Playing sound through the skin improves hearing in noisy places

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Hundreds of thousands of people with severe hearing loss depend on surgically implanted electronic devices to recover some of their hearing. These devices, known as auditory or cochlear implants, aren't perfect. In particular, implant users find it difficult to understand speech when there is background noise. We have a new approach to solve this problem that involves playing sound through the skin.

People with auditory implants hear the world in a very different way to people with healthy hearing (the video below simulates what it's like to hear through an auditory implant). In an implant user, the sound that is usually transmitted to the brain by tens of thousands of extraordinarily sensitive cells in the ear is instead transmitted by just 22 tiny electrodes. This means that the information transmitted to the brain is severely limited.

This is a big problem in complex sound environments, with a conversation in the corner, music blaring, the bang of a door and the clatter of cutlery. The implant user is unable to join a conversation in a busy office or hear a teacher in a chaotic classroom. We need a new way to get crucial sound information to the brain and bypass the information bottleneck at the implant.

Fusing the senses

The brain is continuously combining information from all our senses to build a picture of the world. When a sense is impaired, as in a deaf or blind person, the brain can compensate by using information from another sense.

In the late 1960s, Paul Bach-y-Rita showed that blind people are able to "see" what is happening in a film when visual information is presented through vibration on the lower back. Since then, researchers have shown that people are able to "see" using sound, and that people who have lost their sense of balance are able to balance again when the missing information is presented through touch.

As auditory implant users only get limited sound information through their implant, we wondered whether providing extra sound information through touch could improve their hearing.

To do this, we developed a simple, adaptable system that takes speech in a noisy environment and extracts the broad sound-level fluctuations, known as the "speech envelope". This speech envelope information is not conveyed effectively by the implant and is known to be important for understanding speech in noise. The speech envelope information is then converted into small vibrations on the skin. The brain can then combine these signals with the implant signal to improve understanding of speech.

In our latest study, published in Trends in Hearing, we presented speech in noise with and without vibration from our system and measured how many words participants were able to identify. We found that the device improved word identification for seven of our eight participants. Training was important. Participants were able to identify an average of 5 percent more words in noise with the device when first using it, and an average of 11 percent more words, after just 30 minutes of practice. It is possible that, with everyday use, we may find even larger benefits.

Our goal is to develop a compact, inexpensive, wrist-worn device that can be used in the real world within two years. We hope that this device will help implant users hear in noisy places and expand their access to education, work and leisure.

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