Neural Responses to Narrative Speech Differentiate Patients with Disordered Consciousness

Ivan Iotzov 1, Brian C. Fidali 2, Agustin Petroni 1, Mary M. Conte 2, Nicholas D. Schiff 2, Lucas C. Parra 1
1City College of New York, New York, New York 2Laboratory of Cognitive Neuromodulation, The Feil Family Brain and Mind Research Institute, Weill Cornell Medicine, New York, New York

Disorders of Consciousness (DOC)

Incoming patients with disordered consciousness must be categorized to determine treatment course
- Vegetative State (VS) - Complete absence of self or stimulus, but not for outside of startle
- Lack of stimulus driven response - No command following

Additionally, MCS can be subdivided into MCS+, MCS-, and emerging MCS (eMCS). Correct clinical assessment of disordered consciousness is essential to better clinical outcomes for patients. Clinical diagnoses rely on physician assessment, which is difficult and can lead to misdiagnosis rates as high as 41% (Belmaker et al., 2009).

Therefore, it is important to find objective neural measures of cognitive processing in order to more effectively treat patients and allocate limited health resources.

Inter-subject correlation (ISC): A measure of neural variability

Inter-subject correlation (ISC)

Implicated in:
- Memory (Cohen et al., 2016)
- Attention (Xi et al., 2016)
- Engagement (Dmochowski et al., 2014)

Audio consisted of 2 narratives, an Alice in Wonderland audiobook excerpt, and a stand-up comedy routine, Pieman.

ISC during backward playback is predictive of DOC diagnosis

The ISC procedure provides a novel method that can differentiate patients with disordered consciousness. Importantly, this method uses naturalistic speech, which is both more salient to patients and more representative of the type of auditory processing in everyday situations.

The scores of DOC patients on the backwards listening task appear to be correlated with their clinical diagnosis but are not of interest to healthy subjects. This could be due to the novelty of the backwards stimuli, or is perhaps a reflection of the auditory brainstem response being relatively stronger in DOC subjects due to lack of interference. These data show the potential of ISC of neural activity during audition as a biomarker for DOC, but further research is needed to determine optimal stimuli and testing procedures, as shown by the varied results between stimuli.

Discussion

Healthy subjects showed significantly higher ISC than DOC subjects, as well as showing higher ISC in the forward condition compared to backward for the Alice stimulus, but not for Pieman. Additionally, DOC patients did not show a stronger ISC response for forward vs. backward playback, and in fact show slightly higher ISC for the backward condition.

References


