Scientists discover neurons that control willingness to mate in female fruit flies

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How can you tell if an individual is expressing sexual interest? With males, it's usually quite obvious and can be anything from lavish theatrical displays of song and dance to downright relentless insistence. Females, on the other hand, are far more subtle, to the degree that very similar behaviours can have opposite intentions.

In fruit flies, for instance, males are known to chase after the female

while producing a distinct courtship song using their wings, whereas the female's behaviour often involves mild acts of rejection. It is no wonder that capturing the features that define female receptivity has been such a longstanding challenge.

In a study published in the journal *Scientific Reports*, researchers at the Champalimaud Centre for the Unknown in Lisbon use advanced genetic and behavioural tools to establish that walking speed is, in fact, a key indicator of female's receptivity, and discover neurons that control mating in the brain of fruit flies.

"Courtship behaviour is an integral part of sex and reproduction," says Maria Luisa Vasconcelos, the researcher who led the study. "In most species, including fruit flies, it is the female who decides whether or not to copulate with a given courting male, but until now the manner by which she expresses her interest and the brain circuitry that underlies it were largely unknown."

To find out how the brain controls receptive behaviour in female fruit flies, Vasconcelos, together with her team, performed a wide search across many types of neurons in the brain, and came up with one strong candidate. "When we silenced these particular neurons, called apterous neurons, females significantly reduced their receptivity towards males."

Once the team identified that manipulating this specific set of neurons leads flies to stop mating, they decided to take a closer look at the behaviour of the flies to try to see what changed. "There are many possibilities, but we uncovered that only one behavioural hallmark was affected: The female never slowed down her walking pace."

"We were very encouraged when we observed this," says Márcia Aranha, the first author of the study. "Modulation of the female's walking speed has been contemplated as a sign of receptivity by the scientific

community and our results support this idea."

But this was just the first step. As Aranha explains, they still had to rule out many factors before they could be certain that the neurons they found control specifically female receptivity. "We had to make sure that silencing these neurons did not result in motor or sensory deficits that would change the behaviour of the fly in a way that looks as though she's less receptive, but is in fact just physically unable to slow down or perhaps can't even sense the presence of the courting male."

To that end, the researchers performed a series of experiments. "First, we checked whether the locomotion of the flies was intact, and it was. We found that silencing the neurons only affected the fly's walking speed during courtship and remained normal in other situations. Then we evaluated if we were affecting sensory modalities that are critical for the female to evaluate the male. It is known that females assess the male's qualities using auditory and olfactory information, but we think it is unlikely that we are affecting their capacity to smell or hear, given the location and anatomy of the identified neurons," Aranha explains.

Final confirmation of their discovery included additional tests, but the researchers discovered a set of neurons in the brain that control what they now knew to be a key behavioural feature of female receptivity.

For the next step, the team is trying to pin down the neural circuitry these neurons tap into. According to Vasconcelos, they believe that "these neurons might be in charge of integrating different types of information about the male. This way, when we silence them, even though the female is aware of the presence of the male, she is not able to make a proper overall evaluation and that's why she doesn't slow down. We are currently pursuing this hypothesis and we hope to know the answer soon enough," she concludes.

More information: Márcia M. Aranha et al. apterous Brain Neurons Control Receptivity to Male Courtship in Drosophila Melanogaster Females, *Scientific Reports* (2017). DOI: 10.1038/srep46242

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