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Novel Method for Measuring Functional Connections in the Human Fetal Brain

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An unprecedented method for measuring functional connections in the human fetal brain developed at the Wayne State University School of Medicine could open a window into how the brain becomes "wired-up" at the beginning of life. Application of this method may help scientists discover the origins of neural injury or disease before a child is born.

Scientists can now detect abnormal signaling between two or more brain regions, a once impossible achievement. Many early childhood diseases, including autism, attention deficit hyperactivity disorder, prematurity, schizophrenia and dyslexia, involve abnormal connectivity with no structural irregularity.

"As a result, how the human brain is connected into functional systems, or 'wired-up,' has become a question of global interest," said study principal investigator Moriah Thomason, Ph.D.

She led the team that applied functional connectivity magnetic resonance imaging in the womb, making it possible to learn how the brain builds circuits at the beginning of human life. The advancement puts a new spin on the use of graph theory, an established math function already applied to study airline flight routes, migration patterns and social networks.

"The goal of our work is to develop, for the first time, fetal functional connectivity MRI as a new and vital tool for examining human fetal brain development. By shifting the current paradigm of brain imaging to the time when injury is occurring rather than after birth, this work will have major transformative impact on perinatal diagnoses, prognosis, intervention and evaluation," Dr. Thomason said.

The research, "Intrinsic functional brain architecture derived from graph theoretical analysis in the human fetus," a collaboration between Wayne State University and the Perinatology Research Branch of the Eunice Kennedy Shriver National Institute of Child Health and Human Development of the National Institutes of Health, appears in the May issue of PLOS ONE. Read the article at http://dx.plos.org/10.1371/journal.pone.0094423.

Dr. Thomason is an assistant professor in the WSU School of Medicine Department of Pediatrics and the Merrill Palmer Skillman Institute for Child and Family Development, and director of the Unit on Perinatal Neural Connectivity at the Perinatology Research Branch.

The study divided the brain into 150 approximately equally-sized units and used newly available templates of a 32-week-old fetus as reference to compare brain circuitry in younger and older fetal groups.

Project templates are available for free at www.brainnnexus.com, and downloadable connectivity matrices in the fetal population are coming soon. "PLOS ONE has an open data sharing philosophy and we could not agree more – data sharing is critical to accelerating the

rate of progress in scientific research," Dr. Thomason said.

The study follows a project published in February 2013 that proved brain connectivity in human fetuses can be measured. Study co-author Roberto Romero, M.D., D.Med.Sci., is chief of the Perinatology Research Branch, which focuses on the prevention of preterm birth and its long-term consequences. More than half of preterm children require special assistance in the classroom: 20 percent are in special education and 50 percent repeat at least one grade in high school, Dr. Romero has said. The new study is part of an overall focus to determine how issues such as "silent" intrauterine infection or fetal oxygen deficiency affect the development of brain connectivity in utero, which accounts for many neurological disorders.

The study published in PLOS ONE is part of ongoing research to determine whether such issues during fetal life have an effect on the brain, and how science can prevent long-term consequences.

The MRI examinations were performed at WSU's Vainutis Vaitkevicius, M.D. Magnetic Resonance Research Facility, located at the Detroit Medical Center's Harper University Hospital, under the direction of E. Mark Haacke, Ph.D., a WSU professor of radiology and biomedical engineering. The project was supported by WSU's Perinatology Virtual Discovery Grant (made possible by the W.K. Kellogg Foundation) and WSU's Research Grant Program.

Source: http://wayne.edu/

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