White matter structure in the brain predicts cognitive function at ages 1 and 2

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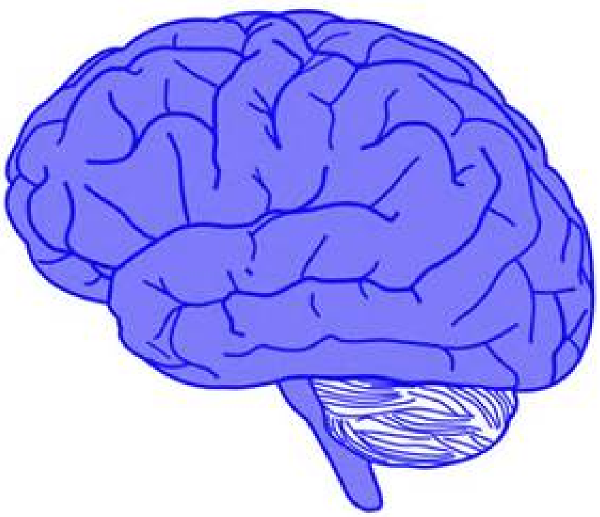

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A new study led by UNC School of Medicine researchers concluded that patterns of white matter microstructure present at birth and that develop after birth predict the cognitive function of children at ages 1 and 2.

"To our knowledge, this study is the first to measure and describe the development of white matter microstructure in children and its relationship to cognitive development from the time they are born until the age of 2 years," said John H. Gilmore, MD, senior author of the study and director of the Early Brain Development Program in the UNC Department of Psychiatry.

The study was published online on December 19, 2016 in the *Proceedings of the National Academy of Sciences*.

White matter is the tissue in the brain that contains axon fibers, which connect neurons in one brain region to neurons in another region. White matter is critical for normal brain function, and little is known about how white matter develops in humans or how it is related to growth of cognitive skills in early childhood, including language development. In the study, a total of 685 children received diffusion tensor imaging (DTI) scans of their brains. DTI is a magnetic resonance imaging (MRI) technique that provides a description of the diffusion of water through tissue, and can be used to identify white matter tracts in the brain and describe the organization and maturation of the tracts.

The study authors used these brain scans to investigate the microstructure of 12 white matter fiber tracts important for cognitive function, their relationship to developing cognitive function and their heritability. They found all 12 of the fiber tracts in the newborns were highly related to each other. By age 1, these fiber tracts had begun to differentiate themselves from each other, and by age 2 this differentiation was further advanced. The most interesting finding from the study was that the common relationship between white matter tracts at birth predicted overall cognitive development at age 1 and language development at age 2, indicating that it may be possible to use brain imaging at birth to better understand how a child's cognitive development will proceed in the first years after birth.

Because the sample included 429 twins, the study authors were also able to calculate that this predictive trait was moderately heritable, suggesting that genetics may be a factor in its development.

"There is rapid growth of brain structure, cognition and behavior in early childhood, and we are just starting to understand how they are related," Gilmore said "With a better understanding of these relationships, we ultimately hope to be able to identify children at risk for cognitive problems or psychiatric disorders very early and come up with interventions that can help the brain develop in a way to improve function and reduce risk."

In addition to Gilmore, authors of the study are Seung Jae Lee, Rachel J. Steiner, Yang Yu, Sarah J. Short, Michael C. Neale, Martin Styner, and Hongtu Zhu. All are at UNC except for Neale, who is in the Virginia Institute of Psychiatric and Behavioral Genetics at Virginia Commonwealth University.

More information: Common and heritable components of white matter microstructure predict cognitive function at 1 and 2 y, *PNAS*, www.pnas.org/cgi/doi/10.1073/pnas.1604658114

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