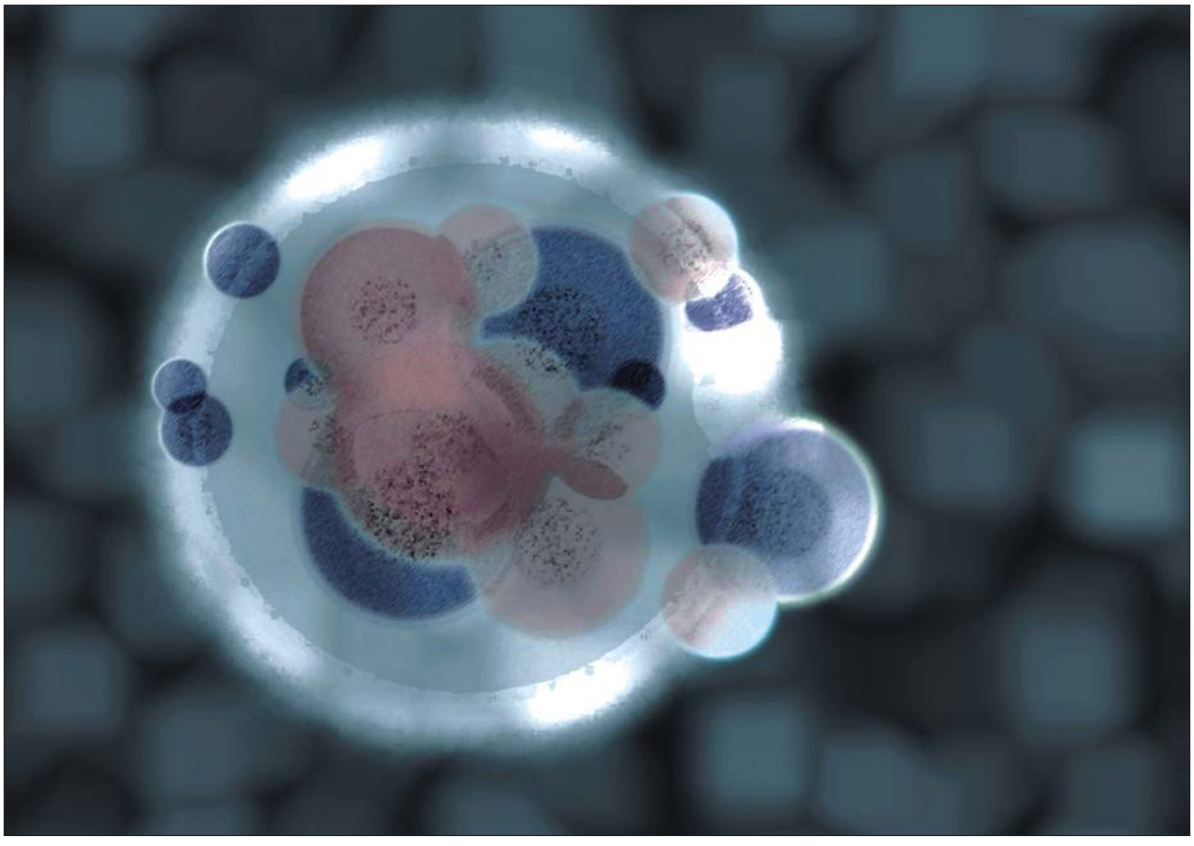

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Battle of the Sexes: Researchers Change 'Femaleness' or 'Maleness' of Fruit Flies

Pity the female fruit fly. Being a looker is simply not enough. To get a date, much less a proposal, you have to act like a girl, even smell like one. Otherwise, you might just have a fight on your hands.

Like most animals, fruit flies must distinguish between a potential mate and a potential competitor. When a male fruit fly suspects he's encountered a female, he'll court; when he senses the other is a male, he'll fight. What triggers these sex-specific responses?

According to new research by scientists at Harvard Medical School, the answer lies with both pheromonal profiles and behavioral patterns. The researchers investigated the effects of taste and action by manipulating a gene that governs both the sex specificity of a fruit fly's body-surface hydrocarbons, or pheromones, and the sex-linked behavioral cues that issue through the dense nerve-cell network that constitutes the fly's brain.

"These findings underscore the importance of behavioral feedback in the manifestation of aggression," says Edward Kravitz, the George Packer Berry Professor of Neurobiology at Harvard Medical School.

The research is published in the November 23 issue of PLoS Biology.

María de la Paz Fernández and Yick-Bun Chan, post-doctoral researchers in the Kravitz lab, discovered these links to aggression when investigating whether a male fruit fly would ever attack a female. They focused on a particular gene called transformer, which is active in females but not in males. Through blocking transformer expression in a variety of different tissues in females, the researchers could specifically alter the "femaleness" or "maleness" of the pheromones, which in turn altered the patterns of aggressive behavior encoded in the fly's brain.

When they changed pheromone profiles so that females "tasted" like males, the researchers found that males would attack them. This indicated that pheromonal cues alone could label another fly as a competitor. But the researchers were surprised to discover that males also attacked "aggressive females" -- flies that still looked, smelled and tasted female but had been genetically altered to display male-like patterns of behavior.

When the researchers turned the tables by triggering the expression of transformer in males so as to feminize both the pheromonal and behavioral profiles, control males showed no aggression toward the transformed males. Instead, they began to court them. These results show that it is possible to completely reverse normal behavioral responses by presenting males with unanticipated and conflicting sensory cues.

"Future studies will aim at unraveling the neuronal circuitry that governs this type of decision-making behavior, as such decisions are essential for survival," says Kravitz. "With the powerful genetic methods available in fly neurobiology, it should be possible to dissect the decision-making circuitry at far greater levels of detail than have heretofore been possible in other species."

"This study addresses a classic question in animal behavior: What motivates an individual to do X rather than Y, or vice versa," said Laurie Tompkins, Ph.D., who manages Kravitz's and other behavioral genetics grants at the National Institutes of Health. "Because the general principles of how behaviors are controlled are conserved among species, Kravitz's conclusions about how flies make simple choices may illuminate how humans and other animals make more complex decisions."

The study was supported by grants from the National Institute of General Medical Science and by a Pew Latin American Fellowship awarded to Fernández.