How the fruit fly could help us sniff out drugs and bombs

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The "nose" of a fruit fly can identify odors from illicit drugs and explosives almost as accurately as wine odor. Credit: Andre Karwath

A fly's sense of smell could be used in new technology to detect drugs and bombs, new University of Sussex research has found.

Brain scientist Professor Thomas Nowotny was surprised to find that the 'nose' of fruit flies can identify odours from illicit drugs and explosive substances almost as accurately as wine odour, which the insects are naturally attracted to because it smells like their favourite food, fermenting fruit.

Published on 15 October 2014 in the journal *Bioinspiration and Biomimetics*, the study brings scientists closer to developing electronic noses (e-noses) that closely replicate the sensitive olfactory sense of animals.

The hope is that such e-noses will be much more sensitive and much faster than the currently commercially available e-noses that are typically based on metal-oxide sensors and are very slow, compared to a biological nose.

Professor Nowotny, Professor of Informatics at the University of Sussex, led the study alongside researchers from Monash University and CSIRO in Australia. He said: "Dogs can smell drugs and people have trained bees to detect explosives. Here we are looking more for what it is in the nose - which receptors - that allows animals to do this.

"In looking at fruit flies, we have found that, contrary to our expectation, unfamiliar odours, such as from explosives, were not only recognised but broadly recognised with the same accuracy as odours more relevant to a fly's behaviour."

Professor Nowotny and his collaborators recorded how 20 different receptor neurons in fruit flies responded to an ecologically relevant set of 36 chemicals related to wine (the 'wine set') and an ecologically irrelevant set of 35 chemicals related to hazardous materials, such as those found in drugs, combustion products and the headspace of explosives (the 'industrial set').

By monitoring the 'firing rate' of each neuron, they were able to assess which smells elicited the strongest reactions from the flies. They then used a computer program to simulate the part of the fly's brain used for recognition to show that the receptor responses contained enough information to recognise odours.

Of the wine set, 29 out of the 36 compounds elicited clear excitatory responses in at least one receptor neuron. They were surprised to find, however, that the flies also responded to 21 out of the 35 substances related to drugs and explosives.

Professor Nowotny adds: "The long-term goal of this research direction is to 'recreate' animals' noses for technical applications. As well as the detection of explosives, chemical weapons and drugs, there is a broad array of other possible applications, such as measuring food quality, health (breath analysis), environmental monitoring, and even geological monitoring (volcanoes) and agriculture (detecting pests).

"And, of course, the fly's success in identifying the 'wine set' might prove useful for those in the winemaking industry.

"But it would be quite difficult to recreate the entire nose; even adopting all sensors would be too difficult. One may be able to do five or maybe 10, out of 43 in the fruit fly or hundreds in the dog. So the question is, which 10 should we use and would it work? In this paper we show that it could work with as little as 10 fruit fly receptors and we identify the most likely candidates to use."

More information: iopscience.iop.org/1748-3190/9/4/046007/article

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