Brain structure, function predict future memory performance in children, adolescents

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Assessing structural and functional changes in the brain may predict future memory performance in healthy children and adolescents, according to a study appearing January 29 in the *Journal of Neuroscience*. The findings shed new light on cognitive development and suggest MRI and other tools may one day help identify children at risk for developmental challenges earlier than current testing methods allow.

Working memory capacity—the ability to hold onto information for a short period of time—is one of the strongest predictors of future achievements in math and reading. While previous studies showed that

MRI could predict current working memory performance in children, scientists were unsure if MRI could predict their future cognitive capacity.

In the current study, Henrik Ullman, Rita Almeida, PhD, and Torkel Klingberg, MD, PhD, at the Karolinska Institutet in Sweden evaluated the cognitive abilities of a group of healthy children and adolescents and measured each child's brain structure and function using MRI. Based on the MRI data collected during this initial testing, the researchers found they could predict the children's working memory performance two years later, a prediction that was not possible using the cognitive tests.

"Our results suggest that future cognitive development can be predicted from anatomical and functional information offered by MRI above and beyond that currently achieved by cognitive tests," said Ullman, the lead author of the study. "This has wide implications for understanding the neural mechanisms of cognitive development."

The scientists recruited 62 children and adolescents between the ages of 6 and 20 years to the lab, where they completed working memory and reasoning tests. They also received multiple MRI scans to assess brain structure and changes in brain activity as they performed a working memory task. Two years later, the group returned to the lab to perform the same cognitive tests.

Using a statistical model, the researchers evaluated whether MRI data obtained during the initial tests correlated with the children's working memory performance during the follow-up visit. They found that while brain activity in the frontal cortex correlated with children's working memory at the time of the initial tests, activity in the basal ganglia and thalamus predicted how well children scored on the working memory tests two years later.

"This study is another contribution to the growing body of neuroimaging research that yields insights into unraveling present and predicting future cognitive capacity in development," said Judy Illes, PhD, a neuroethicist at the University of British Columbia. "However, the appreciation of this important new knowledge is simpler than its application to everyday life. How a child performs today and tomorrow relies on multiple positive and negative life events that cannot be assessed by today's technology alone."

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