Understanding the fruit fly's nose

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How odours influence actions is one of the fundamental questions in neuroscience. Richard Benton, associate professor at the Center for Integrative Genomics at the University of Lausanne, follows the molecular trail of chemical messages from the nose to the brain of insects. For his work, the Swiss National Science Foundation (SNSF) on behalf of the International Latsis Foundation awards Benton with the National Latsis Prize 2015.

The 38-year-old researcher mainly studies the model organism Drosophila melanogaster, the common vinegar fly, to decipher the molecular logic of how insects receive chemical signals to distinguish kin, mates, competitors, prey and predators.

This involves identifying the receptors in the nose and the neurons in the brain that respond to information insects receive via their sense of smell. Benton tries to understand how a specific substance triggers activity in certain regions of the brain to provoke particular behaviours.

Similarities to humans

"Although the fruit fly's nose is simpler than our own, odour perception in insects is strikingly similar to how humans detect smells," Benton explains. "It becomes apparent when you look at how their neural circuits are organised and respond to odours." What we learn from the fruit fly can therefore help us better understand neural circuits in more complex brains.

One particular interest of Benton's group is to define how pheromones are detected. Insects – like most animals – use chemical signals to attract mates, to mark their paths or their territory, and to signal danger. The British researcher investigates the molecular pathways for pheromone sensing to explain how these vital chemical messages in minute quantities are detected and how they specifically trigger the correct behavioural response.

Benton is also interested in understanding how nervous systems evolve, over thousands of generations, to adapt an animal's behaviour to its environment. Some species of flies, for example, feed only on specific fruits. This specialisation is accompanied by changes in their smell receptor genes and the wiring of neurons in the brain. Understanding the genetic changes that underlie the tweaking of the structure and function of neural circuits is important to understand how brains are built and operate.

Repel harmful insects

The studies are not restricted to provide fundamental knowledge on neuroscience. "From the basic research my group conducts it is only a small step to practical applications," says Benton.

Understanding molecular mechanisms of the insect's sense of smell may give researchers clues on how to interfere and manipulate odour-evoked behaviours in the wild. For example, Benton's findings in Drosophila melanogaster could inspire solutions to help trap or ward off closely related Drosophila suzukii, a pest that is damaging grape and strawberry crops.

"Our findings also have the potential to reduce the incidence of human diseases." Malaria, dengue fever or sleeping sickness are transmitted by bloodsucking insects including mosquitoes and tsetse flies, who rely on their sense of smell to find their hosts.

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