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News

Fruitfly larvae smell the light

Genetic tweak fools flies into mistaking light for unpleasant odours.

Lucas Laursen

Researchers in Germany have genetically modified fruitfly larvae so that they can smell light. The team, led by Klemens Störtkuhl of Ruhr University in Bochum, Germany, managed to change the larvae's odour receptors so that they respond to blue light instead of smells[1]. The researchers hope that the move will allow them to unravel the way in which the larvae detect and interpret smells.

Genetically modified fruitfly reacted to light as if it were an unpleasant odour.

T. Zachariasz/ iStockphoto

Fruitfly larvae normally shy away from light, but will move towards favourable smells, such as those of food, or flee unpleasant odours. Trying to work out which receptors are responding to which odour, though, is difficult. "Multiple odorant receptors may be activated by one odour, a single odorant receptor may be sensitive to multiple odours," says biologist Elaine Fishilevich of Carnegie Mellon University in Pittsburgh, Pennsylvania, who was not involved in the work. "And then there is the timing of activation."

To try to get round this, Störtkuhl and his team aimed to swap the multiple confusion of odours for the direct and simple stimulation of one nerve cell with light. They expressed one of two light-sensitive proteins instead of the normal odour receptors in an olfactory nerve of the larvae's dorsal organs. The result was a nerve that responded to blue light as if it was sensing smells known to be unpleasant to flies, such as ethyl propionate or octyl acetate.

When placed in a Petri dish with sections illuminated either by blue light or in darkness — but containing a strong octyl acetate scent, the modified larvae headed for the dark, scented region, preferring the real bad smell to the 'virtual' one. But unmodified larvae took their chances in the light.

Störtkuhl's group used an electrode to confirm that it was the larvae's nerves that were detecting the stimulation — and as a result the researchers say they have shown that just one nerve is sufficient to provoke pursuit or flight behaviour in the larvae.

Fly fishing

Fishilevich and her team have previously tried to map the fruitfly olfactory system by genetically deactivating all of the olfactory receptors in fruitflies and then reactivating individual receptors one-by-one in an attempt to study each receptor's influence on behaviour[2]. And other studies have used light to activate neurons in fruitflies[3], but they have not fed the signal through an existing sensory network, which the latest study by Störtkuhl and his team does, says Fishilevich.

"Our aim was to keep the network intact and put some tools into the network that allows you to stimulate individual neurons," says Störtkuhl. His group hopes that the technique will help them to explore the relationships between the 21 olfactory nerves in *Drosophila* larvae, and eventually in the more complex adults.

Using light to activate odour receptors allows the researchers to sidestep questions such as which odour to use and how to deliver it, says Fishilevich. However, a problem with any study that attributes a natural behaviour to an artificially stimulated nerve is that the brain deals not only with the 'on' signals coming from stimulated nerves, but also with a pattern of background signals from the remaining nerves and inhibited nerves, says Matthew Cobb of the University of Manchester, UK. In fact, his group has found that *Drosophila* olfactory receptors and nerves do not always work in partnership. Sometimes an odour receptor activates its accompanying nerve, and sometimes it doesn't, a response he refers to as "fuzzy coding"[4].

Cobb says that although Störtkuhl's technique "will enable us to avoid some of the difficulties of direct stimulation with odours, on the other hand it will miss out the richness of peripheral coding such as inhibition, temporal aspects and fuzzy coding".

References

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