Quantitative EEG Analysis of the Severely Injured Brain in Response to Language
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**Introduction**

In patients with disorders of consciousness (DOC), residual cognition can be masked by motor deficits. The use of fMRI or EEG as a response measure bypasses the need for an overt behavioral response, allowing paradigms based on these measures to demonstrate residual cognitive abilities in minimally conscious patients with severe motor deficits. However, existing paradigms, which ask the patient to imagine a motor act on command, nevertheless require the execution of a complex volitional act. This has been shown to lead to false negative results in some cases. Here, we present a new, entirely passive, EEG-based paradigm for the identification of language processing. Since this approach does not require the performance of an active task, it significantly expands the tools for identification of cognitive function in patients with severe brain injury.

**Methods**

Subjects listened to 2-3 minute, personally meaningful stories recorded by family members, alternating with time-reversed versions of the same recordings. Time-reversed stories serve as a useful control condition as time-reversed versions of the same recordings. Time-reversed language was recorded from 37 individually attached scalp electrodes. EEG was recorded from 37 subjects, and 2 vegetative state (V1-2) subjects were studied.

**Results**

Boxplot of difference in power between forward and time-reversed language across all artifact-free channels in each subject. Results show a clear decrease in low-freq power (4-12 Hz) and an increase in high frequency power (20-30 Hz; example MCS subject shown below). Black stars represent a change that is significantly different from zero (p < .05). Low-frequency changes were centered around 4-8 Hz for MCS subjects and 8-12 Hz for control subjects. VS subjects showed no change in power.

**Conclusions**

Spectral analysis reveals robust changes in power and coherence with forward vs time-reversed language. These changes are seen in control and MCS but not VS subjects, suggesting this method might be useful in stratifying subjects with disorders of consciousness.

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