Lab develops novel approach to study sound recognition in acoustically orienting animals

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The acoustic parasitoid fly Ormia ochracea and its host, a field cricket. Credit: Norman Lee

If you wander outside on these late summer nights, you might hear the din of calling songs from field crickets. Male crickets produce these songs to attract their mates—but they may also draw the attention of acoustically orienting parasitiod flies. The fly *Ormia ochracea* has evolved directionally sensitive ears to eavesdrop on the communication signals of field crickets. Crickets that are parasitized by these flies face almost certain death. How these flies recognize cricket songs and whether crickets can change their love songs to avoid parasitism is unknown.

A new study by Dr. Norman Lee, in collaboration with St. Olaf College students Alexander Kirtley '19, Isaiah Pressman '19, and Karina (Kari) Jirik '20, and University of Toronto collaborators Dean Koucoulas and Dr. Andrew C. Mason, show a novel approach that can be used to study song recognition in *O. ochracea*. Their work is published as part of a special research topic called "How Enemies Shape Communication Systems: Sensory Strategies of Prey to Avoid Eavesdropping Predators and Parasites" featured in *Frontiers in Ecology and Evolution*.

This approach relies on using a newly developed performance index and a treadmill system to measure how well flies respond to different cricket songs.

"This is an exciting advance because the approach can be broadly applied to better understand the sensory basis of song recognition, signal discrimination, learning and memory, and other auditory perceptual phenomenon in eavesdropping enemies," says Lee, an assistant professor of biology at St. Olaf. "This, in turn, will allow us to evaluate the effectiveness of behavioral strategies and the design of communication signals that prey or hosts may take to mitigate the risk of death."

The Lee Lab Neural Systems and Behavior at St. Olaf College will apply this new approach to unravel how different geographic populations of *O. ochracea* have evolved to recognize and prefer species-specific cricket songs that mainly differ in the temporal patterning of sound pulses. Temporal pattern recognition is a common sensory processing task shared by many animals that communicate with acoustic signals, including human speech. Studying temporal pattern recognition in *O. ochracea* may provide insights into general auditory system function involved in signal recognition.

Lee believes that his research into *O. ochracea* hearing can be harnessed to help improve human hearing by providing engineers with insights into how the natural world has solved common hearing challenges such as recognizing temporally patterned sounds. Engineers have relied on biomimicry to design miniature microphones based

on *O. ochracea* ears, with the hope of applying these microphones to create directional hearing aids.

"Understanding the signal features that auditory systems have evolved to assess to recognize salient sounds may help engineers improve signal processing strategies implemented in hearing aid technology," Lee says.

More information: Norman Lee et al, Developing a Phonotaxis Performance Index to Uncover Signal Selectivity in Walking Phonotaxis, *Frontiers in Ecology and Evolution* (2019). DOI: 10.3389/fevo.2019.00334

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