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Fly Ear Research May Improve Hearing Aids

A tiny fly and its extraordinary hearing ability may hold the key to better hearing aid technology, according to a study published today in the journal *Nature.*

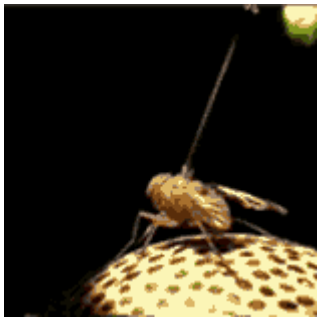

Image: ANDREW MASON

Whereas most flies have no sense of hearing whatsoever, the parasitic fly *Ormia ochracea* enjoys an excellent sense of directional hearing—one rivaled only by humans. "We thought humans were the champions at sound localization, thanks to our highly evolved auditory apparatus and the fact that our ears are up to six inches apart, a separation that allows for ample localization cues," says Cornell University neurobiologist Ron Hoy. "*Ormia*'s ears are a minuscule half millimeter apart, but it has evolved a system for localizing sounds very different from any other animal."

There is a very good reason why this fly has such good hearing: *Ormia* needs to find the cricket it parasitizes—a species of cricket that sings. The flies deposit on these crickets their larvae, which feed on the cricket tissue as they mature.

In order to test just how keen *Ormia*'s hearing really is, Hoy and his colleagues created an elaborate experiment. They tethered the tiny fly to a Ping-Pong ball, which functioned as a spherical treadmill. The ball was dotted so that a computer could track the movement of the ball, and thus the fly (*see animation*). The researchers then played artificial cricket sounds from various locations and observed the fly's movements. They found that *Ormia* could detect directional changes as small as two degrees. "Even humans trying to detect who is speaking in a crowded room can't do better than that," team member Andrew Mason of the University of Toronto remarks.

A key aspect of the fly's sound localization system is that its eardrums beat out of phase with each other. "The near ear, the one closest to the sound source, responds more vigorously, compared to the far ear," Hoy explains. Based on that pressure difference, the fly's brain calculates the location of the sound source. Whereas humans make that calculation in about 10 microseconds, the fly, with its tiny head, does the math in almost a thousandth of that time—50 nanoseconds.

That *Ormia* has managed to develop such a sophisticated sense of hearing despite its miniscule size leads the researchers to hope that they will eventually be able to copy the fly's hearing apparatus to make better hearing aids. Already they have developed a preliminary prototype "microphone eardrum," but so far it works only at ultrasonic frequencies. "This might make a good hearing aid for a bat," Hoy observes, "but we need a device that responds to critical frequencies in the human hearing range, especially in speech—and one that will be highly directional, fit inside the ear canal and be affordable." — *Harald Franzen*