# What your mother did when she was young has an effect on your memory

**A mother's life experience can affect the biology of her offspring, according to new animal research in the February 4 issue of** *The Journal of Neuroscience*. The study shows that a stimulating environment improved the memory of young mice with a memory-impairing genetic defect and also improved the memory of their eventual offspring. The findings suggest that parental behaviors that occur long before pregnancy may influence an offspring's well-being.

"While it has been shown in humans and in animal models that enriched experience can enhance brain function and plasticity, this study is a step forward, suggesting that the enhanced learning behavior and plasticity can be transmitted to offspring long before the pregnancy of the mother," said Li-Huei Tsai, PhD, at Massachusetts Institute of Technology and an investigator of the Howard Hughes Medical Institute, an expert unaffiliated with the current study.

The researchers, led by Larry Feig, PhD, at the Department of Biochemistry and Sackler School of Graduate Biomedical Sciences of Tufts University School of Medicine, had previously shown that in young mice, brief exposure to a stimulating environment — including new toys and opportunities for exercise and social interaction — enhanced long-term potentiation (LTP), which is thought to form the cellular basis of memory.

In the current study, Feig and his colleagues found that the offspring of mothers who had experienced environmental enrichment before adolescence also showed enhanced LTP, despite never experiencing the stimulating environment themselves. Offspring born to environmentally enriched mothers, but reared by other mice, showed enhanced LTP as well. These findings suggest that environmental enrichment's enhancement of LTP is transmitted to the next generation before birth.

Just as environmental enrichment enhanced memory at the cellular level, it also enhanced memory at the behavioral level. Although mice with a memory-impairing mutation normally show deficits in associating a location with a shock, environmental enrichment restored this fear memory. These mice carried mutations in Ras-GRF genes that regulate a signaling pathway known to be involved both in cancer and in brain cell communication and memory.

Despite carrying the memory-impairing mutation and never being exposed to the stimulating environment, the offspring of these mice also showed enhanced fear memory. These findings demonstrate that maternal experience can impact offspring behavior.

"A striking feature of this study is that enrichment took place during pre-adolescence, months before the mice were even fertile, yet the effect reached into the next generation," said senior author Feig.

"This study and others are revolutionizing our understanding of how nature — starting with an individual's DNA sequence — and nurture — including the way life experience alters the way DNA is expressed — can combine, not only to regulate the health of subsequent generations, but also possibly the incidence of disease," said Anthony Hannan, PhD, an expert in environmental enrichment and its effects on neural plasticity at the Florey Neuroscience Institutes, University of Melbourne, in Australia who was unaffiliated with the current study.

Source: Society for Neuroscience