control

- 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

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