Medical Xpress

Nature vs. nurture: Depression amplified in difficult environments for youth with a larger left hippocampus, study finds

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While the mental health crisis has touched the lives of young people across a broad age spectrum, new Northwestern University research has

found that the presence of difficult social environments and the absence of positive social environments predicted greater increases in depressive symptoms in youth, aged 9–11, over a two-year period.

In addition to environment, left hippocampal volume amplified the social context effects, suggesting that youth with a larger left hippocampus experience greater increases in major depressive disorder symptoms in challenging social spaces.

"Our research has implications not only for future research, but we also hope it increases awareness among parents, educators, mental health professionals and policy makers," said co-lead author Claudia Haase, associate professor of human development and social policy at Northwestern's School of Education and Social Policy (SESP).

"Over the years, the pendulum has swung back and forth between some researchers and practitioners emphasizing the role of nature and others emphasizing the role of nurture. And we have come to really appreciate that we need to look at both and their interplay together."

The study, in *Proceedings of the National Academy of Sciences*, underscores the importance of families, peers and schools in the development of depression during adolescence, and how variation in neural structure can amplify or diminish sensitivity to their environment.

The study was first authored by Matías Martínez, doctoral student at SESP, with senior co-authors Haase and Yang Qu, associate professor of human development and social policy at SESP. Titled "Depressive symptoms during the transition to adolescence: Left hippocampal volume as a marker of social context sensitivity," additional authors include Tianying Cai; Beiming Yang; Zexi Zhou; Stewart Shankman; and Vijay A. Mittal.

"Our study emphasizes the importance of paying attention to individual differences and how some people are more sensitive to social environments than others," Qu said. "We should never assume that the same environment will have the same impact for everyone. There is no one size fits all."

The findings

Since neuroscience has seen major developments over the past few years, the researchers focused on brain-based sensitivity in the development of depressive symptoms.

"Previous studies have focused on physiological processes or genetic variants, but with the development of neuroscience, now we can look at how the brain can play a role in the sensitivity to environments," Martinez said.

"There's a longstanding debate on whether some individuals are more or less sensitive to environments and in this study, we focused on sensitivity to social experiences, both negative and positive."

The results concluded that the left hippocampus—a region of the brain that is primarily associated with memory, learning and how humans experience the world around them—plays an important role in whether a person becomes depressed if they find themselves in a challenging social space. A larger hippocampus would result in an individual being better able to remember an experience or recall a memory.

"It is one of the most plastic regions of the brain," Martinez said. "It's very responsive to the environment, especially in a person's early years. Our findings show that this brain region is playing a role in making youth more sensitive to difficult environments and to the absence of positivity in their life experiences—leading to depression symptoms."

That area of the brain being larger in a child could result in that child having more sensitivity to social experiences—family conflicts, primary caregiver's depressive symptoms, peer victimization, parental warmth and prosocial school environment—into adolescence.

"Some people tend to assume that we are 'born this way' when it comes to the human brain. But the more we learn about the brain, the more scientists have come to understand how open and malleable our brains are, not just in infancy but across the life span," Haase said.

"Our brains can change in response to the environments we find ourselves in—and studies show that this is certainly the case for the hippocampus as a brain region."

The method

The researchers examined two-year longitudinal data from the Adolescent Brain Cognitive Development study. The study—one of the largest studies in the U.S. conducted by 21 research sites across the country—aims to follow a diverse sample of 11,800 kids aged 9–11 over a 10-year period to observe their cognitive, brain, social and emotional development over time.

"The ABCD study is phenomenal, and we are deeply indebted to the National Institutes of Health and all the researchers involved for making this possible, and, of course, to all the youth and their families who are participating," Qu said. "It's the largest long-term study of brain development and child health in the United States."

The data revealed a stronger association between socio-experiential environments and MDD symptoms for youth with a larger left hippocampal volume and no differences in MDD symptoms between individuals with different sizes of left hippocampus at low levels of

negative and high levels of positive context exposure.

What's next

The researchers are hoping the study helps parents, teachers and policymakers better understand and support youth's mental health during adolescence. Martinez is hoping their expanded research can better explain how children in difficult social environments adapt to their surroundings in the long term.

"The ABCD study is such a comprehensive project that will continue to follow youth development for many more years," Martinez said. "It will be exciting to examine what the interplay between exposure to different environments, hippocampal volume and depressive symptoms looks like as our youth navigate their teenage years."

More information: Matias Martinez et al, Depressive symptoms during the transition to adolescence: Left hippocampal volume as a marker of social context sensitivity, *Proceedings of the National Academy of Sciences* (2024). DOI: 10.1073/pnas.2321965121

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