Researchers Make Breakthrough in Understanding Early Brain Development

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Researchers at the University of Wyoming have made what they describe as a "breakthrough" in understanding how sensory experiences during early life promote the formation of fine connections in the brain, paving the way for development of interventions to treat disease and trauma.

The results of the study, led by Qian-Quan Sun, an assistant professor in the Department of Zoology and Physiology, are published in the August issue of the *Journal of Neuroscience*, the official journal for the Society of Neuroscience.

The question of how sensory experiences promote maturation of the brain is a topic under intense investigation, Sun says.

"Understanding the processes and mechanisms underlying experience-dependent plasticity of the brain will have important implications for developing novel treatment strategies for developmental neurological and psychiatric disorders that result from aberrant connectivity among brain cells," he says.

The study was supported by two recent multi-million dollar grants from the National Institutes of Health. One grant is through the NIH INBRE (IDeA Networks for Biomedical Research Excellence) program, the other study is part of a COBRE (Center of Biomedical Research Excellence) project led by Bill Flynn, director of UW's Neuroscience Program.

Sun, the paper's senior author and the principal investigator of the UW Laboratory of Neural Development and Learning, notes that graduate student Yuanyuan Jiao of Shandong, China, the first author, and others who work in the laboratory, contributed to the findings.

"They have found that the sensory cortex, which is the part of the brain most responsive to environmental cues, undergoes drastic structural and physiological changes during a very short time period during postnatal development," Sun says. "These large changes can occur within less than three days during a critical period in mouse development, which is equivalent to a few months in humans and primates."

The second significant finding, Sun says, was that the degree of structural changes induced by lack of sensory experience is much larger than what was anticipated. They found more than a one fold reduction in the number of chemical synapses, which are the structural substrates for cell-to-cell communication in the brain.

"The implication for this study was that if a similar situation occurs in humans, such as if a newborn were raised in an environment of neglect, it will result in severe developmental delay and mental retardation," he says. "If the neglect occurs in early postnatal developmental periods, it will cause damage to the brain that may be irreversible."

The UW researchers' long-term goal is to identify mechanisms responsible for experience-dependent brain maturation, and to use this information for therapeutic interventions and to promote recovery from disease and trauma.

"If we can understand how an enriched environment may accelerate brain maturation, we could theoretically design a drug that improves human intelligence. Similar drugs could also be used to treat neurodegenerative disease, such as Alzheimer's disease, or improve the

memory capacity of normal individuals," Sun says.

Other projects in Sun's lab include studying the mechanisms underlying fragile-X syndrome, epilepsy and autism. Two graduate students, Jiao and Andrew Young of Cleveland, Ohio, and two undergraduate students, Leah Selby of Cheyenne and Jonathan Musser, Gillette, are involved in these studies.

Source: University of Wyoming