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Communicating with patients with disorders of consciousness by translating thoughts into light

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Western BrainsCAN Transforming brain research.

Project **Summary**

KNOWLEDGE MOBILIZATION & IMPACT

Communicating with patients with disorders of consciousness by translating thoughts into light

Background

Disorders of consciousness (DOC) are a big challenge - if we can't communicate with a patient and they can't communicate with us, how can we tell if they're conscious?

fMRI is currently the most useful tool in differentiating between the vegetative state (VS) and the minimally conscious state (MCS), which is vital for end-of-life decision-making and communicating with patients at a basic level. Unfortunately, it is expensive to undertake and availability is limited. Electroencephalogram (EEG) has been investigated as a cost-effective alternative but despite early encouraging results, individual patient studies proved unreliable. It has shown some effectiveness at detecting preservation of basic 'low-level' cognition but not consciousness.

The Problem

We need reliable, cost-effective tools to detect brain activity in patients with DOC that would allow more frequent assessments in hospitals, chronic-care institutions and at home.

Functional near-infrared spectroscopy (fNIRS) is a promising alternative to EEG - it is safe, portable and is analogous to fMRI in how it detects brain activity. However, to date the adoption of fNIRS has been low, due in part to an inherent limitation of conventional fNIRS, that light is absorbed by superficial tissue which limits depth sensitivity.

We have focused on a slightly different technique, time-resolved (TR) fNIRS, that can penetrate deeper into the brain. Using this approach, we were recently able to increase sensitivity to a specific type of brain activation (known as motor imagery activation, where you imagine completing a physical activity) from 64% to 93% and have even used this approach to communicate with a conscious patient who was unable to move or communicate verbally (a condition known as *locked-in syndrome*).

Funding Program

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Additional BrainsCAN Support

Imaging Core

Western Faculty, Group or Institution

Schulich School of Medicine & Dentistry

Keywords

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The Project

Given our recent progress, we intend to show, for the first time, that fNIRS can be used to reliably communicate with DOC patients. This is not an easy task as there are many practical challenges to resolve (which are common to both fNIRS and EEG) such as involuntary movements by the patient, variability in consciousness itself, physical distortion in the head (such as from trauma) and a person's limited ability to perform repetitive mental tasks.

We will focus on patients who have already demonstrated by fMRI that they can perform motor imagery activation and plan to study up to 20 such patients over the course of a year.

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