Information Handout

Professional Version | US English

What Does The Brain Do? (Lobes and Regions)

Description

The human brain is the center of the body's nervous system and the seat of cognition. It is responsible for everything that we do, feel, and perceive. The brain receives information from sensory inputs and uses that information to make sense of the world, by comparing and integrating it with past experiences. The brain creates, stores, and retrieves memories, as well as controlling body movements to enable action and communication.

The main part of the brain is called the cerebral cortex, and it is divided into four lobes (frontal, parietal, occipital, and temporal). The cognitive functions associated with these lobes can be summarized as follows:

- **The frontal lobe** is the last area of the cerebral cortex to mature, and is associated with some of the most complex aspects of human cognition, especially the executive functions that guide and monitor complex behavior (Vincent et al, 2008). This includes goal setting, planning, reasoning, decision making, adapting behavior to suit changing circumstances, inhibiting unwanted or inappropriate responses, and regulating emotional responses (Mateer & Sira, 2006; Miyake et al, 2000). The inferior parts of the frontal lobe are closely associated with working memory: the ability to temporarily store and use information (such as when doing mental arithmetic or solving an anagram), which is sometimes included as part of the executive functions (Miyake et al, 2000). The inferior frontal regions are also associated with the production of speech, in particular with retrieving and articulating words (Hirshorn & Thompson-Schill, 2006). The primary motor cortex is located at the posterior of the frontal lobe, anterior to the central sulcus. This brain area is responsible for voluntary movement of body muscles.
- **The parietal lobe** is an association cortex, where different kinds of information are brought together (Ham et al, 2014). The primary somatosensory cortex is behind the central sulcus, and it receives information from the body about touch, temperature, and pain. The superior parietal lobe is associated with proprioception (where the body is oriented in space), attention (particularly spatial attention), spatial reasoning, and mathematical ability. The inferior region of the parietal lobe, close to the sylvian fissure, houses the gustatory cortex where information about taste is processed. The inferior parietal lobe also contains the supramarginal gyrus, which sits around the posterior end of the sylvian fissure. This is involved in the comprehension of speech and language (Ogar et al, 2011).
- **The temporal lobe** is another association cortex and in the left hemisphere it is most closely associated with language processing. The primary auditory cortex receives sensory inputs for auditory stimuli (hearing). The left superior temporal lobe is closely associated with the recognition and comprehension of language, and the retrieval of word meaning (Ogar et al, 2011). The right temporal lobe is associated with recognizing individuals, identifying individual voices, and non-verbal auditory processing (Scott, 2005). The inferior temporal lobes are visual association areas, involved with recognizing people, objects, words (reading), and semantic memory (Ogar et al, 2011; Karnath et al, 2009).
- **The occipital lobe** contains the primary visual cortex, which receives input from the eyes via the optic nerves and is responsible for visual perception. This processes information about shape, color, orientation, and movement. The visual association cortex in the occipital lobe supports visual recognition of objects and faces, and the mapping of visual scenes by determining depth, size, and distance (Biran & Coslett, 2003).

Description

The cerebellum sits outside the cerebral cortex, sitting posterior and inferior to the occipital and temporal lobes. It has a principal role in motor skills and movement, and helps to co-ordinate and monitor body movements, balance, and posture (Manto, 2010).

The limbic system is particularly relevant to psychological therapists, as it is closely associated with emotions, emotional processing, and memory. Key structures of the limbic system sit medially within the cerebral cortex. These include:

- **The cingulate.** The anterior cingulate is involved in the regulation of one's emotional and physiological state, and assigning emotional valence to stimuli (Leech & Sharp, 2014). The middle cingulate plays a role in attention and decision making, in particular the appraisal of a situation, monitoring and response selection (Ham et al, 2014). The posterior cingulate is thought to be involved in interoception and the internal focus of attention (such as when retrieving autobiographical memories or planning; Leech & Sharp, 2014).
- **The amygdala** is part of the medial temporal lobe, and is involved in detecting threats and attributing affective value to stimuli. It has a role in decision making, in particular responding to emotional stimuli (e.g. reward/punishment, social judgments), and initiating appropriate behavioral responses to threats (Gupta et al, 2011; Dellacherie et al, 2011). A central part of the fight-or-flight response, it is closely associated with emotional states of anger, aggression, fear, and anxiety.
- **The thalamus** has been described as a hub or relay station. Visual, auditory, and somatosensory signals pass through the thalamus before being relayed to other parts of the brain, and motor signals pass from the cerebral cortex to the peripheral nervous system via the thalamus (Carrera & Bogousslavsky, 2006). This gives it a key role in a wide range of cognitive functions, including the regulation of consciousness, sleep, and attentional states.
- **The hippocampus** is part of the medial temporal lobe, and is required for the formation and retrieval of autobiographical memories, and memory for spatial navigation (Bird & Burgess, 2008).

Description

Over the last 40 years, cognitive neuroscience has dramatically expanded our knowledge of how brain structure relates to function, and brain imaging techniques have enabled us to link psychological phenomena to changes in brain activity. Cognitive, emotional, and mental health difficulties can be caused by structural or physiological damage to brain tissue (e.g., following a stroke, traumatic brain injury, dementia or disease). In these cases, it is often possible to link the areas of the brain that have been damaged with the symptoms experienced by the individual. For example, damage to frontal regions is associated with impairments in executive function: most notably planning, flexible and adaptive decision making, and regulating behavior and emotions. Some mental health conditions are associated with changes in brain function without structural damage. For example, the hyperarousal and memory dysfunction that accompany post-traumatic stress disorder have been associated with changes to activity in the brain's limbic system.

Depending on the condition, therapists may find it helpful to provide psychoeducation to clients about the structure and function of the brain. This can help to normalize distressing symptoms and engage the client in rehabilitation, or motivate them to pursue a course of therapy. This information handout is designed to introduce your client to the gross anatomy of the brain and the relevant cognitive functions associated with it. Brain lobes are annotated on the lateral view, with limbic structures and the cerebellum annotated on the sagittal view. The design and language have been kept simple so that the handout can be used with a wide range of clients, including those with neurological conditions.

Instructions

This handout can be used as a psychoeducation resource, to introduce your client to brain structure and function.

For clients with neurological conditions (e.g., stroke or traumatic brain injury), it can be useful to add a highlight color for the key brain regions or cognitive functions that have been affected, or add color to areas of the brain where they have suffered damage. Useful prompts include:

- I wanted to talk to you about your brain injury/stroke/infection/accident. I have a picture of the brain here; it can help us to understand what has happened to you.
- You have been having some problems with concentration/word finding/emotions, and I wanted to talk to you about why you have these problems.

For clients whose mental health conditions have a clear neurobiological underpinning, it can help to introduce brain structure and function:

- We have already talked about the intrusive memories that you have from your trauma. To help you understand why those memories keep coming back, I have a picture of the brain, so that I can show you which parts of your brain are involved in having unwanted flashbacks.

For clients with neurological conditions, this handout can be used to start discussions on cognition and cognitive impairment.

- We know that your brain injury/stroke/infection/accident has damaged parts of your brain. Today, I want to talk about what problems you are having, and how you are feeling.
- Different parts of your brain do different tasks. For example, the front of the brain is important for making plans and solving problems. Let's use this picture of the brain to think about what difficulties you are having after the brain injury/stroke/accident.
- After a stroke/brain injury/infection that has damaged the brain, it is very common to have problems with…

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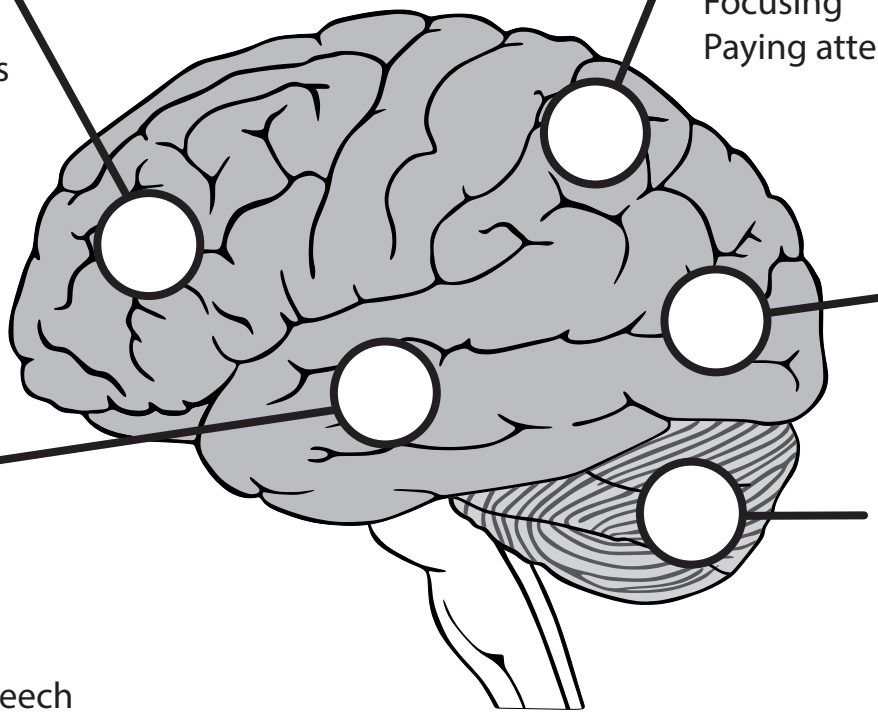
What Does The Brain Do? (Lobes and Regions)

Your brain is responsible for everything you do.
Different parts of your brain do different jobs.



Frontal lobe
Focusing
Checking
Solving problems
Planning
Making choices
Moving

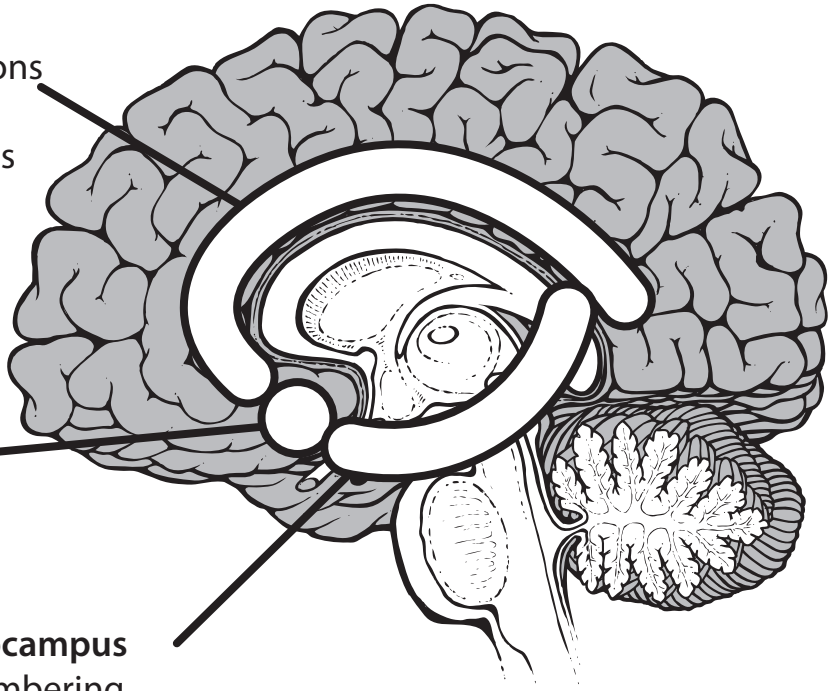
Parietal lobe
Bringing information together
Focusing
Paying attention

Occipital lobe
Seeing

Temporal lobe
Remembering
Recognizing
Speaking
Finding words
Understanding speech

Cerebellum
Moving
Positioning your body

Side view



Cingulate
Feeling emotions
Learning
Making choices

Amygdala
Feeling emotions
Learning

Hippocampus
Remembering
Recognizing

View through the middle

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