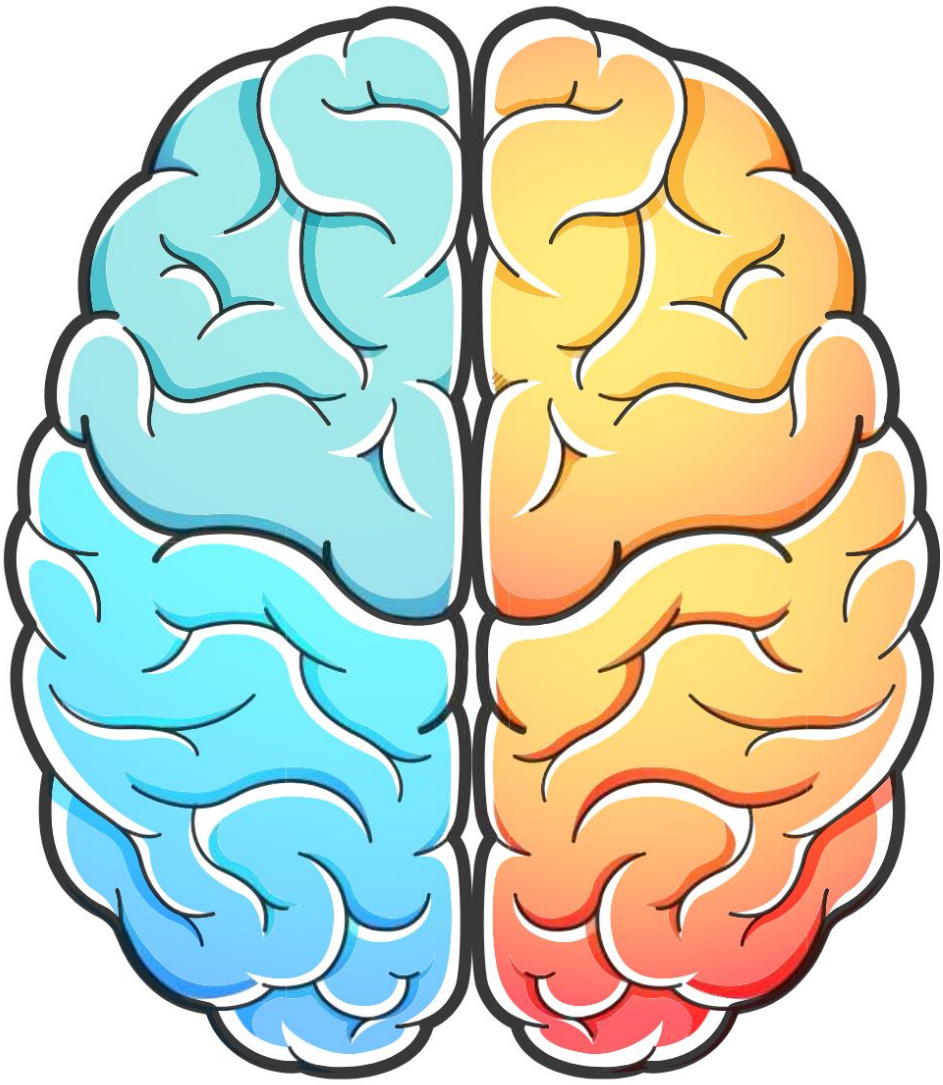
ADHDadultUK

The ADHD Brain



Key Points

- ADHD brains develop differently than non-ADHD brains
- This development means ADHD brains mature more slowly
- ADHD brains have structural differences to non-ADHD brains
- Chemicals that allow the brain to function do not work as well in ADHD

What is a brain?

The brain is on organ that sits inside your skull and is connected to the rest of the body through a system of nerves that sprout out of the spinal column. The brain itself contains almost 100 billion nerves (also called neurons) and is responsible for thoughts, emotions, controlling basic biological things such as breathing, movement and many other actions. As well as neurons, the brain contains other cells which support the neurons, including blood vessels to deliver blood, and cells known as 'glial cells' support, nourish, and protect the neurons. There are far more glial cells than neurons in the human brain!

The brain is divided into two halves (known as 'hemispheres') connected by a bundle of nerves (see Figure 1). Each hemisphere is separated into several parts. The cerebrum, which receives sensations, controls thoughts and emotions, is separated into 4 'lobes'; frontal (at the front up to the top), temporal (at the sides), parietal (at the top towards the back) and occipital (at the back).

Deeper in the brain there is an area known as the 'hindbrain' which controls the more 'unconscious' needs of the body, such as regulating body temperature, breathing rate, hormones and eating behaviours.

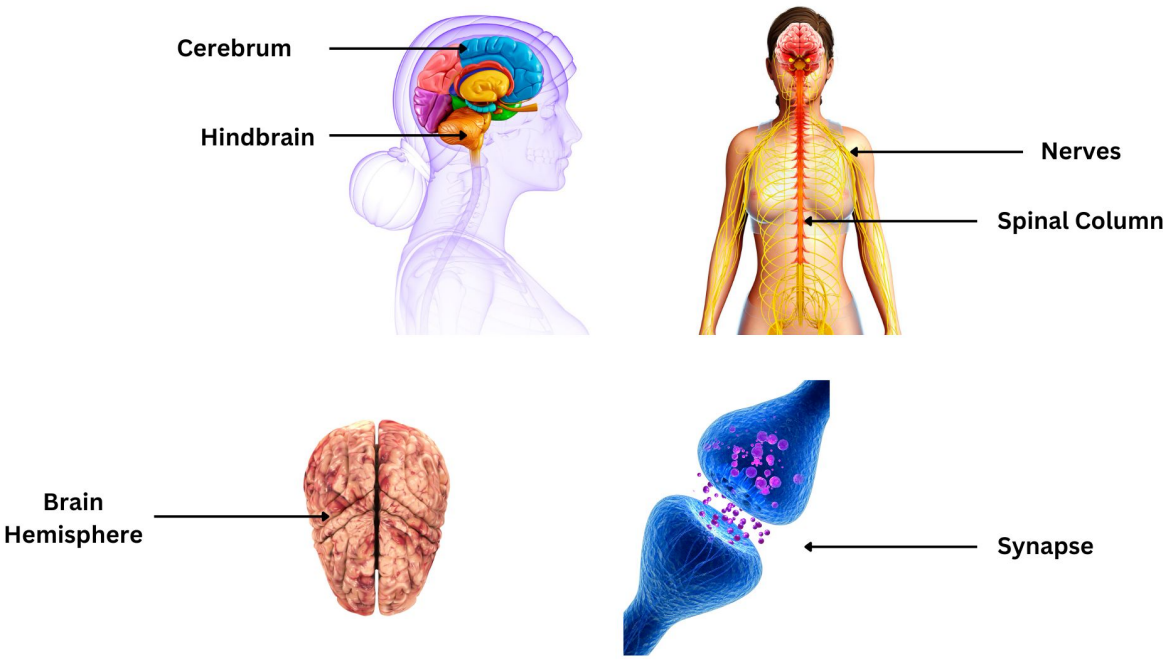


Figure 1: The human brain and central nervous system

How does the brain work?

The neurons in the brain communicate with each other using chemicals called ‘neurotransmitters’. These chemicals are released from one neuron into the tiny gap between neurons, called a ‘synapse’ (see Figure 2), where they travel to the next neuron and bind to a specific ‘neurotransmitter receptor’. This allows neurons to communicate very rapidly, taking less than 1/1000 of a second for a signal to pass from one neuron to the next.

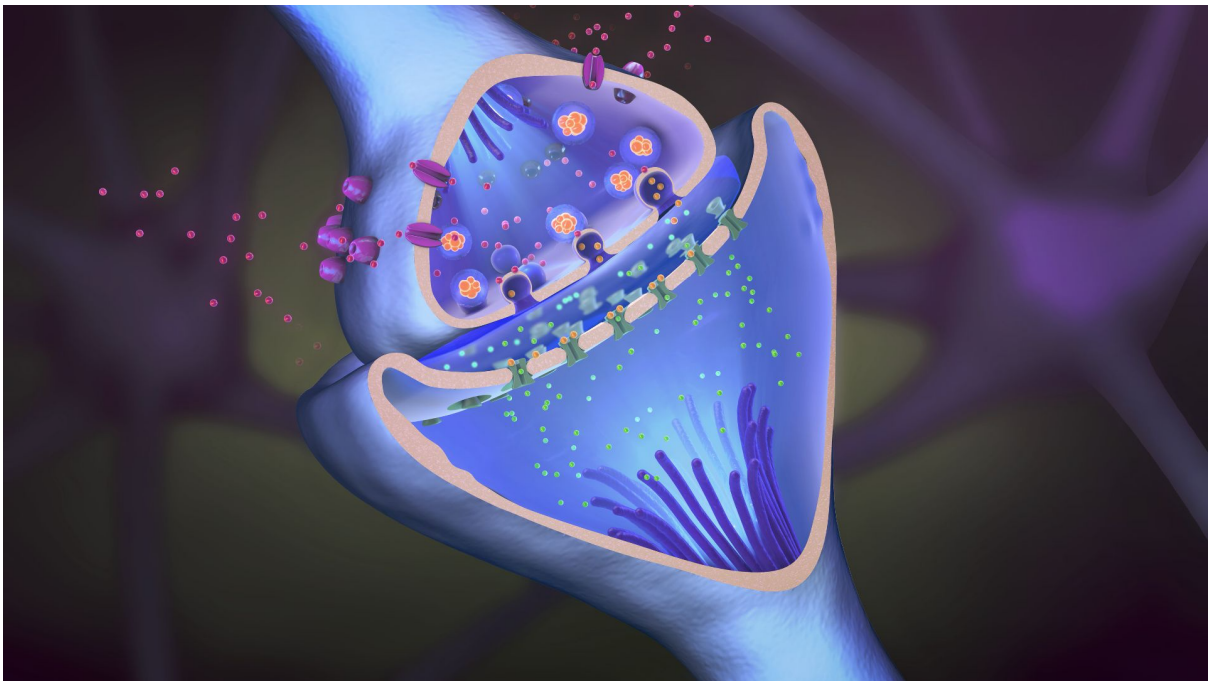


Figure 2: Neurotransmitters passing from one neuron to another across the 'synapse'

Neurons connect to other neurons to form 'networks' in the brain. These networks are *essential* for complex brain functions like language, emotion, and attention as no single brain area is solely responsible for these brain functions.

The ADHD Brain.

Lots of research using different ways of scanning the brain have shown that ADHD is a 'neurodevelopmental disorder'. This means that parts of an ADHD brain develop at a slower rate (around one to three years) compared to non-ADHD brains, and never fully mature to look or act like the brain of a person who does not have ADHD.

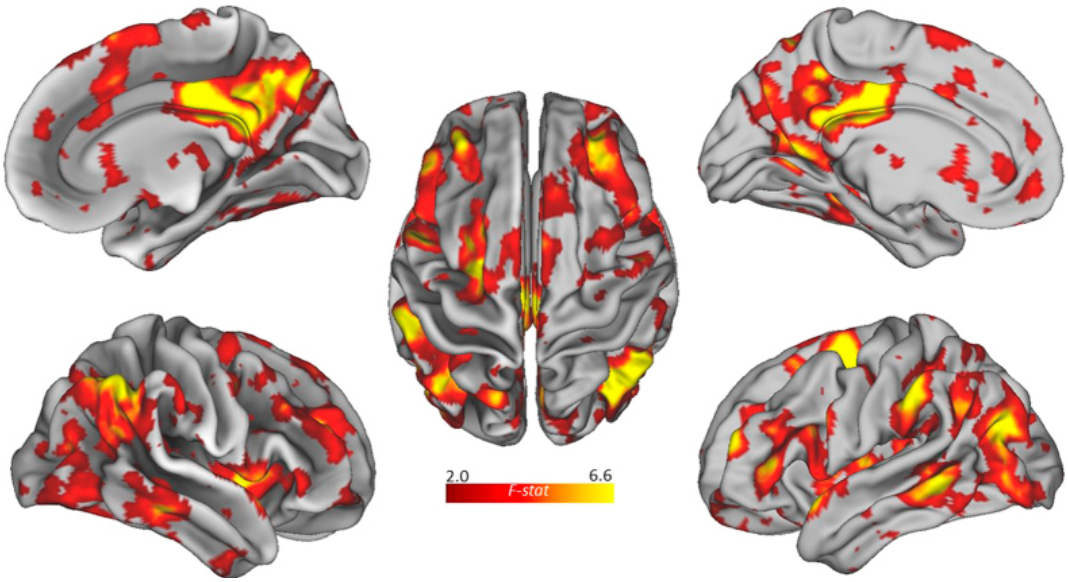


Figure 3: A network of brain areas working together to think creatively. Source - Roger E. Beaty, Mathias Benedek, Scott Barry Kaufman, and Paul J. Silvia, CC BY-SA 4.0 <https://creativecommons.org/licenses/by-sa/4.0>, via Wikimedia Commons

Studies have shown that in children with ADHD, the brain is slightly smaller, especially in areas associated with attention, emotion, and inhibition (stopping yourself from doing things) and this lack of size may continue into adulthood. As well as these changes in large brain structures, ADHD brains also have very small changes in some brain areas involved in emotions, attention planning and inhibition.

Alongside these structural changes, other studies have shown that brain areas which are involved in attention, emotion and inhibition are less 'active'. Not all areas of the brain are less active in ADHD however, some networks of brain areas involved in daydreaming and vision are actually more active.

Finally, further studies have shown that some neurotransmitters do not work properly in ADHD brains. One of these neurotransmitters, dopamine, which is

involved in pleasure, reward and voluntary movement, has been shown to commonly have receptors and transporters (which allow dopamine to leave the synapse and re-enter neurons) that don't work properly. Other neurotransmitters which do not work as they should in ADHD brains include noradrenaline. These two neurotransmitters are essential for normal attention regulation and the stimulant medications used in ADHD increase their levels in the brain.