Title: Electrophysiological measures of consciousness in epileptic absence seizures

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Abstract: 1.1

Objective measures of consciousness are needed to address clinical challenges and to further the scientific study of consciousness. In recent years, several electrophysiological measures of consciousness have been proposed and tested in altered states of consciousness, including anaesthesia, sleep, and disorders of consciousness. Here, we focus on epileptic patients with episodes of generalized spike wave discharges (GSWDs) in their electroencephalogram (EEG), but without overt neuromuscular symptoms. These GSWD episodes are often associated with a reduced level of consciousness (absence or petit mal seizures). We tested whether some promising EEG-based measures of consciousness are reduced in response to GSWDs, and whether they reflect differences in the behavioral responsiveness of the patients during seizures.

For this preliminary analysis we used EEG data from 6 patients admitted to the National Centre for Epilepsy (Oslo University Hospital), of which 2 patients (53 GSWD episodes) had impaired response and 4 patients (162 GSWD episodes) had spared response on simple behavioral tests during GSWDs. We tested three proposed measures of consciousness: Lempel-Ziv complexity (LZC), amplitude coalition entropy (ACE), and synchrony coalition entropy (SCE). For each measure, the value within each GSWD episode was compared to an immediately preceding baseline period of seizure-free EEG. The mean percentage change in LZC, ACE, and SCE was assessed for each patient individually, and also compared between GSWD episodes in patients with impaired behavioral response versus spared response.

For each patient, the tested measures of LZC, ACE, and SCE were all significantly reduced during periods of GSWD relative to baseline (one-sample Student’s t-test, p < 0.0005). In the limited sample used for this preliminary analysis, LZC, ACE, and SCE were also slightly less affected by GSWD episodes in patients with spared versus impaired responsiveness (permutation test, 100 000 permutations, p < 0.025), but further experiments and analysis are needed.