Choosing a mate—it's the brain, not the nose, that knows

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European Corn Borer. Credit: University of Amsterdam

How does a male moth find the right type of female for mating when there are two similar types luring him with their pheromones? In many species, differences in the antenna used by the male to smell these perfumes are responsible for his choice. However, in the European Corn Borer (Ostrinia nubilalis), changes in the male's brain seem to dictate his choice between two types of available females. This is the finding of research conducted by an international team from the University of Amsterdam (UvA), the Swedish University of Agricultural Sciences and the Max Planck Institute for Chemical Ecology.

The team's results are published in the latest edition of *Proceedings of the National Academy of Sciences*.

Smelling a mate

Female moths produce a sex pheromone, a different blend of chemicals for each species, which attracts males from a distance. Males detect these chemicals with exquisitely sensitive hair-like structures in the antenna. These hairs contain specialised neurons, nerve cells that express pheromone receptors that are activated when they bind to individual pheromone components. Different species have different pheromone receptors, and so the ability to most accurately smell females of the same species prevents attraction to other females. Solving the puzzle of why a certain pheromone receptor is activated only by a specific chemical has motivated much past research. But the European Corn Borer doesn't fit this mold, and another approach was necessary.

It's in the brain

This species uses a simple pheromone with only two isomeric compounds, identical except for the orientation of a double bond. The two "pheromone strains" of this species produce them in different proportions. E-strain females make mostly the E isomer with traces of the Z isomer, which is highly attractive to E-strain males. Z-strain females release the opposite ratio, attracting Z-strain males. In both cases, both components are absolutely necessary for attraction, and males of both strains can smell both, with similar or identical antennal structures and pheromone receptors. So what difference among the E and Z males could explain their differing preferences?

By crossing the E and Z strains in the laboratory and mapping the gene governing male preference, the researchers found that the pheromone receptors had little or no effect. Instead, a chromosomal region containing genes involved in neuronal development explained most of the male behavioural response. This unexpected result fits with previous work showing that E and Z males have different connections between the neurons harboring pheromone receptors and the brain. This suggests that females of the E or Z strain smell the same to both E and Z males, while their preferences are controlled not by their noses but instead by their brains.

Molecular mechanisms

According to Fotini Koutroumpa, lead author of the study and researcher at the UvA's Institute for Biodiversity and Ecosystem Dynamics (IBED), the results point to future research on the tiny but complex moth brain, which will shed light on how the diverse pheromone systems of the thousands of moth species has changed throughout evolution. 'The discovery that new molecular mechanisms can be explored in insect smell is crucial not only for evolutionary biology, but also for pest management, especially with the newly developed genome editing technology (CRISPR).'

More information: Fotini A. Koutroumpa et al. Genetic mapping of male pheromone response in the European corn borer identifies candidate genes regulating neurogenesis, *Proceedings of the National Academy of Sciences* (2016). DOI: 10.1073/pnas.1610515113

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