

New way to ID cognitively aware yet unresponsive people with severe brain injury

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Some brain-injured people left with disorders of consciousness—unable to communicate or respond, such as people in a coma—nevertheless show normal brain responses to spoken language as measured through

the scalp by electroencephalography (EEG). Functional magnetic resonance imaging (fMRI) studies also show that such patients retain the ability to carry out repeated mental imagery tasks, as demonstrated in earlier studies.

The findings reported in *Current Biology* on November 29 suggest that EEG might offer a cost-effective and efficient means to identify [patients](#) who are cognitively aware but unable to respond, a condition known as cognitive motor dissociation (CMD). More broadly, the researchers say, they underscore the importance of rethinking the way patients with [severe brain injury](#) are assessed.

"These findings emphasize the urgency to screen and identify patients who may be trapped in their heads and treated as unconscious," says Nicholas Schiff, a professor of neuroscience in the Feil Family Brain and Mind Research Institute at Weill Cornell Medicine, New York, NY. "They also highlight how important it is that resources be developed to bring greater medical infrastructure and efforts to enhance communication with such persons."

Brain activity rises and falls with the variation in sound pressure produced by speech. This variation of sound pressure is known as the speech envelope. The [brain](#) follows this envelope with matched [electrical activity](#) that arises with a time delay of around a tenth of a second in [healthy people](#).

In the new study, the researchers set out to study the natural speech envelopes (NSEs) of 13 healthy controls in comparison to 21 people with a severe brain injury. Those brain-injured patients in the study had widely varying patterns and types of structural brain injuries.

Healthy controls listened to a portion of Alice's Adventures in Wonderland by Charles Lutwidge Dodgson. Those with brain injury

heard stories and recollections about their own lives prior to the injury spoken by family members. The researchers measured the [time delay](#) of electrical activity in the brain that followed that continuously spoken language.

Their studies found that normal time delays were preserved in brain-injured patients with high-level cognitive functions as independently assessed using fMRI. Those patients included people without any reliable means of communication.

"Our findings confirm that patients who harbor the cognitive capacity to carry out fMRI mental imagery tasks are biologically different and show the integrity of cortical speech processing mechanisms in their EEG signals," says Schiff, who has stock options with Enspire DBS Therapy, Inc., a company focused in revitalizing stroke recovery to restore motor functions for hemiplegic stroke patients.

The findings suggest that the NSE may be used as a screening tool to help stratify patients with severe brain injuries and identify those patients who show only covert evidence of command following utilizing neuroimaging or electrophysiological methods that demand high levels of cognitive function, according to the researchers.

EEG is "cost effective and efficient and may be adapted for continuous tracking of recovery over time," the researchers write. "Once identified, patients with evidence of command-following activity can be tested to determine whether they can modulate the NSE response with attention to speech stimuli to guide auditory brain-computer interfaces to restore communication and reveal the fullness of their consciousness."

Schiff says that his team hopes to test the NSE as a measure to screen large numbers of patients for hidden cognitive capacities. They also plan to work toward developing new methods to help those patients they've

already identified as having high levels of cognitive function improve their ability to interact with the outside world.

More information: *Current Biology*, Braiman et al.: "Cortical Response to the Natural Speech Envelope Correlates with Neuroimaging Evidence of Cognition in Severe Brain Injury" www.cell.com/current-biology/full-issue ... 0960-9822(18)31458-1 , DOI: 10.1016/j.cub.2018.10.057

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