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Research on normative brain development in children could help doctors test for depression

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A focus on brain development, particularly in early childhood, may eventually be the key to detecting psychiatric risk before the symptoms have the chance to progress. Research at Binghamton University, State University of New York suggests that significant changes in the structure of brain activity occur during the early school years, and that such changes can potentially benchmark normative brain development in children.

Binghamton psychology researchers measured the "resting state" brain activity of over 450 children ages 7 to 11 using electroencephalography (EEG) technology to learn how brain electrical activity changes during this period. The brain waves of older children were found to contain greater signal complexity compared to the younger children. The researchers also found that, from year to year, the most impressive changes in this complexity of brain signals was occurring over frontal brain regions, known to be important for things like planning and impulse inhibition. The largest jump in brain signal complexity occurred between 7 and 8 years of age.

"We were looking for how the ways in which different brain regions are communicating is changing across age to sort of test this theory that as kids get older, there is more integration happening within their brain," said Vladimir Miskovic, assistant professor of psychology at Binghamton University. "So there's more exchange of information in terms of their

brain signals, representing a greater space of neuronal possibilities. We found that as kids transition from 7 to 11 years of age, these connections become more dense, so the brain is more inter-connected."

"We're establishing this normative, benchmark data. What a 7 year old should look like, what an 8 year old should look like. I think we need to know how the brain develops in its normative state, how its activity matures in a healthy child, before we can hope to say anything about having approaches for identifying risk for psychopathology or deviant neurological development."

"You can say that we're getting a better understanding of the precise ways and timing of kids' brain development," said Brandon Gibb, professor of psychology at Binghamton University and director of the Mood Disorders Institute and Center for Affective Science. "We know kids are developing, but now we're trying to learn what exactly that means, what's the timing, and what are these critical periods when you see these massive changes."

For the bigger picture, these critical periods can be most important to detect "developmental lagging" before it worsens. According to Gibb, it's important because it can start telling doctors and psychologists not only how to intervene, but when. They are hoping to establish a normative standard for children's neurological development, much like pediatricians use standardized growth charts to evaluate children's physical development. However, they're looking to build on this information with more specific studies in the future.

Miskovic laid out some of the team's next steps. "One is looking at genetic influences on the developmental trajectories, especially since we know that certain genes influence neurogenesis and neural pruning. Also, looking at environmental influence, particularly things like family income as a measure of poverty, and also neighborhood crime statistics.

And using these trajectories and seeing if variations from normal in terms of brain development is associated with depression, anxiety, externalizing problems," he said.

The research team is hoping to bring more to the science field in terms of neurological studies, which they feel is lacking. According to Gibb, the ultimate goal is to develop and standardize brain growth charts than include normative development of brain structure and function as a way of assessing children's development and spotting early warning signs for mental illness so that these can be addressed prior to the child developing any significant problems.

The paper, Charting moment-to-moment brain signal variability from early to late childhood," appeared in *Cortex*.

More information: Vladimir Miskovic et al, Charting moment-to-moment brain signal variability from early to late childhood, *Cortex* (2016). DOI: 10.1016/j.cortex.2016.07.006

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