Genetically driven gut feelings help female flies choose a mate

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Even among flies, mating is a complicated ritual. Their elaborate courtship dance combines multiple motor skills with advanced sensory cues. Remarkably this behavior is entirely innate. Now, researchers at Rockefeller University have determined that the Abdominal-B (Abd-B) gene, previously known as the gene that sculpts the posterior parts of the developing fly, is also important for this complex behavior, at least in the case of female flies (*Drosophila melanogaster*).

The Abd-B gene is needed for the development of neurons that decide whether or not a female fly becomes receptive to sexual advances from a male of her species. Their findings, from Leslie B. Vosshall's Laboratory of Neurogenetics and Behavior, appear July 2 in the journal *Current Biology*, and are the first to uncover this genetic link to receptivity. Vosshall is Robin Chemers Neustein Professor and is a Howard Hughes Medical Institute investigator.

"Female fly receptivity is hardwired into the nervous system by genetic programing, and we have identified a gene and neurons responsible for a major part of this behavior," says Jennifer J. Bussell, lead author of the study and a former graduate student in the lab. "Our results provide an entry point into understanding the complex neural circuitry that drives courtship behavior on the female side of the equation."

Flies are a useful scientific tool for studying genetics, particularly the genetics of behavior. In the present study, the researchers link Abd-B to a set of neurons that control a specific behavior, namely receptivity to sexual advances. According to the researchers it is an example of how innate behaviors are often controlled by bundling neurons into modular units, examples of which can be seen repurposed across species, from flies to rodents—and possibly even humans.

"Neurons can act as modules controlling different components of a behavior, and the modules can be used differently by the two sexes," Bussell says. "The Abd-B neurons might be a module for the components of female receptivity."

In choosing their mates, male and female flies take part in an elaborate courtship ritual. Until recently, researchers have primarily focused on the showier behavior of the males, who actively court females through pursuit and song—extending a single wing and tapping out notes of woo to potential mates.

"Because the male courtship routine was so obviously complex, it was previously thought that the role of the female was a matter of passive acceptance," says Bussell. "In fact, according to our studies, it turns out that there is much more going on than a simple yes or no from females."

The Rockefeller team took a detailed look at what constitutes female receptivity. First, the female fly must slow down periodically to allow the pursuing male to catch up—a behavior the researchers called "pausing." Second, she must open the "vaginal plates" of her exoskeleton to allow access to her genitalia.

To determine which gene or genes controls this behavior, the researchers employed a technique called RNA interference—using small segments of RNA to silence individual genes throughout the entire fly genome, but doing so only in neural cells. In silencing a gene, researchers can see the effect of that gene on the organism, much like flipping the circuit breaker on an unlabeled electrical panel to see which lights turn off in a house.

Using a strain of fly that allowed them to easily assess neuronal behavior, the researchers were able to link Abd-B activation to a set of 150 neurons connected primarily to the genitalia and the abdominal ganglion, a cluster of nerves found at the bottom of the *Drosophila* nerve cord, which is a structure roughly analogous to the human spinal column. These Abd-B neurons, they found, were crucial to the pause response in courtship.

"We found that silencing Abd-B neurons directly decreased the pausing behavior during courtship, but was a separate component from the opening of vaginal plates," Bussell says.

From controlled observational studies, they discovered that the male courtship song alone could not get the females to "pause." The exact mechanism by which Abd-B neurons control pausing remains unknown, but their findings suggest that Abd-B neurons play a role in translating sensory input from the male's courtship behavior into the physical response of pausing.

So, the activity of Abd-B neurons depends entirely on the female fly receiving just the right amount of stimulus from the male's song and dance routine—a gut response to the male's qualities, perhaps. Or, at least, a response from the abdominal ganglion.

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