'Feeling' sound: The sense of hearing and touch may have evolved together

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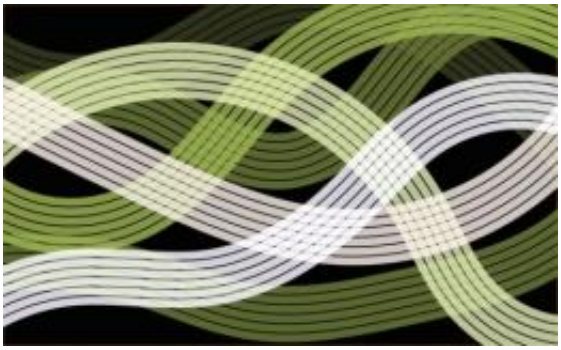

Credit: John LeMasney via flickr

Lying in bed at night, one of the worst sounds a person can hear is the buzz of a nearby mosquito. Concentrating on the buzzing might keep you from falling asleep, but it also seems to heighten the awareness of your skin to that inevitable moment when the critter actually lands. Scientists have now gathered information about why our sense of touch can be influenced by our sense of hearing.

The five known senses -- hearing, vision, taste, touch, and smell -- each have their corresponding sensory organs: ears, eyes, taste buds, skin, and olfactory bulb, respectively. They each possess a corresponding part of the brain where the incoming sensory information is processed and later passed along to our conscious mind.

Scientists have long suspected, however, that some of these sensory signals in the brain might have some circuits in common or might otherwise be related. Researchers can test these ideas with an array of tests and direct imaging of the brain. A session on this subject was held during a recent meeting of the Acoustical Society of America in Seattle.

One of the speakers, scientist Jeffrey M. Yau from Johns Hopkins University in Baltimore, described experiments in which participants wearing headphones listened to sounds at two particular frequencies and were asked to tell which was at a higher pitch. Meanwhile, the participants' fingers were in contact with pads that were fed vibrations, also at several frequencies.

The ability of subjects to tell sounds apart was affected by the presence of fingertip vibrations, and vice versa.

"The interesting result is that audition and touch interact bi-directionally in frequency perception," Yau said. "This suggests that the brain is combining this information."

When perceiving the intensity of the sound or vibrations, rather than the frequency, the interaction between hearing and touch was not reciprocal.

"We hear with our ears and feel with our skin, but our brains may combine this information in specific ways," Yau said. "Frequency information from the two senses appears to be always combined."

Perception of intensity -- on the other hand -- doesn't always get a boost by combining sound and touch information.

Yau said that one practical benefit of his research might be the design of better headphones to be worn in noisy environments, such as airplane cockpits, and the design of better feedback from smartphones.

Psychology professor Tony Ro from The City College of New York, who also spoke at the meeting, monitored people hearing sounds over headphones and feeling vibrations through their hands and feet. Ro and his colleagues took pictures of the participants' brains during the experiment using a variety of equipment including electroencephalography and MRIs in order to measure the sensory responsiveness of the participants -- and, at the same time -- see which parts of their brains were active while responding to sound and touch stimulus.

Like the Johns Hopkins tests, Ro's tests see a connection between hearing and touching.

"We find in most of our experiments that sounds affect the way we feel, and can produce feeling sensations even when no touch was presented to them," Ro said.

Does that mean that in some sense we can "feel" with our ears or "listen" with our fingertips?

"On an abstract level we may feel with our ears, but most of this crossing of the senses, or 'synesthesia,' is actually happening in our brain rather than in the sensing organs like our ears or skin," Ro said.

Ro hopes that his studies can be used to develop sensory substitution techniques that help those who have impairments in one or more of their senses.

"I think that these results strongly suggest that hearing and feeling have the same underlying physical and neural underpinnings," Ro said. "Not only do the two senses use similar processing mechanisms in the body and in the brain, but our results imply that hearing actually evolved out of the sense of touch. Such findings could help develop therapies for the

hearing and visually impaired by substituting touch sensations for lost hearing and vision and could aid rehabilitation after brain damage."

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