



Kursk State Medical University
Normal Physiology Department

Limbic System and Cortex of the
Brain

Kursk 2012

Hess Amanda B.
Repalova Natalya V.
Group 20

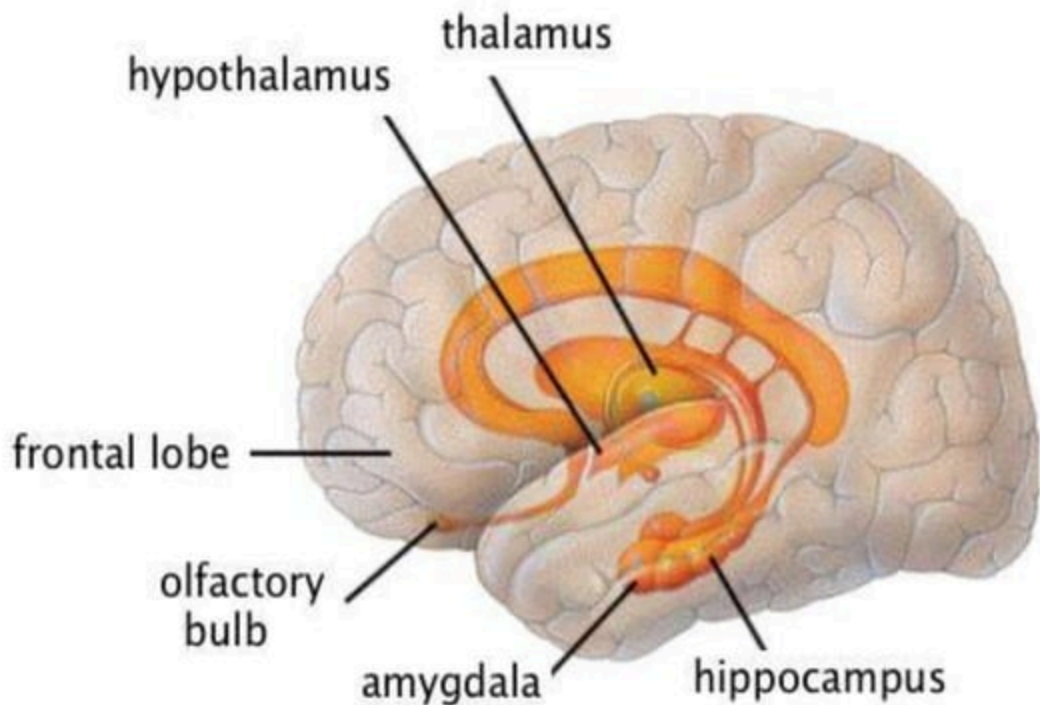
Plan

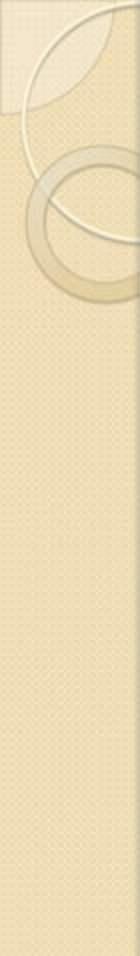
- Structure of the Limbic System
- Functions of the Limbic System
 - Behavioral, Emotional, Motivational function
 - Reward and Punishment function
- Specific functions of the others parts of Limbic System
 - Hypothalamus, hippocampus, amygdala, limbic cortex
- Structure of Cerebral Cortex
- Function of the Cerebral Cortex
 - Archio-, Paleo-, and Neocortex functions
- Histological structure of the Cerebral Cortex

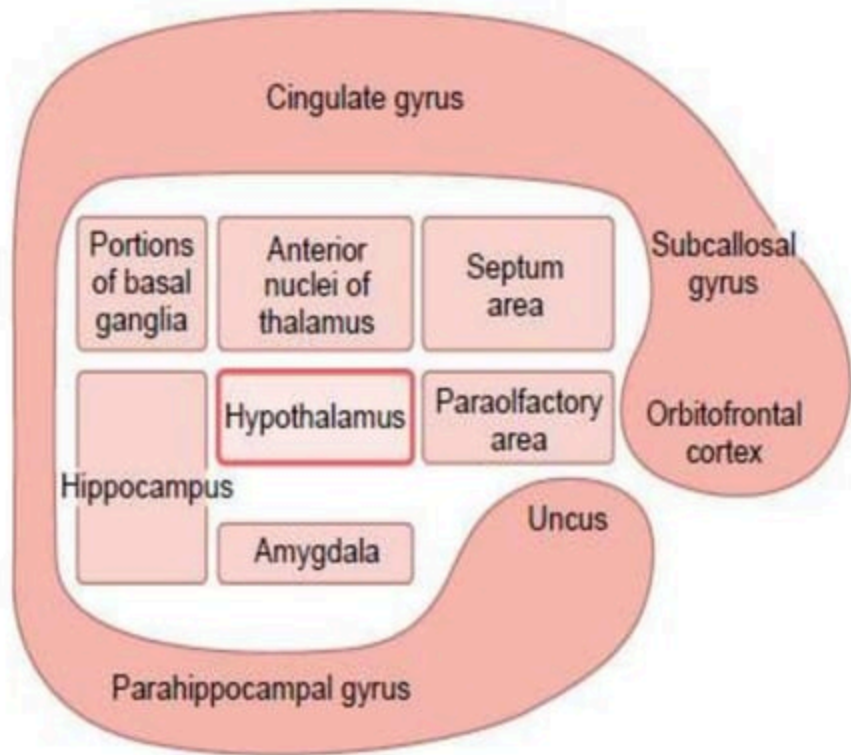
- Cerebral Cortex parts:
 - Motor cortex
 - Somatosensory cortex
 - Auditory cortex
- Association areas:
 - Parieto-occipitotemporal association area
 - Prefrontal association area
 - Limbic association area
 - Broca's area
 - Wernicke's area
- Concept of the Dominant Hemisphere
- References

Structure of Limbic System

- The Limbic System is the entire neuronal circuitry that controls emotional behavior and motivational drives.
- Has a complex set of structures that lies on both sides of the thalamus, just under the cerebrum.



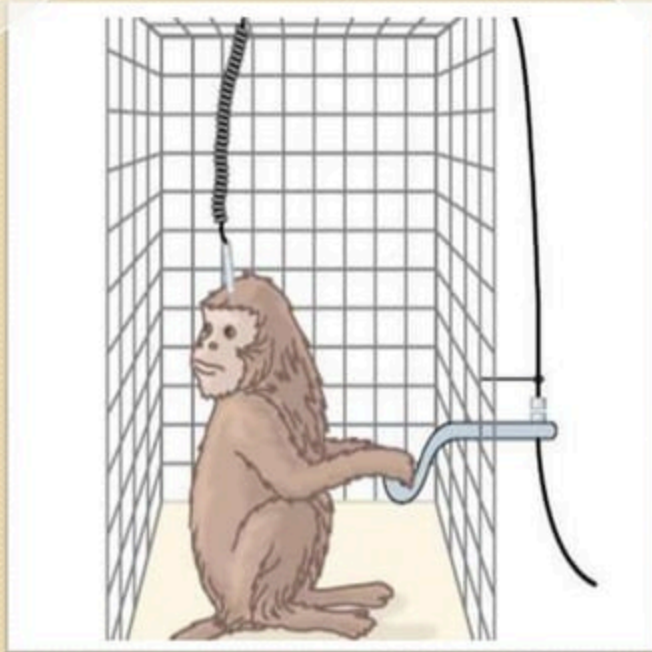
- 
- The major part is the hypothalamus, which is located in the center and surrounds are other subcortical structure of limbic system, as the septum, anterior nuclei of thalamus, basal ganglia, hippocampus, amygdala and parolfactory area.
 - Surrounding subcortical limbic is the limbic cortex that is compose of a ring which includes: orbitofrontal cortex, subcallosal gyrus, cingulated gyrus, parahippocampal gyrus and uncus.



Functions of the Limbic System

- Behavioral function: the actions or reactions of an organism, usually in relation to the environment.
- Emotional function: the mental and physiological state associated with a wide variety of feelings, thoughts and behavior.
- Motivational function: the set of reasons that determines one to engage in a particular behavior.

- Reward function:
 - Lateral and ventromedial nuclei of hypothalamus;
 - This is the center that is said to mediate pleasure or allow reward.
- Punishment function:
 - in central gray area surrounding the aqueduct of Sylvius in mesencephalon and extending upward into periventricular zones of hypothalamus.
 - Stimulation in the punishment centers can frequently inhibit the reward and pleasure centers, demonstrating that *punishment and fear can take precedence over pleasure and reward.*



Technique for localization reward and punishment centers in the brain of a monkey

If no reward and punishment, repetition of stimuli will cause habituation and therefore will cause the animal to ignore it.

If got reward and punishment effect, stimuli will be reinforced and animal will build up strong memory trace.

So this 2 effect are important in learning and memory and selection of information do take place.

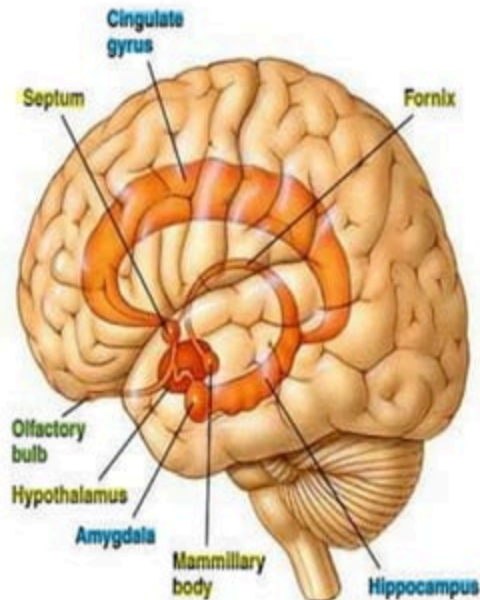
Specific functions of the others parts of the Limbic System

- Hypothalamus: has vegetative functions (cardiovascular regulation, arterial pressure regulation, influence on the heart rate; regulation of body temperature; regulation of body water); endocrine function (regulation of uterine contractility and milk ejection by breast).
- Hippocampus: function as remembering (transform the short memory into a long term memory), stimulation of any part can cause any of the different behavioral pattern, such as rage, pleasure, passivity or excess sex drive.

- Amygdala: controls of fear and anxiety, takes part in memory process, controls sexual desires, helps to pattern the person's behavioral responses in each occasion.
- Limbic Cortex: (intermediate associative positions between function of cerebral cortex and limbic system)
 - Anterior temporal cortex: the same as amygdala.
 - Posterior orbital frontal cortex: promotes sleep, calm emotion.
 - Anterior cingulate gyru and subcallosal gyru: control the rage centers of the spetumand hypothalamus.

Structure of the Cerebral Cortex

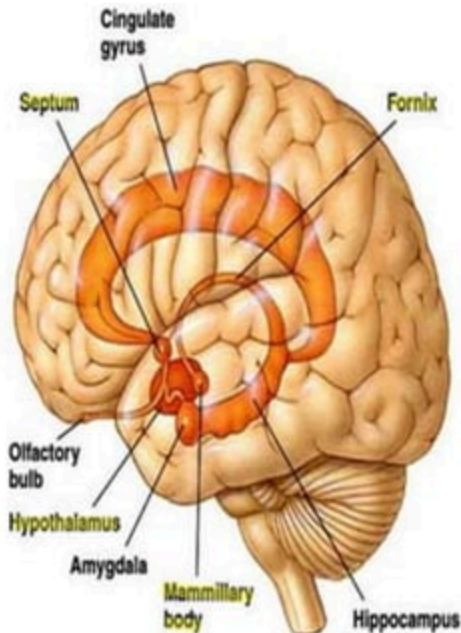
- **Archicortex**: include the olfactory bulbs which receive afferentation from olfactory epithelium, olfactory tractcs, olfactory tubercles.
- **Paleocortex**: comprises the gyrus cinguli, hippocampa gyrus and amygdala
- **Neocortex**: include all others regions.



Functions of the Cerebral Cortex

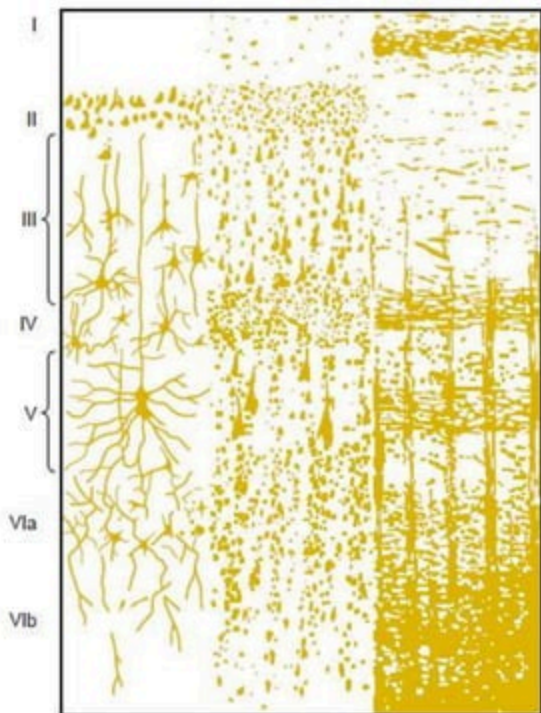
- Morphological investigations consider the archio- and paleocortex as a “visceral brain”.
- Functions:
 - Visceral brain is connected with attention, participates in the regulation of autonomic functions, play a main role in the instinctive behavior and formation of emotions.
 - Together with the hypothalamus and limbic area, the visceral brain regulates the activities of the body concerned with homeostasis, self preservation and preservation of species.

- Neocortex (mammillary bodies, hypothalamus, septum and fornix) has function in the:
 - Memory
 - Hearing
 - Mechanism related to language



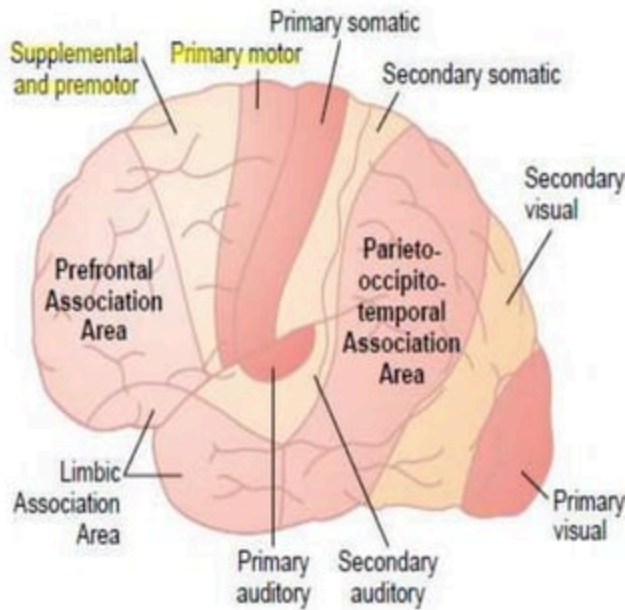
Histological Structure of the Cerebral Cortex

- I- molecular layer
- II-external granular layer
- III- pyramidal cells layer
- IV- internal granular layer
- V- large pyramidal cell layer
- VI a- fusiform cells layer
- VI b- polymorphic cells

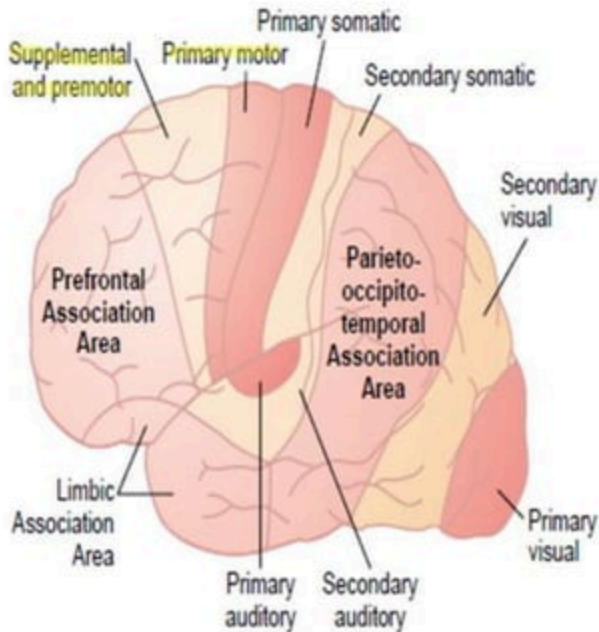


Cerebral Cortex: Motor Cortex

- Primary motor cortex: controlling the activity of the muscle.
- Premotor area: generate complex “pattern” of the movement and sends signals to the primary motor cortex or to the basal ganglia and after signals from the thalamus come back to the primary motor cortex.



- Supplementary motor area: regulate bilateral muscle contractions, eg.: grasping movements, rotation of the different parts of the body, positional movements of the head and the neck).

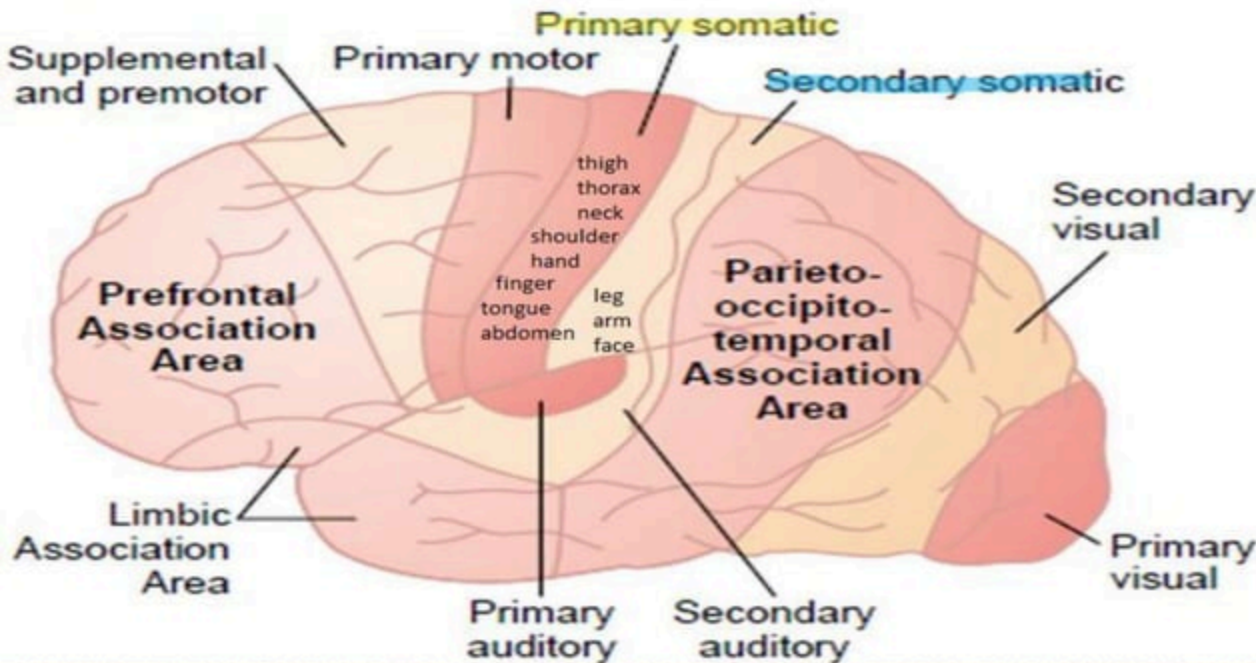


Somatosensory area I: High degree of localization of the different parts of the body.

Receive and differentiate the sensation from opposite side of the body.

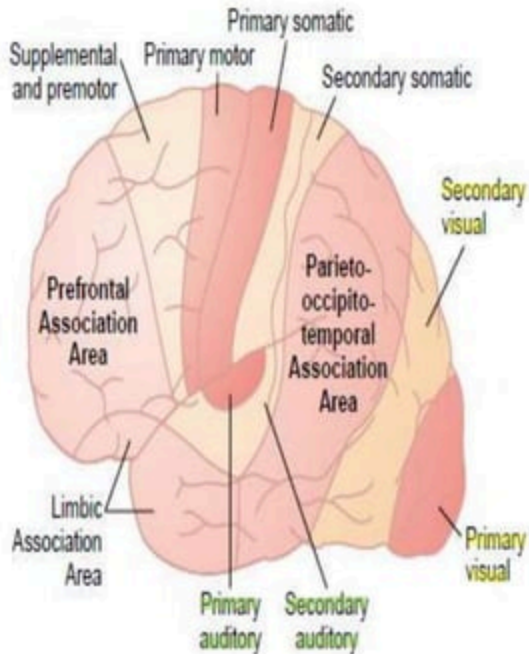
Somatosensory area II: Low degree of localization of the different parts of the body.

Receive the signals from somatosensory area I, brain stem, visual and auditory



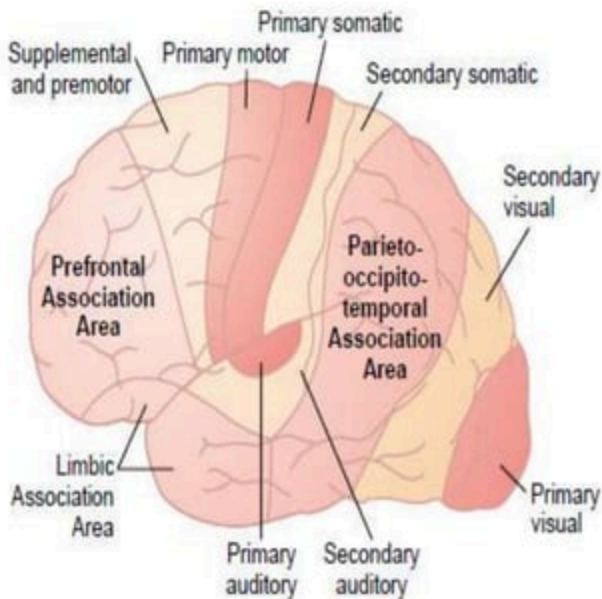
Somatosensory cortex

- Primary visual cortex: signal from the macular area of the retina terminate near the occipital pole, whereas the signal from the more peripheral retina terminate in concentric circles anterior to the pole.
- Secondary visual cortex: receive the visual signals from the primary cortex and transmitted to the other area for analysis of the visual meaning.
- Auditory cortex: sound frequency perception in the primary auditory cortex and discrimination of the sound "pattern" in

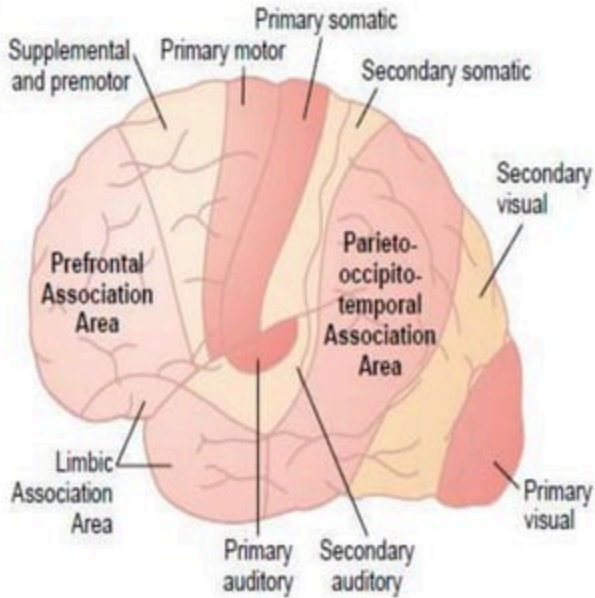


Association Areas: Parieto-occipitotemporal Association Area

- 1-analysis of spatial coordination of the body
- 2- area for language comprehension
- 3- area for initial processing of the visual language (reading)
- 4- area for the naming of objects



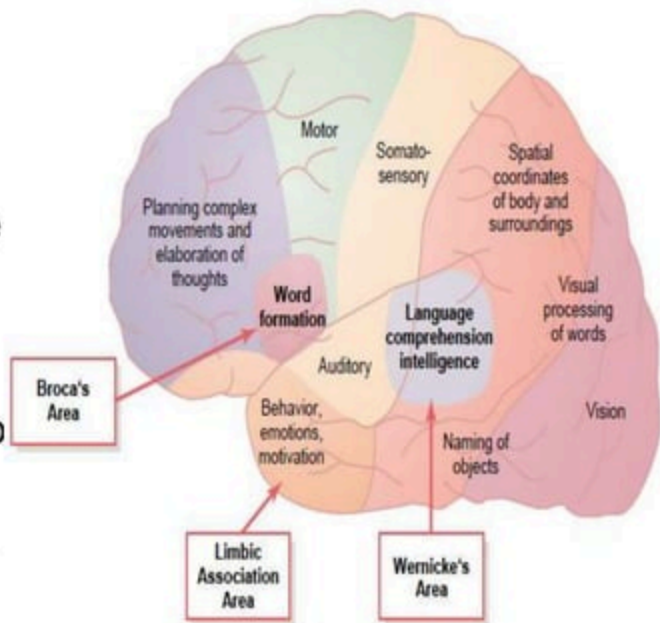
Prefrontal Association Area



- 1- association with the motor cortex to plan complex patterns and sequence of the motor movements.
- 2- working memory: transform words in information.
- 3- carrying out thought processes in the mind.

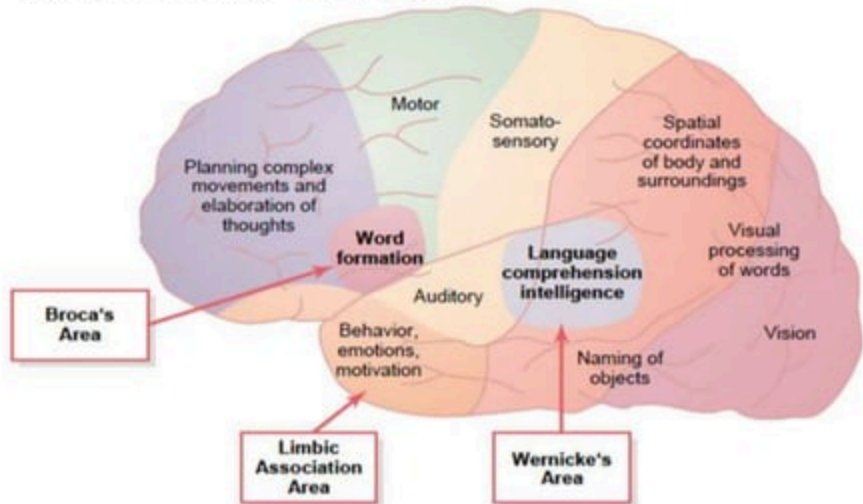
Limbic Association Area

- The Limbic Association Area is primarily concerned with behavior, emotion, motivation.
- Is associated with the limbic system that provides most of the emotional drives for setting the other areas of the brain into action and even provides the motivational drive for the process of learning itself.

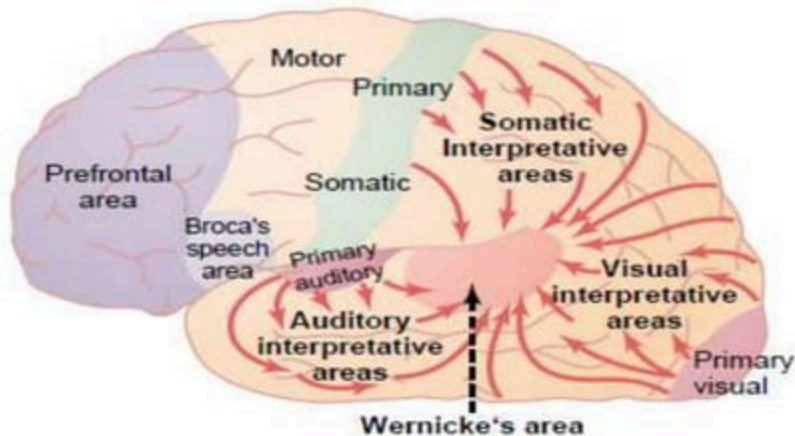


Broca's Area

- A special region in the frontal cortex, providing the neuronal circuit for word formation.
- Plans the motor patterns for the expressing individual words or even short phrases are initiated and executed.



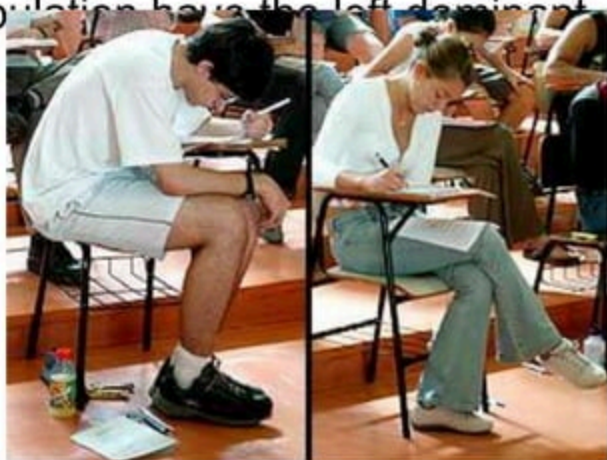
Wernicke's Area



- Direct connect with cortex, visual area, auditory area, language comprehension, intelligence.
- General interpretative area. Knowing area.
- It plays the greatest single role of any part of the cerebral cortex in the high comprehensive levels of the brain function. (intelligence, interpreting the complicated meanings of different patterns of sensory experiences)

Concept of the Dominant Hemisphere

- The general interpretation function of the Wernicke's area and the angular gyrus as well as the functions of the speech and the motor control areas are usually much more developed in the one cerebral hemisphere than in the other.
- 95% of the population has the left dominant hemisphere.



Ex.: Lefty and
Dexterous

References

- ▶ Lecture of Prof. Avdeev Elena V.
- ▶ Arthur C. Guyton, M.D.
Physiology, Eleventh Edition



Thank you for your Attention!