Neuroscientists uncover important thinning mechanism that affects how the brain matures in adolescence

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What determines how a teenager's brain is structured and how it evolves? In a scientific first, researchers led by Université de Montréal

neuroscientist Tomas Paus and postdoctoral fellow Zhijie Liao have established a close link between brain activity and a maturation process called cortical thinning.

Their study is published in *Proceedings of the National Academy of Sciences*.

Like all parts of the human body, the brain's hemispheres are not perfectly symmetrical. Using magnetic resonance imaging data from the brains of 532 teenagers, the study shows for the first time that this asymmetry changes with age, and that each region of the cortex and each hemisphere thins at a different rate.

The right hemisphere thins faster than the left, with a few exceptions. But even within each hemisphere, thinning occurs at different rates from one region of the brain to another.

"So the differences in thickness between the two hemispheres are not the same at age 14 as they are at age 22," explained Paus. "By early adulthood, however, the asymmetry between the two hemispheres has largely stabilized."

More receptors, more thinning

Probing the roots of this process and asymmetry, the study also found that the rate of thinning reflects the density of neurotransmitter receptors , the substances that enable communication between brain cells. The more neurotransmitter receptors there are in a given area, the faster that area thins.

As well, the corresponding areas in the right and left hemispheres thin at a more similar rate the more they communicate with each other and act in concert, the researchers found.

"There's a correlation, but it seems that the more you use a region of the brain, the faster it matures," said Paus. "It's possible that the organization of the neurotransmitter system is genetic, but the way we use our brains also has an impact."

For certain psychopathologies where an abnormal asymmetry has been identified, this may enable people to modify the structure by changing their brain's activity and function.

"If these results are confirmed, it means that we could, for example, give personalized exercises to stimulate brain maturation right down to the structural level," said Paus, a medical professor and researcher at the UdeM-affiliated CHU Sainte-Justine Research Center.

"Just as we can prescribe exercises to strengthen underused muscles, we could help stimulate less active parts of the brain," he said.

More information: Zhijie Liao et al, Hemispheric asymmetry in cortical thinning reflects intrinsic organization of the neurotransmitter systems and homotopic functional connectivity, *Proceedings of the National Academy of Sciences* (2023). DOI: 10.1073/pnas.2306990120

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