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The love song of a fly

Neurobiologists at Vienna's Research Institute of Molecular Pathology use the mating ritual of the fruit fly to study how the nervous system initiates, controls and utilizes behavior. Using newly developed thermogenetic methods, the researchers are able to initiate the courtship song of the male fly by "remote control", and study the involved neural networks. The scientific journal NEURON recently published their findings.

Male fruit flies of the *Drosophila melanogaster* species perform a complex courtship ritual to attract the attention of female flies and make them amenable to mating. As part of the ritual, the male fly performs a "song" by extending a wing and vibrating it. The pulsating acoustic signal produced by this exercise sounds rather like static crackling or humming to the human ear. However, the female fly finds the sound irresistible. Singing is an important part of the fly's courtship; how well the male performs its song is crucial for the success of its mating.

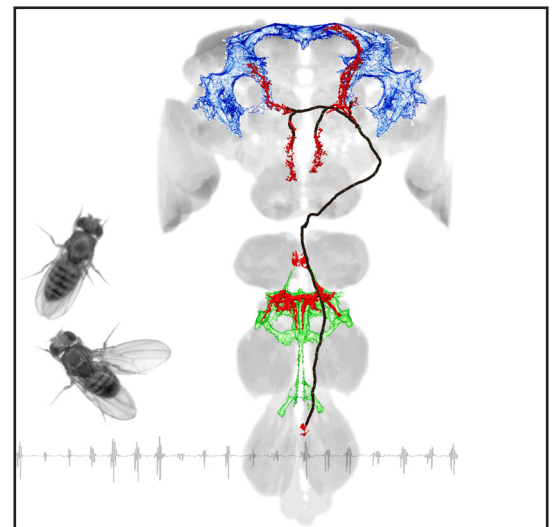
Under natural circumstances, the sight and smell of a female fly induce courtship in the male. At the Institute of Molecular Pathology in Vienna, scientists have developed a kind of molecular "remote control" to initiate the ritual. Anne von Philipsborn, a biologist and Postdoc in the lab of IMP Director Barry Dickson, works with genetically modified fruit flies. By raising the ambient temperature, she can get an isolated male fly - in the absence of a female, and presumably not thinking at all about sex - to become aroused and initiate courtship.

This condition is achieved by the use of a method known as thermal activation. Defined sets of nerve cells (neurons) are fitted with temperature-sensitive ion channels. These channels open up when the temperature approaches 30 degrees and become permeable for certain small molecules. The flow of ions, in turn, activates the nerve cell and triggers an impulse.

By switching on and off targeted nerve cells, the neurobiologists in Vienna were able to identify two centers in the fly's nervous system that control singing. The command to sing comes from a center located in the brain. This network of cells receives input from various sources; the most important of these are sensory organs and other regions of the brain. What the fly sees, hears and smells is channeled to this circuit and, together with pre-existing information obtained from prior experience, a decision is made to court or not to court the female.

The second neural circuit is located in the chest and is connected to the muscles that move the wings. This network is a so-called pattern generator. It coordinates the movement of the muscles and produces their rhythmic pattern.

For the scientists at the IMP, the courtship song of the fruit fly serves as a model to investigate the neural mechanisms of decision-making, action selection, and motor pattern generation. In short, they want to find out how meaningful behavior is orchestrated.



*A neural circuit for the courtship song of the fruit fly *Drosophila melanogaster* (copyright: IMP)*

Having found the key neurons that make the fly sing, the team of neurobiologists will continue to look deeper into the mechanisms that control behavior. Barry Dickson explains their future plans: “We now need to figure out exactly how this circuit works under normal conditions, when the male is naturally aroused by a virgin female. And we are also now starting to use the same method to look for neurons that trigger other components of mating behavior, such as copulation itself.”

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Original publication:

„Neuronal control of *Drosophila* courtship song“ (Anne C. von Philipsborn et al.). *NEURON*, February 10, 2011 (Vol. 69, pp. 509–522).

For a sample of the fly song and an illustration of the neuronal circuits, please visit the IMP’s website at <http://www.imp.ac.at/contact/communications-department/press-releases/>

Caption / illustration:

A neural circuit for the courtship song of the fruit fly *Drosophila melanogaster*. The male fly pursues the female and produces a song by extending a wing and vibrating it. The nervous system of the male fly (brain and thoracic ganglia) is shown on the right, with the neurons involved in the production of the song highlighted in color. The audio track below represents a pulse song.

Caption / audio file:

The typical pulse song of a male *Drosophila melanogaster* fly.

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