'SWAT'z new? -- A fly that's setting the hearing world abuzz

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Don't swat that fly!

That crafty little bug on the windowsill could possess the smallest, most sophisticated hearing device the world has ever known. And, as researchers learn more about how this special fly's ears function, they may also figure out how to build a similar device for use by people with hearing problems and robots who perform services for people and industry.

By using a free-floating ping-pong ball as a "fly treadmill," scientists were able to measure precise changes in the fly's direction of motion. Dots on the ball enabled tracking by computer.Copyright © Cornell University

Ormia ochracea (OR-mee-uh oh-KRAY-see-uh) is no ordinary fly. Sure, this North American insect has the same large compound eyes, antennae, and ultra-sensitive, jointed legs of the familiar housefly. But its ability to hear sounds and to locate precisely where those sounds are coming from set it miles apart from most other species.

Ormia's sense of hearing is important because of the manner in which it hunts for food. Unlike other flies, which eat plants and animals that are already dead or decaying, the species *Ormia ochracea* is a "parasitoid." A parasitoid is an animal that lives off living animals, eventually killing them. When a female Ormia hears the chirp of a male field cricket, she flies to within inches of it, quietly crawls aboard its body, and deposits larvae that burrow down and feast on the cricket's insides.

It's how well Ormia zeroes in on the cricket that has folks most amazed. Until recently, humans were considered the best creatures at locating sounds. However, researchers at Cornell University in Ithaca, N.Y., have discovered that Ormia is capable of hearing just as well as humans can. In addition, it accomplishes this feat with much smaller equipment and in a fraction of the time!

To test Ormia's talents, the scientists performed an experiment in which a fly on a leash was lowered onto a Ping-Pong ball floating on a stream of air. The ball was painted with hundreds of dots so that, as the fly walked, the ball's position could be tracked by a computer--just like your computer tracks the movements of your mouse. Finally, a speaker emitting cricket sounds was attached to a rotating mechanical arm. That way, the scientists could switch the direction from which the sounds came at a moment's notice.

The researchers discovered that no matter where the cricket's chirping was coming from, Ormia was able to detect the sound and walk precisely in that direction. What's more, it was able to locate sound as accurately as humans can.

Animals compute where a sound is coming from on the basis of two auditory "cues," or hints. The first cue is based on the amount of time it takes for a sound to reach each ear. For example, the ear that is closest to the sound will hear the sound more quickly than the other ear. The second cue is based on the loudness of the sound in both ears. The ear that is closest to the sound will hear it more loudly than the ear that is farther away from the sound.

Because humans have six or so inches between their right and left ears, the difference between what each ear hears is greater, making it easier to compute the location of the sound. But with its right ear only half a millimeter away from its left, Ormia has a much bigger challenge in telling the difference.

So how does she do it?

Ormia's eardrums are connected by a small bridge, kind of like a playground seesaw. When a sound is detected in the right ear, the right eardrum vibrates, causing the left eardrum to vibrate out of sync. This "back-and-forth" vibration of the eardrums creates a difference in pressure between the two ears, which the fly's ganglia and brain quickly compute. Within 50 nanoseconds--1,000 times faster than a human--Ormia's brain sends a signal to its muscles, and the fly is sneaking up on its unlucky target.

According to Dr. Ron Hoy, a professor of neurobiology at Cornell University, the possibilities for this unique hearing system are very exciting. Dr. Hoy is hoping to develop an affordable hearing device that accurately pinpoints where a sound is coming from and that responds to frequencies that people can hear. Dr. Hoy, along with Dr. Ron Mason and Dr. Michael Oshinsky, worked on the experiment. NIDCD funded the research.

"We have a lot to learn from creatures in the natural world," said Dr. Hoy. "They have been working on difficult problems much longer than we have."

- Cornell University article

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