Insect-inspired microphone could revolutionise hearing aids

A microphone inspired by the hearing of a parasitic fly could revolutionise hearing aids by allowing wearers to hear which direction sounds come from.

Professor James Windmill[1] and his team at the University of Strathclyde used funding from BBSRC, EPSRC and Dstl to create the tiny fly-inspired microphone, which can determine whether sounds have come from the back, front, left or right, despite measuring only a few millimetres across. The researchers hope to improve the quality of life for people with hearing problems by incorporating this microphone into a hearing aid.

"For humans, if we are listening to a sound from someone then we concentrate on that sound and we dampen out everything else," says Windmill. "To make an engineered system that does that is very difficult. The idea of having a directional hearing aid is that at least the hearing aid is only focussing on sound from in front of your head and ignoring other noise around you."

"We've created a design where, instead of just sensing whether the sound is coming from in front of you or behind you, it can tell whether the sound is coming from in front, behind, left or right. So you can work out where the sound originates very accurately."

One in six people in the UK suffer from hearing loss[2]. Although more than half of over 60s have some loss of hearing, only 20% of them use hearing aids[2], because of problems they have experienced. One issue is that, in noisy environments like restaurants and busy streets, it is extremely hard to distinguish one voice in a conversation from background noise.

A solution to this problem might come from an unexpected source: a tiny parasitic fly. *Ormia ochracea* is a small, yellow, nocturnal fly with exceptional, directional hearing. It uses its remarkable ears to find male crickets by listening to their mating call, then lays its eggs on the cricket's back. When the eggs hatch, the larvae bury into the cricket, eat it and kill it.

The parasitic fly Ormia ochracea *has exceptional directional hearing.*
Image: Professor Andrew Mason, University of Toronto

IMPACT SUMMARY

A microphone inspired by a fly's hearing, which could improve hearing aid performance, has been created by researchers at the University of Strathclyde, with funding from BBSRC and EPSRC.

The microphone, inspired by the ears of the *Ormia ochracea*, a tiny parasitic fly with exceptional directional hearing, can distinguish whether a sound is coming from in front, behind, left or right.

If incorporated into a hearing aid, it could allow the wearer to more easily pick out one voice in a conversation from background noise in loud environments.

Other directional microphones exist, but this one is smaller, simpler and can pick up the direction of sounds with a range of different pitches.

The researchers are working with scientists at the MRC/CSO Institute of Hearing Research – Scottish Section, based at Glasgow Royal Infirmary, to find a way create a hearing aid based on their microphone.

These flies' ability to work out which direction a sound comes from is unique. Most flies have no hearing at all.

The Strathclyde researchers have harnessed the power of the fly's ears to create a miniature directional microphone. Other similar directional microphones exist, but this one is smaller, simpler and can pick up the direction of sounds with a range of different pitches.

The researchers are working with scientists at the MRC/CSO Institute of Hearing Research – Scottish Section[3], based at Glasgow Royal Infirmary, to find a way to incorporate their microphones into hearing aids.

Currently available directional hearing aids are bulky and need to be worn outside of the ear. For cosmetic reasons, some users are put off. The size of the new directional microphones means they could be incorporated into a miniature hearing aid fitted inside the ear.

Creating these microphones posed a significant challenge. Humans can perceive the direction of sounds because the distance between our ears is large enough to enable our brains to detect the fraction-of-a-second time difference between the sound arriving at our two ears, and process this to work out where the noise came from. Most directional microphones are based on a similar principle, and so need to be large.

One in six people in the UK suffer from hearing loss.
Image: Dr William Whitmer, Medical Research Council/Chief Scientist Office Institute of Hearing Research - Scottish Section

The parasitic fly, however, can work out the direction of a noise with ears spaced only half a millimetre apart. It can do this because a lever joining its two eardrums amplifies information about the sounds. The Strathclyde researchers' microphone is based on a similar principle.

It was a BBSRC New Investigator grant[4] which allowed Windmill to set up his laboratory at the University of Strathclyde to study insect hearing, and design acoustic sensors inspired by the way insects perceive sounds. Work on this fly-inspired microphone is now being carried out using funding from EPSRC[5].

REFERENCES

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