

Negligent, attentive mouse mothers show biological differences

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A female mouse gathers, grooms and nurses her 3-day-old pups in the research lab of assistant professor of zoology Stephen Gammie. Photo: Jeff Miller

In mice, child neglect is a product of both nature and nurture, according to a new study. Writing in the journal PLoS ONE on April 9, researchers from the University of Wisconsin-Madison describe a strain of mice that exhibit unusually high rates of maternal neglect, with approximately one out of every five females failing to care for her offspring.

By comparing the good mothers to their less attentive relatives, the group has found that negligent parenting seems to have both genetic and non-genetic influences, and may be linked to dysregulation of the brain signaling chemical dopamine.

As a possible model for human child neglect, these mice offer a valuable

opportunity to investigate the biological and behavioral bases of naturally occurring maternal neglect, say UW-Madison zoology professor Stephen Gammie, who led the study, and co-author psychology professor Anthony Auger.

Good mouse mothers suckle, groom, and protect their pups, while their neglectful sisters may start out trying to care for a litter, but fail to follow through. "There seems to be a switch early on. The neglectful mice may nurse for a day or two after birth, but then the parental care ceases," Gammie says.

To separate the effects of genes and environment, the researchers set up a fostering study, in which pups born to previously nurturing mothers and previously neglectful mothers were switched immediately after birth.

Surprisingly, while nurturing moms attentively cared for foster pups born to other nurturing females, some became more neglectful when given foster pups born to a neglectful mother.

"In some cases the previously nurturing mothers would actively scatter the pups away from the nest, suggesting a negative cue from the pups or a lack of a positive cue," Gammie says. The result suggests that the offspring are somehow able to influence females' behavior and shows that maternal care can be affected by non-genetic factors.

In the fostering study, previously neglectful mothers did successfully raise some of the pups born to previously nurturing mothers, but these surviving pups showed lasting effects, including hyperactivity and low adult body weight. Some females neglected as youngsters were also poor mothers as adults, suggesting some aspects of neglect can be transmitted across generations.

The group also found evidence of genetic factors contributing to neglect. For example, virgin females that exhibited poor self-grooming and hyperactive behavior were at greater risk for becoming neglectful mothers.

To identify possible biological differences, the researchers analyzed brains of neglectful and nurturing mothers shortly after birth. In several brain regions - including some implicated in both maternal behaviors and reward responsiveness - they found higher levels of activity as well as signs of abnormal dopamine signaling in the neglectful mothers.

These patterns suggest that naturally occurring maternal neglect in these mice reflects disrupted reward-seeking behavior, Gammie says. In other words, these females may have the physical capability to take care of their pups, but may lack the proper motivation.

"It's been shown in a number of studies that parental care is a motivated, reward-related behavior," he says. "And it has been suggested by others that some aspects of child neglect in humans could result from a lack of reward of an offspring to the parent."

Though often overshadowed by more visible abuse cases, human child neglect may actually be a more widespread problem. A report published last week by the Centers for Disease Control and Prevention on U.S. children found that, among infants less than a week old, nearly 70 percent of nonfatal mistreatment cases from 2005 to 2006 were instances of neglect.

Child neglect has devastating consequences, Auger says, and the natural occurrence of maternal neglect within this mouse strain offers a powerful opportunity to investigate the biological and behavioral bases of maternal neglect.

Though he cautions that it's too early to know how their findings will translate to humans, for the mice "the difference is quite dramatic in the brain. Dopamine is likely not the only thing being disrupted, but it is an important starting signaling pathway to pursue."

Next, Auger says, "We hope to understand in greater detail the basis of naturally occurring neglect and provide treatment paradigms to these animals to restore natural maternal care of offspring."

Source: University of Wisconsin-Madison

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