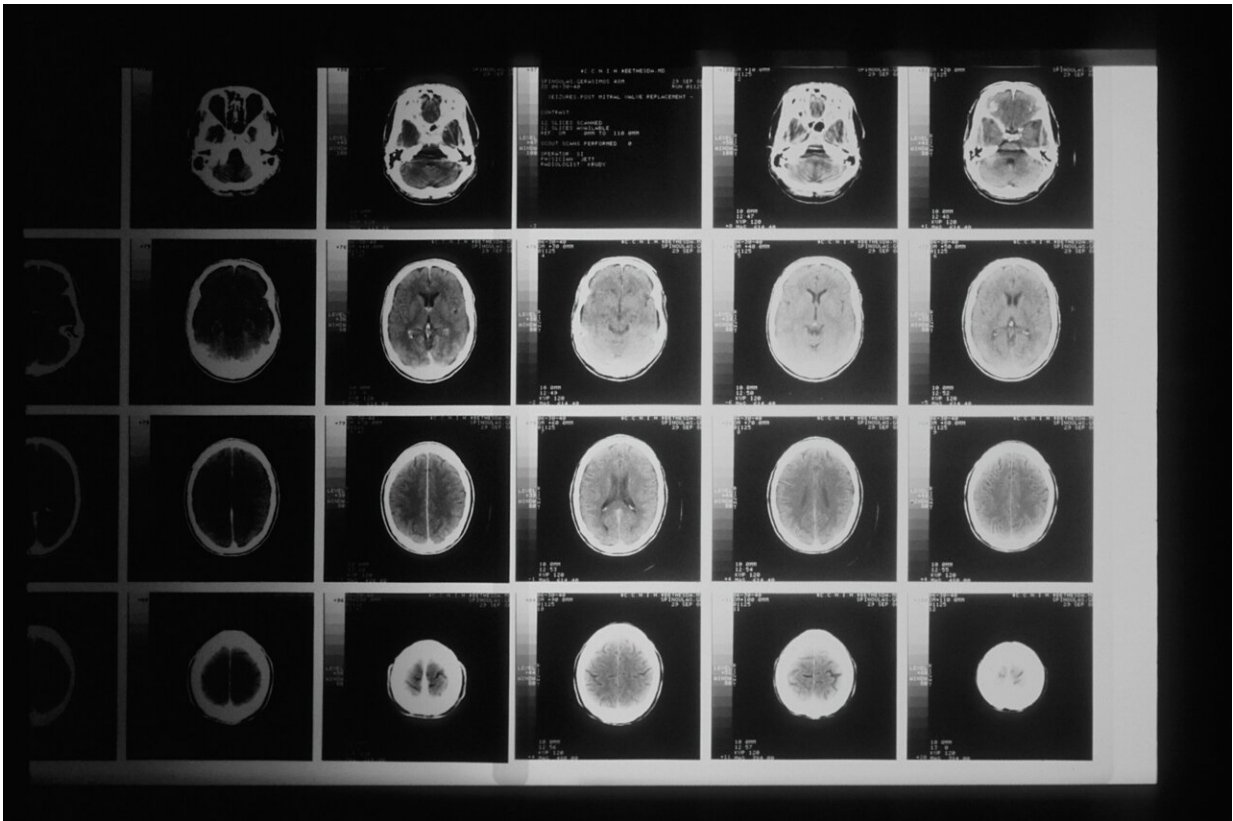


# Brain 'fingerprinting' provides insights into mental health of young adolescents

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Credit: Unsplash/CC0 Public Domain

Medical imaging of a person's unique brain signature—much like a fingerprint—has the potential to predict mental health problems in young adolescents, according to a world-first study by University of the

Sunshine Coast researchers.

In a study published in *NeuroImage*, researchers at USC's Thompson Institute tested the uniqueness of individual adolescent brain activity patterns, and whether changes in their brain networks were associated with their mental health symptoms at different timepoints.

"We examined if there were unique patterns of neural activity in brain networks that might be associated with emerging troubling, confusing, and frustrating feelings experienced by adolescents, particularly those who may be vulnerable to mental health disorders," said Dr. Shan, Head of Neuroimaging Platform at the Thompson Institute.

Dr. Shan, who was lead author of the study, said the team characterized the development of various brain "functional networks" in [young adolescents](#) from [brain scans](#) undertaken every four months on a group of about 70 participants, starting at the age of 12 through to 15 years.

Each time the scans were taken, the participants also completed questionnaires asking about their feelings over the past 30 days, particularly about their levels of depression and anxiety.

"The findings highlight the importance of longitudinal neuroimaging to monitor mental health in adolescents—at a time when the brain is growing and changing dramatically in both structure and function—and its potential to detect changes before abnormal behaviors present," Dr. Shan said.

"Given the nature of emerging mental illness in young people, a continuous measure of psychological distress is more likely to reveal important links between neurobiological measures and mental illness."

## **Mapping changes in the brain as they happen**

The data was collected as part of the Longitudinal Adolescent Brain Study (LABS) by the Thompson Institute—a study designed to track changes in the brain during adolescence, and to gain a deeper understanding of the factors that impact adolescent mental health.

More than half of all [mental health problems](#) are established before the age of 14. In Australia, one in four young people aged 15 to 19 meet the criteria for having a probable serious mental illness.

The brain signature "uniqueness" was determined by how similar an individual was to themselves at other timepoints, as well as how similar they were to their peers (other participants).

## **Key insights into the differences and similarities of young minds**

Like a fingerprint, each [human brain](#) has a unique profile of signals between different regions of the brain that becomes more individual and specialized as people age.

"The brain works like a [symphony orchestra](#), with activities from different brain areas synchronizing in tune to determine our thoughts and behavior," Dr. Shan said.

Unique whole brain synchronization was confirmed to exist in 12-year-olds, with 92 percent of participants having their own functional connectomes or unique brain "fingerprints."

Further analysis of 13 individual [brain networks](#) discovered uniqueness in some networks by the age of 12, while others were still maturing and establishing.

Importantly, the brain network that controls individual "[cognitive flexibility](#)" and the ability to handle negative influences, known as the "cingulo-opercular network" (or CON) was found to have low uniqueness levels.

"This suggests that it hasn't quite reached maturation yet and thus provides a biological explanation of the increased vulnerability in young people," Dr. Shan said.

"Combined with the existence of a high level of whole-brain uniqueness, the results suggested that adolescents are capable of engaging these systems to regulate daily behavior. But they're not yet doing so in a controlled, sustained, reliable fashion."

A key finding was that CON uniqueness was significantly and negatively associated with subsequent levels of psychological distress when assessed four months later.

"This relationship reflected the importance of the CON in the [mental health](#) of adolescents. In future studies, we are planning to disentangle if this reflects a worsening of pre-existing experiences or whether a lag in forming a unique system triggers an increase in psychological distress," Dr. Shan said.

The networks showing the highest uniqueness were the "frontoparietal network," which is responsible for immediate information processing, and the "default mode network" which is important for internal cognitive processes, such as thinking about oneself or the future.

**More information:** Zack Y Shan et al, A longitudinal study of functional connectome uniqueness and its association with psychological distress in adolescence, *NeuroImage* (2022). [DOI: 10.1016/j.neuroimage.2022.119358](https://doi.org/10.1016/j.neuroimage.2022.119358)

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