Medical Xpress

Measuring nurture: Study shows how 'good mothering' hardwires infant brain

July 17 2014

Credit: Anna Langova/public domain

By carefully watching nearly a hundred hours of video showing mother rats protecting, warming, and feeding their young pups, and then matching up what they saw to real-time electrical readings from the pups' brains, researchers at NYU Langone Medical Center have found that the mother's presence and social interactions—her nurturing role—directly molds the early neural activity and growth of her offsprings' brain.

Reporting in the July 21 edition of the journal *Current Biology*, the NYU Langone team showed that the mother's presence in the nest regulated and controlled electrical signaling in the infant pup's brain.

Although scientists have known for decades that maternal-infant bonding affects neural development, the NYU Langone team's latest findings are believed to be the first to show—as it is happening—how such natural, early maternal attachment behaviors, including nesting, nursing, and grooming of pups, impact key stages in postnatal brain development.

Researchers say the so-called slow-wave, neural signaling patterns seen during the initial phases of mammalian brain development—between age 12 and 20 days in rats—closely resembled the electrical patterns seen in humans for meditation and conscious and unconscious sleep-wake cycles, and during highly focused attention. These early stages are when permanent neural communication pathways are known to form in the infant brain, and when increasing numbers of nerve axons become sheathed, or myelinated, to speed neural signaling.

According to senior study investigator and neurobiologist Regina Sullivan, PhD, whose previous research in animals showed how maternal interactions influenced gene activity in the infant brain, the latest study offers an even more profound perspective on maternal caregiving.

"Our research shows how in mammals the mother's sensory stimulation helps sculpt and mold the infant's growing brain and helps define the role played by 'nurturing' in healthy brain development, and offers overall greater insight into what constitutes good mothering," says Sullivan, a professor at the NYU School of Medicine and its affiliated Nathan S. Kline Institute for Psychiatric Research. "The study also helps explain how differences in the way mothers nurture their young could account, in part, for the wide variation in infant behavior among animals, including people, with similar backgrounds, or in uniform, tightly knit cultures."

"There are so many factors that go into rearing children," says lead study investigator Emma Sarro, PhD, a postdoctoral research fellow at NYU Langone. "Our findings will help scientists and clinicians better understand the whole-brain implications of quality interactions and bonding between mothers and infants so closely after birth, and how these biological attachment behaviors frame the brain's hard wiring."

For the study, a half-dozen rat mothers and their litters, of usually a dozen pups, were watched and videotaped from infancy for preset times during the day as they naturally developed. One pup from each litter was outfitted with a miniature wireless transmitter, invisibly placed under the skin and next to the brain to record its electrical patterns.

Specifically, study results showed that when rat mothers left their pups alone in the nest, infant cortical brain electrical activity, measured as local field potentials, jumped 50 percent to 100 percent, and brain wave patterns became more erratic, or desynchronous. Researchers point out that such periodic desynchronization is key to healthy brain growth and communication across different brain regions.

During nursing, infant rat pups calmed down after attaching themselves to their mother's nipple. Brain activity also slowed and became more synchronous, with clearly identifiable electrical patterns.

Slow-wave infant brain activity increased by 30 percent, while readings of higher brain-wave frequencies decreased by 30 percent. Milk delivery led to intermittent bursts of electrical brain activity that were double or five times higher than before.

Similar spikes in rat brain activity of more than 100 percent were observed when mothers naturally groomed their infant pups.

However, these brain surges progressively declined during weaning, as infant pups gained independence from their mothers, leaving the nest and seeking food on their own as they grew past two weeks of age.

Additional experiments with a neural-signaling blocking agent, propranolol, confirmed that maternal effects were controlled in part by secretion of norepinephrine, a key neurotransmitter and hormone involved in most basic brain and body functions, including regulation of heart rate and cognition. Noradrenergic blocking in infant rats mostly dampened all previously observed effects induced by their mothers.

Sullivan says her team next plans similar experiments to look at how behavioral variations by the mother affect infant rat brain development, with the added goal of mapping any differences in brain development.

Long term, they say, they hope to develop diagnostic tools and therapies for people whose brains may have been impaired or simply underdeveloped during infancy.

Sarro says more research is also under way to investigate what other, nonadrenergic biological mechanisms might also be involved in controlling maternal sensory stimulation of the infant brain.

Provided by New York University School of Medicine

Citation: Measuring nurture: Study shows how 'good mothering' hardwires infant brain (2014, July 17) retrieved 22 May 2024 from https://medicalxpress.com/news/2014-07-nurture-good-mothering-hardwires-infant.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.