- Brain

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HEALTH

A new brain implant can decode a person's 'inner monologue'

WORDS SKYLER WARE

Did you know?
We have around 6,200 thoughts per day on average

Scientists have developed a brain-computer interface that can capture and decode a person's inner monologue. The results could help people who are unable to speak communicate more easily with others. Unlike some previous systems, the new brain-computer interface doesn't require people to attempt to physically speak. Instead, they just have to think about what they want to say. "This is the first time we've managed to understand what brain activity looks like when you just think about speaking," says Erin Kunz, an electrical engineer at Stanford University. "For people with severe speech and motor impairments, [brain-computer interfaces] capable of decoding inner speech could help them communicate much more easily and more naturally."

Brain-computer interfaces (BCIs) allow people who are paralysed to use their thoughts to control assistive devices, such as prosthetic hands, or to communicate with others. Some systems involve implanting electrodes in a person's brain, while others use MRI to observe brain activity and relate it to thoughts or actions. But many BCIs that help people communicate require a person to physically attempt to speak in order to interpret what they want to say. This process can be tiring for people who have limited muscle control. Researchers in the new study wondered if they could instead decode inner speech.

In the new study, published in the journal *Cell*, Kunz and her colleagues worked with four people who were paralysed by either a stroke or amyotrophic lateral sclerosis (ALS), a degenerative disease that affects the nerve cells that help control muscles. The participants had electrodes implanted in their brains as part of a clinical trial for controlling assistive devices with thoughts. The researchers trained artificial intelligence models to decode inner speech and attempted speech from electrical signals picked up by the electrodes in the participants' brains.

The models decoded sentences that participants internally 'spoke' in their minds with up to 74 per cent accuracy, the team found. They also picked up on a person's natural inner speech during tasks that required it, such as remembering the order of a series of arrows pointing in different directions. Inner speech and attempted speech produced similar patterns of brain activity in the brain's motor cortex, which controls movement, but inner speech produced weaker activity overall. One ethical dilemma with BCIs is that they could potentially decode people's private thoughts rather than what they intended to say aloud. The differences in brain signals between attempted and inner speech suggest that future brain-computer interfaces could be trained to ignore inner speech entirely.

As an additional safeguard against the current system unintentionally decoding a person's private inner speech, the team developed a password-protected BCI. Participants could use attempted speech to communicate at any time, but the interface started decoding inner speech only after they spoke the passphrase 'chitty chitty bang bang' in their minds. Though the BCI wasn't able to decode complete sentences when a person wasn't explicitly thinking in words, advanced devices may be able to do so in the future. "The future of BCIs is bright," said study coauthor Frank Willett. "This gives real hope that speech BCIs can one day restore communication that is as fluent, natural and comfortable as conversational speech."