

# The brain has 5 'secret ages' with important turning points throughout life

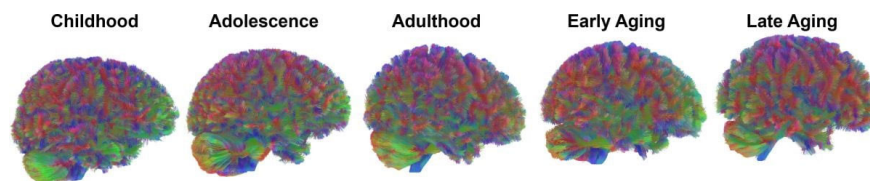
A study of 3,800 MRI scans found that the human brain goes through five major developmental stages, with turning points at ages 9, 32, 66 and 83. Each period reflects dramatic changes in neural networks.

**The human brain actually goes through five 'secret ages', and one of them lasts almost a lifetime.**

A new study finds that brain structure changes in five broad stages, separated by four key 'turning points' at around 9, 32, 66 and 83 years of age. Interestingly, the developmental process often seen as characteristic of adolescence actually lasts much longer, possibly into the early 30s before mature neural connectivity patterns stabilize.

Scientists at the University of Cambridge have identified five distinct 'epochs' that describe how brain structure changes from birth to old age. Each stage reflects large-scale reorganizations of neural networks—changes that facilitate learning, maturation, and even later cognitive decline.

The study, conducted by the MRC Cognition and Brain Sciences Unit, analyzed diffusion MRI data from 3,802 people from birth to 90 years old. This type of scan tracks the movement of water in brain tissue, allowing for the reconstruction of a map of the pathways connecting different brain regions. Published in *Nature Communications* on November 25, the study found that the human brain structure goes through five major stages throughout life, separated by four points that mark significant changes in the layout of neural networks.



## From childhood to pre-adolescence: fundamental changes

The first stage lasts from birth to around 9 years of age. During this time, the brain undergoes a process called 'network consolidation', where the child creates countless synapses. Only the most active connections are retained, while the rest are pruned away. The cortex thickens rapidly, with both grey and white matter growing rapidly, and the folds of the cortex gradually stabilize.

At age 9, the brain reaches its first turning point. Cognitive abilities soar, but so does the risk of mental health problems.

## **Adolescence to about 32: optimizing performance**

The second stage — often referred to as 'adolescence' — actually lasts much longer, into the early 30s. During this stage, white matter volume continues to increase, pathways become more organized, and water movement in brain tissue suggests that networks are being refined toward greater efficiency.

Both the efficiency of individual brain regions and the coordination of the whole system improve significantly. This is also the only stage where 'neural efficiency' – the ability to make fast, short-term connections – increases over time. This change peaks around age 32, which has been described as the 'most dramatic turning point' of the entire lifespan.

## **Adulthood: stability lasting more than 30 years**

Around age 32, the brain enters true adulthood—the longest and most stable of the five ages. Over the course of more than three decades, brain structure changes little, which is consistent with other research suggesting that this is a period of 'flattening' of intelligence and personality.

However, the functional separation between brain regions increases gradually. Regions become more specialized, less cross-connected. The next turning point, around age 66, is relatively mild but still enough to reflect the reorganization of networks as age begins to take its toll, especially as white matter degenerates. This is also the time when the risk of brain-related diseases, such as high blood pressure and cognitive disorders, increases.

## **Late aging: brain-wide connectivity decline**

A turning point around age 83 ushers in the final phase. Although data on this older age group is limited, research suggests that the network shifts from a widespread pattern to one that relies more on specific regions, as the ability to communicate across the brain gradually weakens.

Professor Duncan Astle, co-lead author, said that just as human life is divided into stages, the brain also goes through similar 'epochs'. Many developmental, psychiatric and neurological disorders are directly linked to how the brain is wired. Understanding these critical turning points will help identify when the brain is vulnerable, allowing for more effective intervention or support.

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