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UCLA InterAxon's Media Committee

Summary of "Willful Modulation of Brain Activity in Disorders of Consciousness"

Introduction

In 2010, UCLA Professor Martin M. Monti and a team of researchers conducted a study to determine whether patients in vegetative states could be re-diagnosed as "minimally conscious" based on neuroanatomical responses to certain tasks. A patient who is in a vegetative state is awake, but not aware of his/her surroundings. A "minimally conscious" patient may respond to communication, although inconsistently. This limited consciousness can result from a variety of conditions such as traumatic brain injuries (TBI's), anoxic brain injury, and meningitis.

Materials & Methods

Consciousness disorders are misdiagnosed at a rate of about **40%**, emphasizing the significance of Monti's study. To test the conscious states of a group of 54 patients (compared to a group of 16 healthy control subjects), researchers used functional magnetic resonance imaging (fMRI). This scanning technique measures blood flow to indicate activity levels in different brain regions. Scan data was analyzed with FSL (Functional Magnetic Resonance Imagery of the Brain) software.

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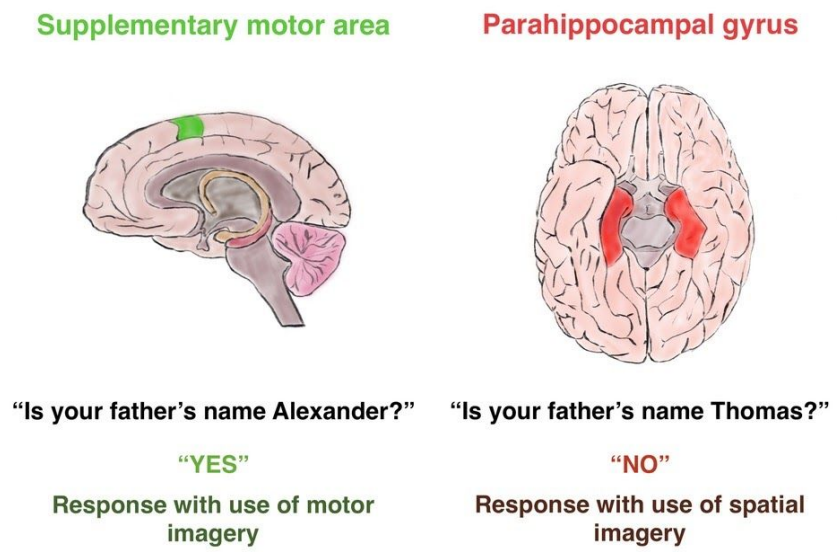

Figure 1 | Brain regions showing activity through motor and spatial imagery tasks. Illustration by Kian Mohseni Mofidi.

To gather fMRI data, researchers instructed patients to perform 2 mental tasks: imagine the motion of swinging a tennis racket (motion imagery) and visualize walking around a familiar area, like the rooms of their house (spatial imagery). Patients engaged in 30-second cycles of imagination followed by 30 seconds of rest. Researchers then combined these instructions with a communication task for 16 healthy subjects and one patient.

Participants were asked a yes-or-no question and responded with motor or spatial imagery tasks. For example, confirming that the subject's father's name was Alexander could be indicated by imagining a swinging tennis racket ("Yes") or imagining a walk through a familiar area ("No") (Figure 1). The purpose of conducting this communication task with the control group was to determine if fMRI scans were an accurate method of assessing communication. The technique's reliability was confirmed when the yes-or-no questions were answered with 100% accuracy based on localizer scans. After data collection, the researchers focused on two brain regions to interpret their results, the **supplementary motor area** and the **parahippocampal gyrus**. Activity in the supplementary motor area corresponded to completion of the motor task (racket swing), and activity in the parahippocampal gyrus corresponded to completion of the spatial task (navigation).

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Results

Out of the 54 patients, 5 were able to "willfully modulate their brain activity", meaning their two brain regions of interest showed significant activity in response to imagery tasks. All 5 of their fMRI scans showed supplementary motor area activity, and 4 out of the 5 showed activity in the parahippocampal gyrus. The patients' brain activity in these regions was comparable to the brain activity of the healthy control group subjects, despite the patients' **diagnoses as being in a vegetative or minimally conscious state**. Although most of the patients did not display brain activity in either region of interest, this does not verify a vegetative state; they could have chosen to not answer the questions, may have lost consciousness during the imaging, or could have lacked the cognitive capacity to understand what was being asked of them.

Significance

Study results indicate that fMRI can help verify a physician's diagnosis about a patient's conscious state. This scan can also act as a communication medium between healthcare workers and patients physically unable to respond to questions at their bedside. Future research will likely lead to substantial increases in the quality of life for consciousness disorder patients after determining an appropriate course of treatment.

Works Cited

"Willful Modulation of Brain Activity in Disorders of Consciousness." *New England Journal of Medicine*, vol. 362, no. 20, 2010, pp. 1936–1938., doi:10.1056/nejmc1003229.