

In fruit flies, homosexuality is biological but not hard-wired

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While the biological basis for homosexuality remains a mystery, a team of neurobiologists reports they may have closed in on an answer -- by a nose.

The team led by University of Illinois at Chicago researcher David Featherstone has discovered that sexual orientation in fruit flies is controlled by a previously unknown regulator of synapse strength. Armed with this knowledge, the researchers found they were able to use either genetic manipulation or drugs to turn the flies' homosexual behavior on and off within hours.

Featherstone, associate professor of biological sciences at UIC, and his coworkers discovered a gene in fruit flies they called "genderblind," or GB. A mutation in GB turns flies bisexual.

Featherstone found the gene interesting initially because it has the unusual ability to transport the neurotransmitter glutamate out of glial cells -- cells that support and nourish nerve cells but do not fire like neurons do. Previous work from his laboratory showed that changing the amount of glutamate outside cells can change the strength of nerve cell junctions, or synapses, which play a key role in human and animal behavior.

But the GB gene became even more interesting when post-doctoral researcher Yael Grosjean noticed that all the GB mutant male flies were courting other males.

"It was very dramatic," said Featherstone. "The GB mutant males treated other males exactly the same way normal male flies would treat a female. They even attempted copulation."

Other genes that alter sexual orientation have been described, but most just control whether the brain develops as genetically male or female. It's still unknown why a male brain chooses to do male things and a female brain does female things. The discovery of GB provided an opportunity to understand why males choose to mate with females.

"Based on our previous work, we reasoned that GB mutants might show homosexual behavior because their glutamatergic synapses were altered in some way," said Featherstone. Specifically, the GB mutant synapses might be stronger.

"Homosexual courtship might be sort of an 'overreaction' to sexual stimuli," he explained.

To test this, he and his colleagues genetically altered synapse strength independent of GB, and also fed the flies drugs that can alter synapse strength. As predicted, they were able to turn fly homosexuality on and off -- and within hours.

"It was amazing. I never thought we'd be able to do that sort of thing, because sexual orientation is supposed to be hard-wired," he said. "This fundamentally changes how we think about this behavior."

Featherstone and his colleagues reasoned that adult fly brains have dual-track sensory circuits, one that triggers heterosexual behavior, the other homosexual. When GB suppresses glutamatergic synapses, the homosexual circuit is blocked.

Further work showed precisely how this happens -- without GB to

suppress synapse strength, the flies no longer interpreted smells the same way.

"Pheromones are powerful sexual stimuli," Featherstone said. "As it turns out, the GB mutant flies were perceiving pheromones differently. Specifically, the GB mutant males were no longer recognizing male pheromones as a repulsive stimulus."

Featherstone says it may someday be possible to domesticate insects such as fruit flies and manipulate their sense of smell to turn them into useful pollinators rather than costly pests.

The research appeared online today in *Nature Neuroscience*, and is scheduled for print in the January issue.

Source: University of Illinois at Chicago

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