Brain network linked to contemplation in adults is less complex in children

March 7 2008

A brain network linked to introspective tasks -- such as forming the self-image or understanding the motivations of others -- is less intricate and well-connected in children, scientists at Washington University School of Medicine in St. Louis have learned. They also showed that the network establishes firmer connections between various brain regions as an individual matures.

The scientists are working to establish a picture of how these connections and other brain networks normally develop and interact. They want to use that picture to conduct more detailed assessments of the effects of aging, brain injuries and conditions such as autism on brain function.

"Having this information will not only help us understand what's going wrong in these patients, it will also allow us to better assess whether and how future interventions are providing those patients with effective treatment," says senior author Bradley L. Schlaggar, M.D., Ph.D., associate professor of pediatrics, radiology, neurology and anatomy and neurobiology.

The results appear online this week in *The Proceedings of the National Academy of Sciences.*

Neuroscientists including co-author Marcus E. Raichle, M.D., professor of radiology, of anatomy and neurobiology and of neurology first identified the network, which is called the default network, in 1996.

Since then, scientists have linked it to a number of inward-looking activities, including the creation of the "autobiographical self," a person's internal narrative of their life story; and "mentalizing," the ability to analyze the mental states of others and use those insights to adjust the self's behavior appropriately.

Schlaggar, Raichle and colleagues including Steve Petersen, Ph.D., the James McDonnell Professor of Cognitive Neuroscience and professor of neurology and psychology, have been using a new technique called resting-state functional connectivity MRI to identify brain networks and analyze their functions and development. Instead of analyzing mental activity when a volunteer works on a cognitive task, resting-state connectivity scans their brains after they have been asked to rest and not engage in any specific tasks. The scans reveal changes in the oxygen levels in blood flowing to different areas of the brain. Researchers interpret correlations in the rise and fall of blood oxygen to different brain areas as a sign that those areas likely work together. In neuroscientist's terms, this means the regions have functional connectivity.

Damien A. Fair, a graduate student in Schlaggar's lab, led the new study, which compared functional connectivity in 13 brain regions linked to the default network in children ages seven to nine and adults ages 21 to 31.

"The difference between children and adults is profound," Fair says. "In a graph depicting the strength of connections between the brain regions we studied, children's minds have just a few connections between some regions, while the adult brains have a web-like mesh of many different interconnecting links involving all the regions."

In papers published in recent years, the researchers have used the same techniques to identify two networks that they think control much of the brain activity behind behaviors directed toward "external" goals,

including observing and interacting with the environment.

Schlaggar and colleagues plan further study of how the brain networks interact during development and in the mature brain. They also are looking at how network functions differ in patients with brain injuries and conditions such as autism.

"Autism spectrum disorder first manifests earlier than the time period we were studying," Schlaggar notes. "But many of the functions it affects have been associated with the default network, so we're eager to see if analysis of this network and its development can give us new insights into autism."

Source: Washington University