Scientists develop brainwave-based test for speech comprehension

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Researchers have developed a test for more accurate diagnosis of patients who cannot actively participate in a speech understanding test. Such patients include very young children or people in comas. In the longer term, the method also holds potential for the development of smart hearing devices.The new technique was developed by Professor Tom Francart and his colleagues from the Department of Neurosciences at KU Leuven, Belgium, in collaboration with the University of Maryland.

A common complaint from people with hearing aids is that they can hear speech but they can't determine its meaning. Being able to hear speech and actually understanding what's being said are two different things.

There are well-established tests to determine a patient's ability to hear soft sounds. Audiologists can test hearing with a series of tones over headphones. An alternative option makes use of EEG, which is often used to test newborns, in which click sounds are presented through small caps over the ears. Cranial electrodes measure brainwaves in response to these sounds. The great advantage of EEG is that it is objective and allows for passive testing. "This means that the test works regardless of the listener's state of mind," says co-author Jonathan Simon from the University of Maryland. "We don't want a test that would fail just because someone stopped paying attention."

But to test speech understanding, the options are much more limited, explains lead author Tom Francart from KU Leuven: "Today, there's

only one way to test speech understanding. First, you hear a word or sentence. You then have to repeat it so that the audiologist can check whether you have understood it. This test obviously requires the patient's active cooperation."

Therefore, scientists set out to find an EEG-based method that can measure hearing as well as speech understanding.

"And we've succeeded," says Tom Francart. "Our technique uses 64 electrodes to measure someone's brainwaves while they listen to a sentence. We combine all these measurements and filter out the irrelevant information. If you move your arm, for instance, that creates brainwaves, as well. So we filter out the brainwaves that aren't linked to the speech sound as much as possible. We compare the remaining signal with the original sentence. That doesn't just tell us whether you've heard something, but also whether you have understood it."

The scientists compare the brain wave sequence to the soundwave of the sample sentence. Sufficient similarity indicates that the patient understood the sentence. This new technique makes it possible to objectively and automatically determine whether someone understands what's being said. This is particularly useful in the case of patients who cannot respond, including patients in a coma.

The findings can also contribute to smart hearing aids and cochlear implants, Francart says. "Existing devices only ensure that you can hear sounds. But with built-in recording electrodes, the device would be able to measure how well you have understood the message and whether it needs to adjust its settings—depending on the amount of background noise, for instance."

More information: Jonas Vanthornhout et al, Speech Intelligibility Predicted from Neural Entrainment of the Speech Envelope, *Journal of*

the Association for Research in Otolaryngology (2018). DOI: 10.1007/s10162-018-0654-z