Senses of sophistication: Mosquitoes detect subtle cues finding food, spreading diseases

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Fruit flies and mosquitoes share similar sensory receptors that allow them to distinguish among thousands of sensory cues – particularly heat and chemical odors – as they search for food or try to avoid danger, researchers from Boston College and Brandeis University report in the current electronic edition of the journal *Nature*.

Pinpointing a tiny portion of a protein found on the surfaces of neurons that give the fruit fly Drosophila and the malaria mosquito Anopheles gambiae the ability to distinguish different stimuli, the findings provide new clues that could be used to develop solutions to target disease-spreading mosquitoes.

"Heat is one element of an ensemble of cues we present that mosquitoes read as they search for their next blood meal," said Boston College Professor of Biology Marc A.T. Muskavitch, a co-author of the report. "These findings give us another chance to look at how we might try to reduce the ability of mosquitoes to sense us, and thereby protect ourselves from their bites and the diseases that they spread."

Receptors that sense heat and chemicals are among the ancient biological tools organisms first developed to find food or avoid harm. Over the ages, these receptors have evolved, allowing humans, animals and insects to detect and distinguish among thousands of stimuli. What's puzzled scientists is how animals distinguish between sensory inputs that are detected by the same sensors.

Transient receptor potential (TRP) channels in the brain, skin and other sensory organs play key roles in deciphering thermal, chemical and other sensory cues. But the mechanism a TRP channel uses to distinguish between signals sent by a heat source or by a noxious chemical has eluded researchers.

Building on earlier research into thermosensation in Drosophila by co-author and Brandeis University Professor of Biology Paul A. Garrity, the team found fruit flies possess slightly different versions, or isoforms, of the TRPA1 channel within their neurons. One version of the channel responds to warmth, while the other version responds only to chemicals. The same two TRPA1 isoforms are found in the malaria mosquito Anopheles gambiae, the team reports, giving mosquitoes the ability to distinguish between warmth given off from a potential host and the odor from a chemical repellent.

Muskavitch, whose prior research includes decoding the genes of mosquitoes that transmit human diseases, says finding ways to disrupt the abilities of mosquitoes to sense and bite humans has been a goal of researchers and public health services around the world for some time. Knowing more about the insect's basic responses to its warm-blooded targets and to chemical insecticides and repellents will help inform efforts to reduce the transmission of mosquito-borne illnesses that kill and sicken millions of people around the globe each year.

"If we could somehow make ourselves less 'visible' to the mosquito by reducing its ability to sense our warmth, or the carbon dioxide and other chemicals we emit, we could improve our ability to evade them," said Muskavitch. "The more veils we put between ourselves and mosquitoes, the less likely it is they will bite us and spread diseases among humans."

Provided by Boston College