Mice study shows middle-brain region prompts females to kill or care for their young

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A middle-brain region tied to the control of emotions likely prompts females to kill their young, a new study in mice shows. With the region

also present in humans, the study authors say the findings could play a similar role in better understanding infanticide by women.

Before giving birth for the first time, female mice are known to often kill others' pups. This behavior may have evolved to preserve scarce food supplies for their own future offspring, according to experts. However, most studies have focused on infanticide by adult males, and the brain mechanism behind this behavior in females has until now remained poorly understood.

Led by researchers at NYU Grossman School of Medicine, the study showed that chemically blocking the region, called the principal nucleus of the bed nucleus of stria terminalis (BNSTpr), prevented infanticide nearly 100% of the time. By contrast, when the study team artificially activated the brain region, both mothers and females without offspring killed pups in nearly all trials, attacking within a second of the stimulation. The mice rarely attacked other adults, the authors say, suggesting that the structure specifically controls aggression toward young animals.

The investigation also revealed that the BNSTpr appears to work in opposition to a brain region called the medial preoptic area (MPOA), itself known to promote mothering behavior. According to the findings, mice that had not yet reached motherhood showed high BNSTpr activity, which dampened activity in the MPOA. After the mice gave birth, however, MPOA activity ramped up, likely suppressing the infanticidal system in the process. The new mothers tended to avoid infanticide regardless of whether the pup was theirs.

"Our investigation pinpoints for the first time the brain mechanisms that we believe encourage and discourage infanticide in females," said study lead author Long Mei, Ph.D., a Leon Levy Foundation postdoctoral fellow in NYU Langone Health's Neuroscience Institute.

The new study, published online June 7 in the journal *Nature*, also demonstrates that the switch to maternal behaviors can be reversed by extra pressure to the BNSTpr.

According to the U.S. Centers for Disease Control and Prevention, child abuse is the fourth leading cause of death among preschool children in the United States. Mei notes that while early studies had largely focused on potential problems in the parenting centers of the brain, experts have more recently begun to search for a separate system dedicated to infanticide and aggression against children.

For the investigation, researchers first narrowed down the most likely brain regions behind infanticidal behavior by tracking which structures were connected to the MPOA. Next, they artificially stimulated each of the resulting seven areas in live mice to determine which, if any, caused the animals to attack pups. Then, the team blocked activity in the BNSTpr, the most promising candidate remaining, to see if this would prevent infanticide.

To demonstrate that the BNSTpr and MPOA counteract each other, the study authors prepared brain slices from female rodents and activated one region while at the same time recording cell activity in the other. They also traced how activity in these structures changed as rodents reached motherhood.

"Since these two connecting regions in the middle of the brain can be found in both rodents and humans alike, our findings hint at a possible target for understanding, and perhaps even treating, mothers who abuse their children," said study senior author and neuroscientist Dayu Lin, Ph.D. "Maybe these cells normally remain dormant, but stress, postpartum depression, and other known triggers for child abuse may prompt them to become more active," added Lin, a professor in the Departments of Psychiatry and Neuroscience and Physiology at NYU

Langone.

That said, Lin, also a member of NYU Langone's Neuroscience Institute, cautions that it remains unclear if the two brain regions perform the same roles in humans as they do in rodents.

She adds that the study team next plans to examine the BNSTpr and MPOA in male mice and to explore ways of turning off activity in the former region without invasive surgery.

In addition to Mei and Lin, other NYU study investigators involved in the study were Rongzhen Yan, Ph.D.; Luping Yin, Ph.D.; and Regina Sullivan, Ph.D.

More information: Dayu Lin, Antagonistic circuits mediating infanticide and maternal care in female mice, *Nature* (2023). DOI: 10.1038/s41586-023-06147-9.
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