Brain puzzle explanation

The Brain Anatomy Puzzle

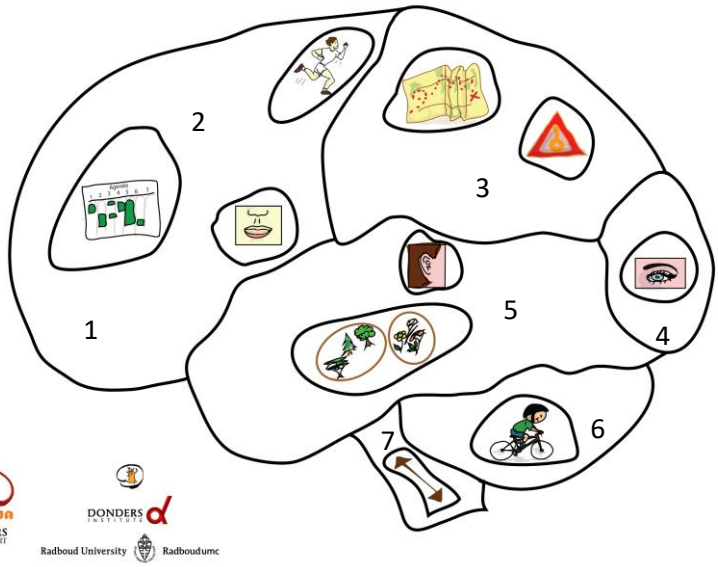
In general, we use this puzzle to introduce the main questions and knowledge that we want to teach in each session. This includes questions such as 'What does a brain look like?', 'What do we use the brain for?', 'What are the different parts in the brain?'.

The expression « Brain Puzzle » is not accurate. In fact, what **the puzzle represents is the encephalon**, which includes the brain, the cerebellum, and the brain stem.

Using this material, we wanted to teach two types of information: (a) the anatomical structure of the brain with its 4 main brain regions (lobes), and its relationship with the cerebellum and the brain stem (b) the functions of each brain region

In general, the division of the brain and its related parts into various components leads to the discussion of "Brain modularity". This is a core concept in many disciplines that study the mind and the brain, including Cognitive Science, Cognitive Psychology, NeuroPsychology, and Artificial Intelligence.

In this puzzle, the 4 cerebral lobes, the cerebellum and the brain stem are designed as the biggest pieces of the puzzle. Within each large puzzle piece is one or more smaller puzzle pieces with a symbol that describes the main function of that brain region. However**, please keep in mind that each area of the brain has multiple functions, and in general, for any cognitive process to take place, multiple neurons from different regions are required.**



Explanation of the Puzzle

1 – The prefrontal lobe

The prefrontal lobe is relatively large, consisting about 25% of of the brain, compared to the 14% in chimpanzees. This increase in development has been interpreted as crucial to explaining the "superior" capacities that humans possess relatively to apes (e.g., language). However, the prefrontal lobe does not only differ in size from the other regions, but also in the degree to which it has connections with other brain areas.

The prefrontal lobe is involved both in cognitive and behavioral regulation. At the cognitive level, it is linked to reasoning, abstract thought and planning. At the behavioural level, it plays a role in emotion regulation and motivation. The study of the prefrontal lobe is related to that of executive functions. These functions are deemed responsible for an individual to **intentionally regulate their thoughts and actions according to a goal.** The executive functions include planning, working memory, flexibility, inhibition, and maintaining attention.

The planning represents the idea of control, voluntary effort, and organization. This symbol is commonly used in cartoons/comics for a character who is focused, trying to concentrate or learn a (new) piece of information.

The mouth indicates Broca's area. This area is known to be important in various aspects of **language processing, including comprehension and production** (which is to differentiate with understanding language).

2 – The motor cortex and the somatosensory cortex

The motor cortex and the somatosensory cortex play a role in **the movement and perception of our body** (hence the symbol of human body). The somatosensory cortex receives somatosensory (input about the environment we are in e.g., pain or pressure) and proprioceptive information (the location of our body parts in space, with regards to each other and the environment).

3 – The parietal lobe

The parietal lobe is involved when we **pay attention to what is being done or an event in the environment.** In certain situations, the parietal regions will be co-activated with certain frontal regions.

We chose the attention sign as a symbol to represent the role of the parietal lobe to help focus our attention on an event or item of interest.

The "where" pathway, refers to a set of neural connections (a neural pathway) between the occipital lobe and the parietal lobe. This pathway is involved in the **perception of the body's position relatively to the outside world and the accompanying objects.** For instance, this pathway helps us to move our body in an appropriate manner and to apply the right amount of strength for an action e.g., reaching our hand to pick up a tomato (without squishing it!).

The map symbol illustrates the ability of the parietal lobe in helping us locate our body in 3D space.

4 – The occipital lobe

The occipital lobe enables vision. It allows us to see shapes, orientation of objects, colors and movement. This ability is represented by the symbol of an eye.

5 – The temporal lobe

The temporal lobe plays an important role in **declarative memory, which is the term for the conscious recall of information.** There are various related types of declarative memory. One type is **episodic memory**: here, the memories are kept in their context, we remember the space and time at which the memory was acquired and created. Another type is **semantic memory**, here we store information about a certain item, object, concept but not the context in which we learned about it. Thus, occasionally, semantic memory is referred to as 'general knowledge'. For example, the definitions of words, or the concept of a particular type of animal.

Here, in the temporal lobe, we can also locate the **"what" pathway** (thus, we have the "what" and "where" pathways). This pathway represents the connection of neurons between the occipital lobe and the temporal lobe. As reflected in its name, this pathway is involved in **object recognition and categorization, which enables us to acquire knowledge about entities in our environment**.

The plants symbol represents how information is stored in memory, grouped into categories.

The ear symbol illustrates the location of Wernicke's area. The symbol is chosen to represent the initial discovery of this area to be involved in comprehending language. However, today, we know that **Wernicke's area is involved both in comprehension and production of language**. It also works with Broca's area, and its connected to it by a neural pathway known as the arcuate fasciculus.

6 – The cerebellum

The cerebellum or "little brain", is involved in **balance**. That is, we are able to balance because the part of the brain regulates muscle tone and posture. This idea is represented by the symbol of a bicycle. The cerebellum also enables us to coordinate voluntary movements depending on size, texture and distance of the object relative to us (how to pick up a tomato that is right next to you vs. one that is 2 meters away).

Naturally, **our movements and actions are largely automatic**, thus this aspect is also represented by the bicycle because once one learns to cycle, it becomes second nature.

7 – The brainstem

The brain stem **binds and shares information from the brain, the cerebellum and the spinal cord**. The relay of information between these regions is represented by the symbol of a double-headed arrow. The brain stem contains of 12 pairs of cranial nerves which process sensory information sent by the organs in the head and face. This information is then carried to the regions in the brain, and muscle in our body, that are involved in planning and executing movements.

Multiple structures within the brain stem are crucial for the regulation of **vital functions** (E.g., beating of the heart and breathing), and whether we take action to approach or avoid a certain (unsafe) situation. A common feature in all these processes is that they occur automatically and unconsciously.

Activities related to the puzzle

In the classroom, we begin with a "brainstorming" session.

We want to get the children thinking, so we ask questions like "**what is the brain?"** and **"what it is used for?"**

We then build on (or correct) their responses to our questions by having them do the puzzle. In order to maximise participation from and interaction between students the various puzzle pieces are distributed across the children.

To build the puzzle, **we begin with a large puzzle piece** (a brain area), and naming the piece. Then, we ask the children to search among themselves to locate who has one (or more) of the smaller puzzle pieces that fits within the large puzzle piece. As mentioned, the smaller pieces correspond to the main functions of the brain area. Once found, we proceeded to explain in detail the function of that brain area. Subsequently, we can proceed with the other pieces of the puzzle in the same manner as above.

Depending on the level of comprehension of the students, the teacher can aim to achieve one or both objectives of the session. The main objective is to learn about the different brain areas and talk about their function. If the children already know about the different brain regions (lobes), then the class can focus more of the function (small puzzle pieces) of each region.

Build the puzzle: template

Want to make your own brain puzzle? Take our template, impose it on a good piece of cardboard, cut out the pieces, and voila! You have a puzzle brain! Naturally, you may adapt the puzzle to your teaching needs.

N.B: The functions of the brain represented here in the brain are non-exhaustive. It is possible to focus on other mechanisms, according to the approach of each class.