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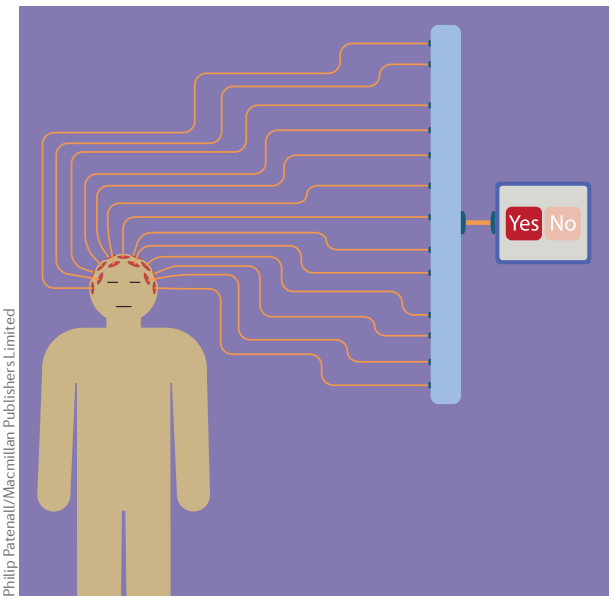
MOTOR NEURON DISEASE

Communication for completely locked-in patients

A brain–computer interface (BCI) has enabled four patients in the completely locked-in state to communicate reliably, according to a recent report. "Our research has significant implications for patients who have no means of communication and are unable to express their feelings, thoughts and desires," says Ujwal Chaudhary, who led the work.



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In the late stages of amyotrophic lateral sclerosis (ALS), patients can lose all motor control despite intact cognitive and emotional processing, leaving them in the completely locked-in state. Previous attempts to create BCIs that enable these patients to communicate have failed. Chaudhary and colleagues took a new approach and developed a system based on functional near-infrared spectroscopy (fNIRS).

"fNIRS is an emerging neuroimaging modality that employs near-infrared light to investigate cerebral oxygenation changes," explains Chaudhary. "It has reasonable spatial and good temporal resolution, is relatively robust to motion artefacts, and can easily be applied at the bedside of these patients who are highly impaired and difficult to move but in desperate need of communication."

Chaudhary and colleagues tested their fNIRS BCI in four patients with ALS: two in the completely locked-in state and two entering this state. The patients were asked questions with known yes or no answers, and changes in cerebral oxyhaemoglobin were measured as patients thought their answer. These changes were used to build a support vector machine model that was then used to interpret answers from open questions, such as "are you in pain?"

> "The fNIRS-based BCI could … provide reliable answers to open questions"

"The fNIRS-based BCI could discriminate between yes and no thinking with 70–75% accuracy, and provide reliable answers to open questions," explains Chaudhary. "Our goal is to make the current system so that it can be used by patients' family members for daily communication, then to design a speller system in which the patients could choose sentences to answer."

Ian Fyfe

ORIGINAL ARTICLE Chaudhary, U. *et al.* Brain–computer interface-based communication in the completely locked-in state. *PLoS Biology* **15**, e1002593 (2017)
FURTHER READING Chaudhary, U. *et al.* Brain–computer interfaces for communication and rehabilitation. *Nat. Rev. Neurol.* **12**, 513–525 (2016)