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# 'Mind-reading' implants let patients speak

## New technology interprets messages sent from the brain to generate synthetic speech in real time

*By* **Sarah Knapton** SCIENCE EDITOR

A "MIND-READING" brain implant that decodes what a person is trying to say and plays it back through a computer could help stroke victims to speak again.

Many diseases leave patients unable to control the muscles that form words, but researchers realised those muscles are still sending messages to the brain when a paralysed person tries to speak.

The team at the University of California San Francisco (UCSF) decoded those signals, working out which tiny pulses from the larynx, lips, jaw and tongue corresponded to which sounds. They then used a computer to recreate the vocal tract of a patient and when they sent the brain signals to the virtual muscles they formed words and sentences, generating natural sounding synthetic speech – although they admit that abrupt sounds like Bs and Ps are still "a bit fuzzy".

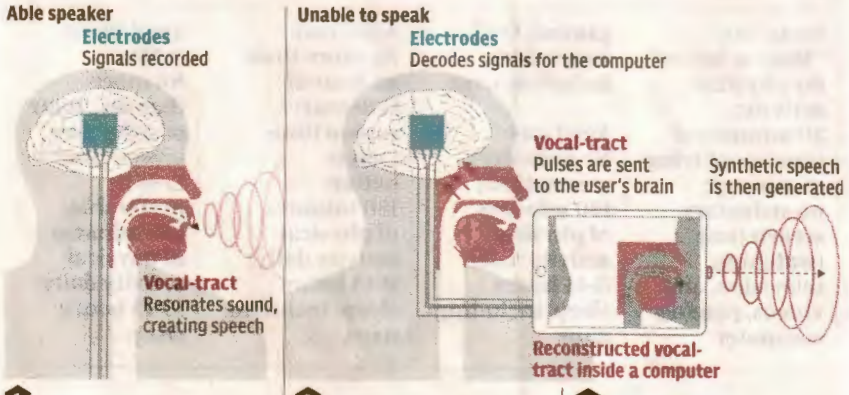
The breakthrough offers hope for people suffering from stroke, traumatic brain injury, or neurodegenerative illness such as Parkinson's disease, multiple sclerosis and amyotrophic lateral sclerosis (ALS), the condition that killed Prof Stephen Hawking.

Before his death last year, Prof Hawking was forced to spell out his thoughts letter-by-letter using an infrared sensor on his glasses, a laborious process that allowed for around 10 words per minute.

The new device could allow people with a disability to speak in real time at the speed of normal speech.

"This study demonstrates that we can generate entire spoken sentences based on an individual's brain activity," said Edward Chang, the professor of

### How to read the mind




1. Scientists recorded hundreds of spoken sentences from volunteers with electrodes in their heads to learn how the vocal tract sends signals to the brain

2. Brain signals were then fed into a computer simulator of the patient's vocal tract so that it could learn to translate them back into sounds.

3. A patient with the device implanted in their brain would then attempt to talk and the brain signals picked up from their vocal tract would be sent to the vocal tract simulator where a speech synthesizer would speak their words.

neurological surgery at UCSF. Previous attempts to turn thoughts into synthesised speech have faltered because the brain regions that control speech do not represent sounds, but rather the instructions needed to coordinate the movements of the vocal tract. The researchers realised that an extra step was needed, and a virtual vocal tract necessary to translate the signals correctly.

Dr Gopala Anumanchipalli, a speech scientist who led the research from UCSF, said: "The relationship between the movements of the vocal tract and the speech sounds that are produced is a complicated one. We reasoned that if these speech centres in the brain are encoding movements rather than sounds, we should try to do the same in decoding those signals."

For the study five volunteers who already had electrodes implanted in their brains for other research were asked to read out aloud hundreds of sentences from children's stories such as *Sleeping Beauty* and *Alice in Wonderland*. Based on the audio recordings of the participants' voices, the researchers reverse-engineered the vocal tract movements needed to produce those sounds, such as pressing the lips together or tightening vocal cords.

They were then able to create a realistic virtual vocal tract for each participant that could decode their own brain activity and create synthetic speech from their thoughts which were understandable to hundreds of human listeners in transcription tests.

Researchers believe the device may not only restore communication to individuals with severe speech disability, but even reproduce some of the musicality of the human voice that conveys emotions.

And as the neural code for speech was found to be similar amongst people, a speech decoder trained on one person is likely to work for several.

The research was published in the journal *Nature*.

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