FUNCTION OF CEREBRAL CORTEX

Course: Neuropsychology CC-6 (M.A PSYCHOLOGY SEM II); Unit I

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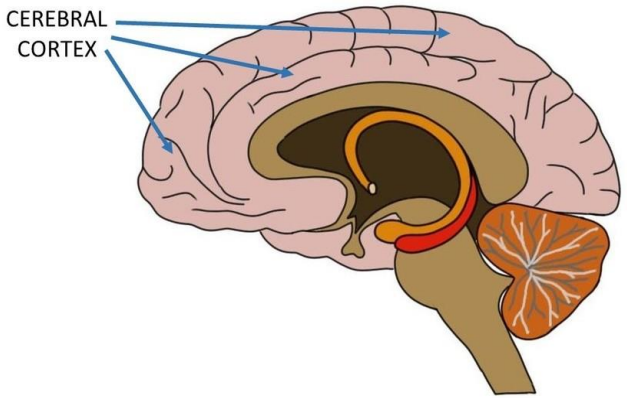
The **cerebral cortex**—the thin outer covering of the brain-is the part of the brain responsible for our ability **to reason, plan, remember, and imagine**. **Cerebral Cortex accounts for our impressive capacity to process and transform information.** The cerebral cortex is only about one-eighth of an inch thick, but it contains billions of neurons, each connected to thousands of others. The predominance of cell bodies gives the cortex a brownish gray colour. Because of its appearance, the cortex is often referred to as gray matter. Beneath the cortex are myelin-sheathed axons connecting the neurons of the cortex with those of other parts of the brain.

The large concentrations of myelin make this tissue look whitish and opaque, and hence it is often referred to as white matter.

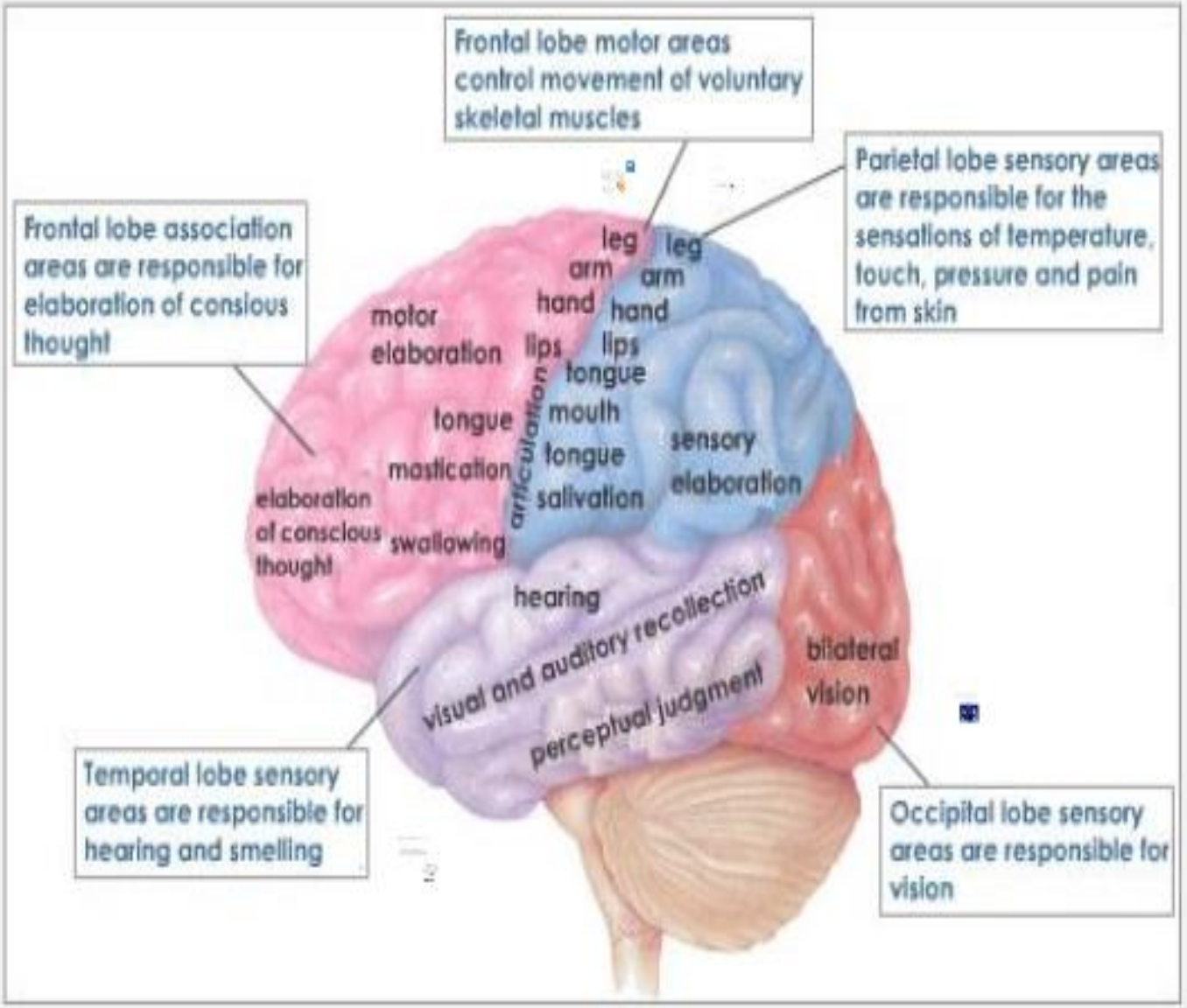


The cortex is divided into two nearly symmetrical halves, the ***cerebral hemispheres*** . Thus, many of the structures of the **cerebral cortex appear in both the left and right cerebral hemispheres. The two hemispheres appear to be somewhat specialized in the functions they perform.**

The cerebral hemispheres are folded into many ridges and grooves, which greatly increase their surface area. Each hemisphere is usually described, on the basis of the largest of these grooves or *fissures*, as being divided into four distinct regions or lobes. The four lobes are:

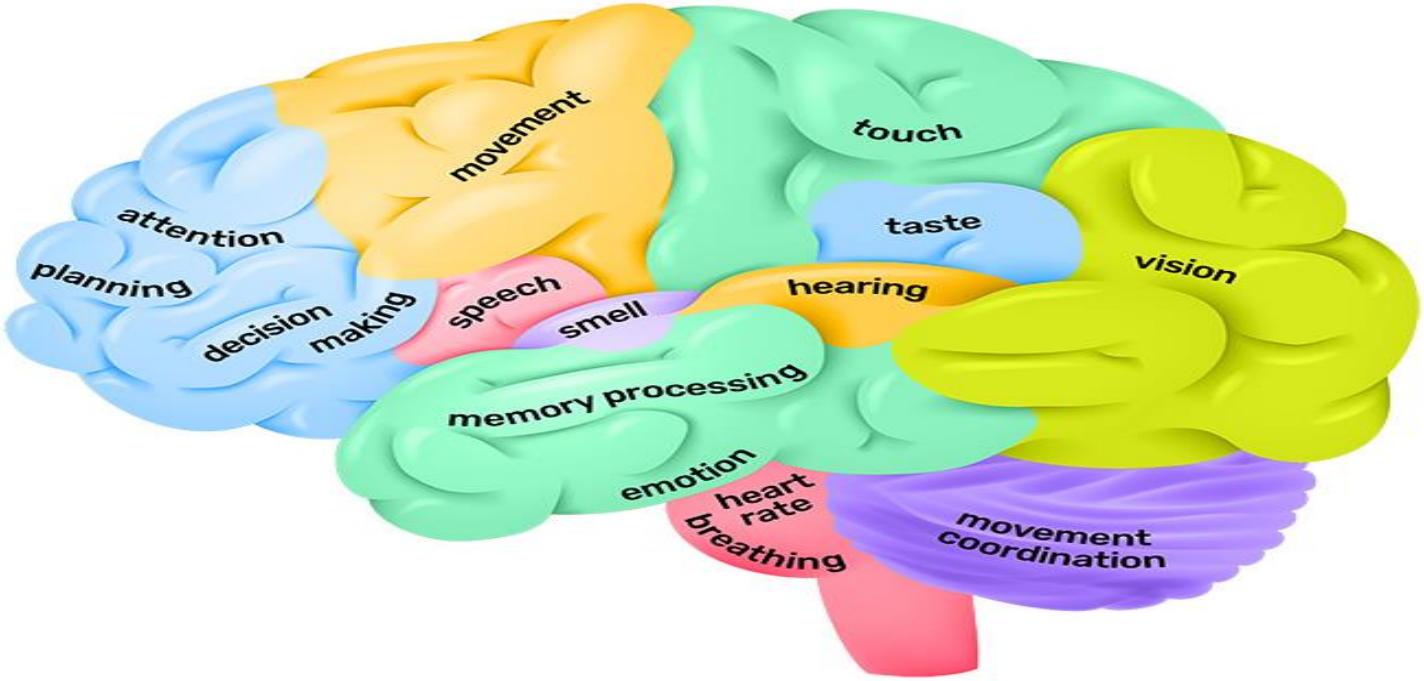
- **Frontal,**
- **Parietal,**
- **Occipital, and**
- **Temporal.**

Functions of the Cerebral Cortex



The **cerebral cortex** is the largest site of neural integration in the central nervous system. It plays a key **role** in

- attention,
- perception,
- awareness,
- thought,
- memory,
- language, and
- consciousness.



The Frontal Lobe

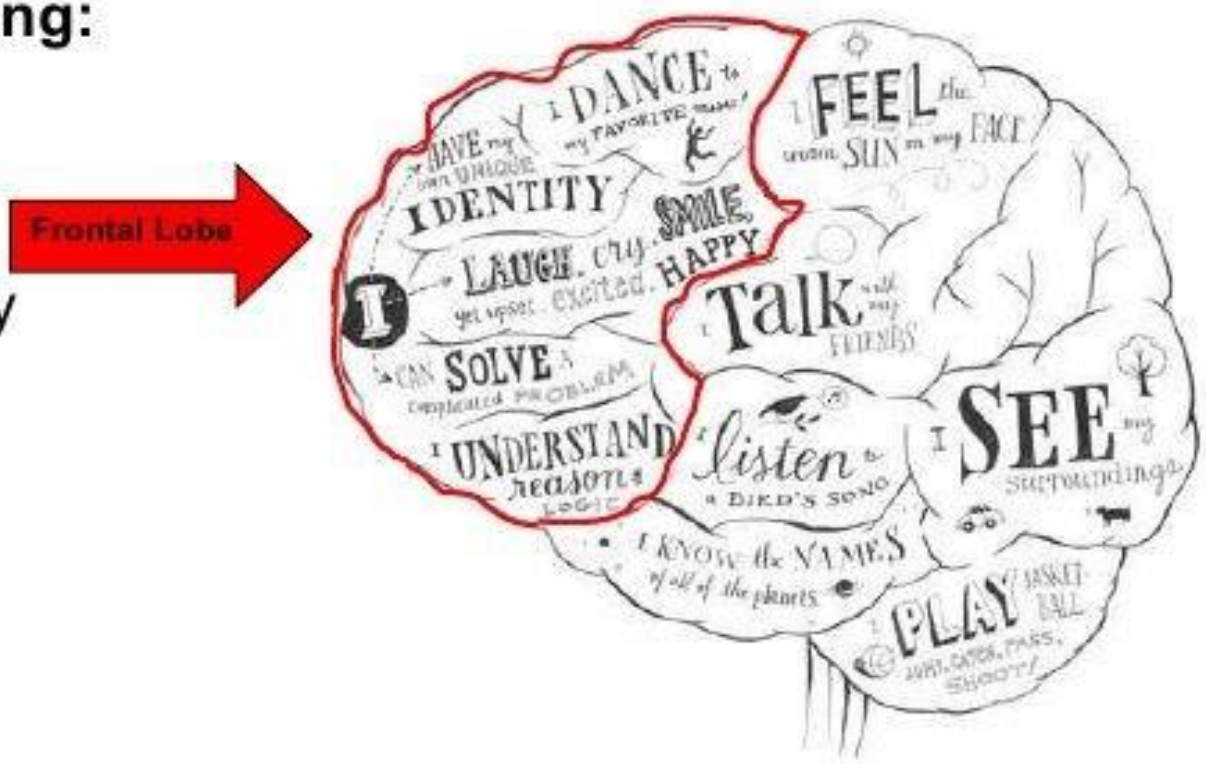
Occupying the area of the brain nearest the face, the **frontal lobe** is bounded by the deep *central fissure*. Lying along this fissure, just within the frontal lobe, is the *motor cortex*, **an area concerned with the control of body movements.** Damage to this area does not produce total paralysis. Instead, it often results in a loss of control over fine movements, especially of the fingers. While a specific area may normally perform a given function, other regions can often take up the slack if an area is damaged and may gradually come to perform the same functions. Such *plasticity*, as it is often termed, is greater at a young age than after maturity, but it seems to operate to some extent throughout life.

Functions

The Frontal lobe is considered the emotional control center and the home of our personality.

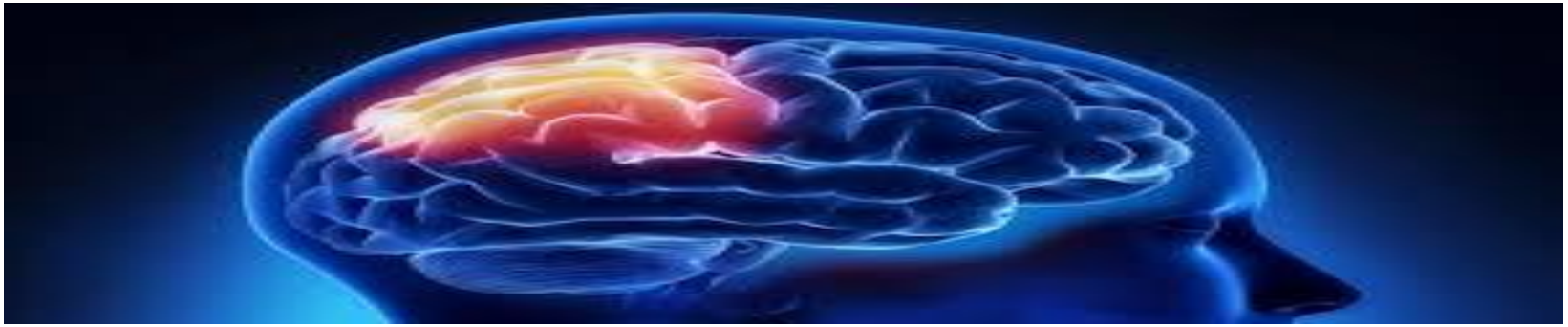
The frontal lobe controls higher level thinking:

- Reasoning
- Planning
- Language
- Long-term Memory
- Impulse control
- Problem Solving
- Emotions
- Judgment
- Motor Function
- Initiation
- Social/ Sexual Behavior



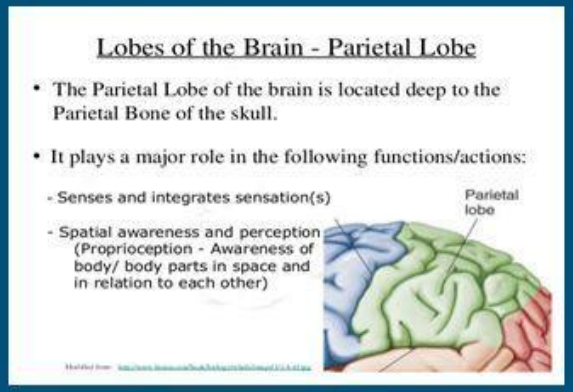
The Parietal Lobe

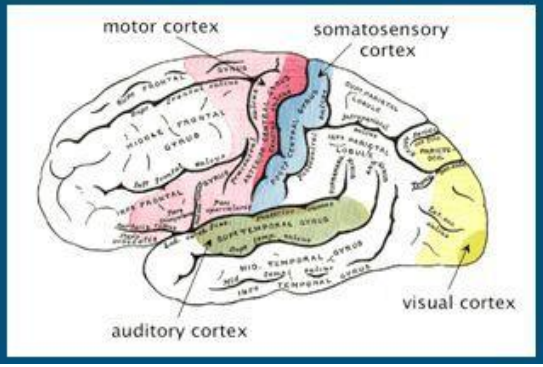
Across the central fissure from the frontal lobe is the **parietal lobe.** This area **contains the primary *somatosensory cortex*, to which information from the skin senses—touch, temperature, pressure, and so on—is carried**. Discrete damage to this area produces a variety of effects, depending in part on whether injury occurs to the left or right cerebral hemisphere. If damage involves the left hemisphere, individuals may lose the ability to read or write, or they may have difficulty knowing where parts of their own body are located. In contrast, if damage occurs in the right hemisphere, individuals may seem unaware of the left side of their body. For example, a man may neglect to shave the left side of his face.



Functions of the Parietal Lobe

- most notable for somatosensory cortex which integrates sensory information such as taste, temperature, and touch
- identifies where parts of your body are in relation to each other
- part of lobe related to visuospatial processing





The Occipital Lobe

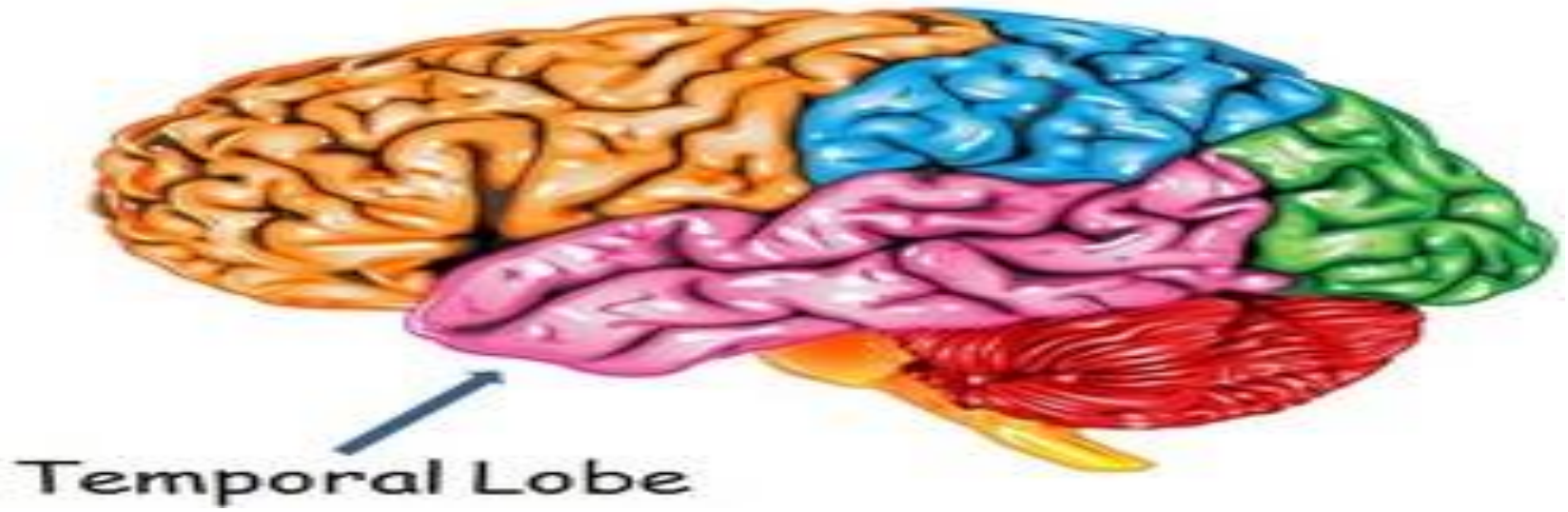
The **occipital lobe** is located near the back of the head. Its primary functions are visual, and it contains a sensory area that **receives input from the eyes**. Local damage to this area often produces a "hole" in the person's field of vision: Objects in a particular location can't be seen, but the rest of the visual field may remain unaffected. As with other brain structures, injury to the occipital lobe may produce contrasting effects depending on which cerebral hemisphere is affected. Damage to the occipital lobe in the right hemisphere produces loss of vision in the left visual field, whereas damage to the occipital lobe in the left hemisphere produces loss of vision in the right visual field.

Occipital Lobe

the processing of vision and visual information

The Temporal Lobe

The **temporal lobe** is located along the side of each hemisphere. The location makes sense, for this lobe is **concerned primarily with hearing and contains a sensory area that receives input from the ears.** Damage to the temporal lobe, too, can result in intriguing symptoms. When such injuries occur in the left hemisphere, people may lose the ability to understand spoken words. When damage is restricted to the right hemisphere, they may be able to recognize speech but may lose the ability to recognize other organizations of sound—for example, melodies, tones, or rhythms.



Temporal Lobe Functions

- Auditory—primary and association
- Olfactory—primary and association
- Visual association (recognition and color)
- Memory
- Emotional and social
- Link past and present sensory and emotional experiences into a continuous self

When added together, areas of the cortex that either control motor movements (*motor cortex*) or receive sensory input (*sensory cortex*) account for only 20 to 25 percent of the total area. The remainder is known as *association cortex* and, as its name suggests, is assumed to play a critical role in integrating the activities in the various sensory systems and in translating sensory input into programs for motor output.

In addition, the association cortex is involved in complex cognitive activities such as thinking, reasoning, and remembering. However, evidence concerning its role in these functions is incomplete at best (Pinel, 1993).

Connections

The cerebral cortex is connected to various subcortical structures such as the thalamus and the basal ganglia, sending information to them along efferent connections and receiving information from them via afferent connections. Most sensory information is routed to the cerebral cortex via the thalamus. Olfactory information, however, passes through the olfactory bulb to the olfactory cortex (piriform cortex). The majority of connections are from one area of the cortex to another, rather than from subcortical areas; Braitenberg and Schüz (1998) claim that in primary sensory areas, at the cortical level where the input fibres terminate, up to 20% of the synapses are supplied by extracortical afferents but that in other areas and other layers the percentage is likely to be much lower.

Cortical areas

The whole of the cerebral cortex was divided into 52 different areas in an early presentation by Korbinian Brodmann. These areas known as Brodmann areas, are based on their cytoarchitecture but also relate to various functions.

The cortex is typically described as comprising three parts:

- **Sensory,**
- **Motor, and**
- **Association areas.**

Sensory areas

The sensory areas are the cortical areas that **receive and process information from the senses.** Parts of the cortex that receive sensory inputs from the thalamus are called primary sensory areas. **The senses of vision, hearing, and touch are served by the primary visual cortex, primary auditory cortex and primary somatosensory cortex respectively.** In general, the two hemispheres receive information from the opposite (contralateral) side of the body. For example, the right primary somatosensory cortex receives information from the left limbs, and the right visual cortex receives information from the left visual field.

Motor areas

The motor areas are located in both hemispheres of the cortex. The motor areas are very closely related to the **control of voluntary movements, especially fine fragmented movements performed by the hand. The right half of the motor area controls the left side of the body, and vice versa.**

Two areas of the cortex are commonly referred to as motor:

Primary motor cortex, which *executes* voluntary movements

Supplementary motor areas and premotor cortex, which *select* voluntary movements.

In addition, motor functions have been described for:

Posterior parietal cortex, which guides voluntary movements in space

Dorsolateral prefrontal cortex, which decides which voluntary movements to make according to higher-order instructions, rules, and self-generated thoughts.

Just underneath the cerebral cortex are interconnected subcortical masses of grey matter called basal ganglia (or nuclei). The basal ganglia receive input from the substantia nigra of the midbrain and motor areas of the cerebral cortex, and send signals back to both of these locations. They are involved in **motor control.** They are found lateral to the thalamus.

Association areas- produce a meaningful perceptual experience of the world, enable us to interact effectively, and support abstract thinking and language. The parietal, temporal, and occipital lobes - all located in the posterior part of the cortex - integrate sensory information and information stored in memory. The frontal lobe or prefrontal association complex is involved in planning actions and movement, as well as abstract thought.

Globally, the association areas are organized as distributed network.

THANK YOU