Taste sensors in fly legs control feeding

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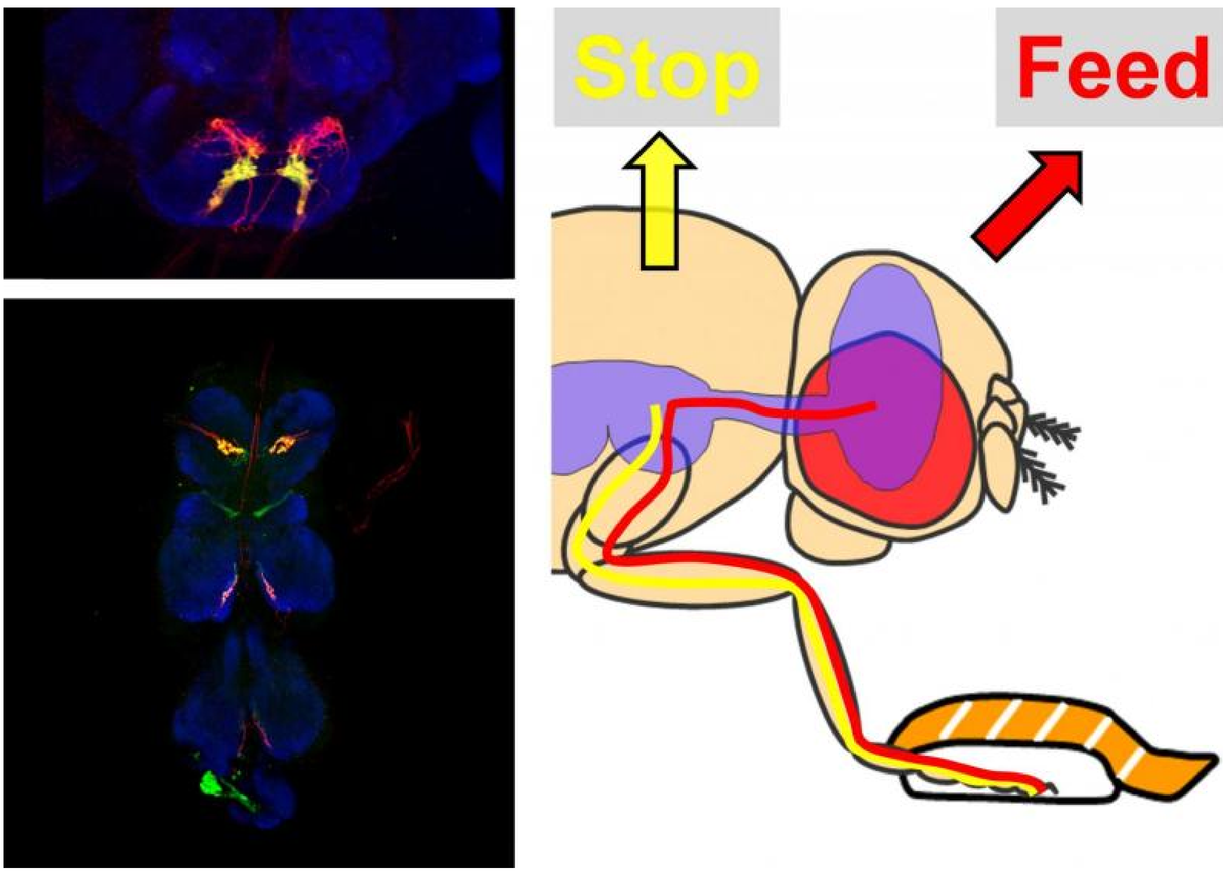

Left: Sweet taste neurons in the fly brain (upper panel; blue) and ventral nerve cord (lower panel; blue). Leg neurons initially project to the ventral nerve cord and can be grouped into two classes. One class terminates in the ventral nerve cord (yellow in lower panel) whereas the other continues projecting to the brain (red in upper and lower panel). Sweet taste neurons from the mouthparts can also be seen (yellow in upper panel). Right: Schematic of the function of leg neurons. As soon as a fly steps on food, sweet taste leg neurons terminating in the ventral nerve cord stop movement, while the brain-projecting neurons initiate feeding.

Feeding is essential for survival. Senses such as smell or sight can help guide us to good food sources, but the final decision to eat or reject a potential food is controlled by taste. Scientists have examined the anatomy of the taste-sensing neurons to reveal their role in the stages of feeding.

While the tongue is the main taste organ in humans and other mammals, insects not only have taste organs inside their mouthparts, but also on the body. Their legs, wings and ovipositor (the organ with which females lay eggs) can contain taste receptor neurons.

The need for so many taste organs in insects is not understood very well. However, a clue for understanding their function comes from examining the anatomy of the taste-sensing neurons. These neurons send projections to different parts of the central nervous system of the fly. This suggests that taste information received from different parts of the body is processed differently in the brain. Therefore, different taste organs may have different functions.

To test this idea, Thoma et al. used the fruit fly Drosophila as a model for insects. With Drosophila, it is possible to target small numbers of neurons and to block them or activate them with genetic tools. The scientists blocked different groups of sweet-sensing neurons and measured sugar choice, the first step in feeding behavior. Normally, hungry flies choose sugar very quickly, but the flies which had all sweet-sensing neurons in their legs blocked could not choose sugar.

The scientists then examined the sweet taste neurons in the legs and found two populations of neurons. One group of neurons connected directly to the brain of the fly. The remaining neurons connected to the ventral nerve cord, a structure analogous to the spinal cord in humans.

The authors blocked each population separately and found that they have specialized functions. While the brain-projecting neurons are important for the initiation of feeding, the ventral nerve cord-projecting neurons are important for stopping the fly's movement as soon as it steps on food. Both of these functions are important for correctly choosing sugar.

These results show how feeding, a complex behavior with many steps, is organized by the specialized contributions of different groups of neurons. The role of the taste neurons in other organs is only partially understood, but it is possible that they are important for the later stages of feeding.

Additionally, popular insect repellents such as DEET rely on chemicals that smell and taste bad to insects. Therefore, a better understanding of insect choice behavior and feeding may also contribute to the development of more effective pest control.

More information: Vladimiros Thoma et al. Functional dissociation in sweet taste receptor neurons between and within taste organs of Drosophila, *Nature Communications* (2016). DOI: 10.1038/NCOMMS10678

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