Study finds that parental 'memory' is inherited across generations

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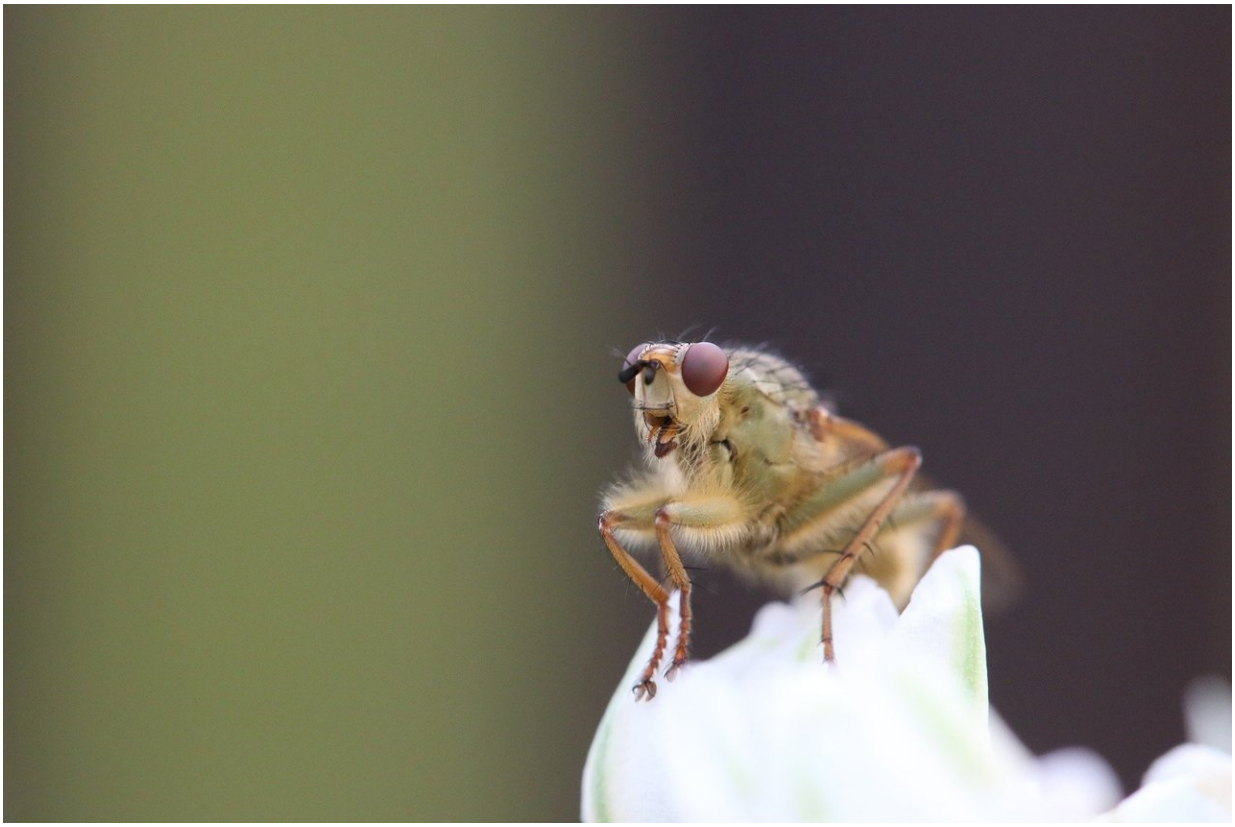

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Are our personalities and behaviors shaped more by our genes or our circumstances? While this age-old "nature vs. nurture" question continues to confound us and fuel debates, a growing body of evidence

from research conducted over recent decades suggests that parental environment can have a profound impact on future generations.

Results of a new Dartmouth study published this week in the journal *eLife*—which examined how environmental stressors put on fruit flies (Drosophilia melanogaster) can influence the phenotypes of their offspring—are adding some intriguing findings to the mix.

"While neuronally encoded behavior isn't thought to be inherited across generations, we wanted to test the possibility that environmentally triggered modifications could allow 'memory' of parental experiences to be inherited," explains Julianna "Lita" Bozler, a Ph.D. candidate in the Bosco Lab at the Geisel School of Medicine, who served as lead author on the study.

When exposed to parasitoid wasps—which deposit their eggs into and kill the larvae of fruit flies—Drosophila melanogaster females are known to shift their preference to food containing ethanol as an egg laying substrate, which protects their larvae from wasp infection.

For the study, the fruit flies were cohabitated with female wasps for four days before their eggs were collected. The embryos were separated into two cohorts—a wasp-exposed and unexposed (control) group—and developed to maturity without any contact with adult flies or wasps. One group was used to propagate the next generation and the other was analyzed for ethanol preference.

"We found that the original wasp-exposed flies laid about 94 percent of their eggs on ethanol food, and that this behavior persisted in their offspring, even though they'd never had direct interaction with wasps," says Bozler.

The ethanol preference was less potent in the first-generation offspring,

with 73 percent of their eggs laid on ethanol food. "But remarkably, this inherited ethanol preference persisted for five generations, gradually reverting back to a pre-wasp exposed level," she says. "This tells us that inheritance of ethanol preference is not a permanent germline change, but rather a reversible trait."

Importantly, the research team determined that one of the critical factors driving ethanol preference behavior is the depression of Neuropeptide-F (NPF) that is imprinted in a specific region of the female fly's brain. While this change, based in part on visual signals, was required to initiate transgenerational inheritance, both male and female progeny were able to pass on ethanol preference to their offspring.

"We're very excited about the findings that Lita, and her lab partner, Balint Kacsoh have made," says Giovanni Bosco, Ph.D., a professor of molecular and systems biology at Geisel, who directs the Bosco Lab. "They are allowing us to better understand not only the biology and epigenetics of fruit flies, but also some of the foundational mechanisms upon which biologic inheritance is based.

"Of particular interest, are the conserved signaling functions of NPF and its mammalian counterpart NPY in humans," he says. "We hope that our findings may lead to greater insights into the role that parental experiences play across generations in diseases such as drug and alcohol disorders."

More information: Julianna Bozler et al, Transgeneratonal inheritance of ethanol preference is caused by maternal NPF repression, *eLife* (2019). DOI: 10.7554/eLife.45391

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