Detecting fluctuation of responsiveness in Minimally Conscious State patients

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Introduction: A Minimally Conscious State (MCS) is a disorder of Consciousness (DOC) showing a within/between subject (spontaneous) variability of clinical signs of responsiveness [1]. Such fluctuations in responsiveness could prevent patients to access the Brain Computer Interface (BCI) to interact with the environment. MCS patients, indeed, could show time windows of responsiveness in which they can potentially communicate (Windows of responsiveness; WoR) and time windows in which they cannot. The objective of this study is to describe the fluctuation of responsiveness by identifying the neurophysiological response (presence/absence of WoR) to an oddball and a motor task within a continuous EEG monitoring.

Material, Methods and Results: Three patients (M=3; age=43±21) with MCS underwent two sessions (morning 2 hours, afternoon 2 hours) of continuous EEG monitoring (32 channels) in resting-state lasting (4 hours of recording in total). An auditory oddball task and a motor command task were presented five times each, in each of the two sessions, with a random interval (range 9-11 min). We identified the presence/absence of the WoR based on the response detection in the two tasks (Figure 1B-C). As for the motor command task, we labeled the WoR by statistically comparing (unpaired t-test, α=0.05) the power spectral density in task and rest conditions: a significant desynchronization of the sensory-motor rhythms (SMR) in alpha and beta bands defined the presence of a WOR. Sleep was monitored by means of a behavioral observation and EEG background activity analysis. For the oddball task we labeled as WoR the time slot where the P300 component was identified in the target/non-target difference. Figure 1-A reports the WoR observed for each participant within the EEG monitoring. One of the three subjects showed 7 blocks labeled as WORs, while 2 subjects showed three WORs.

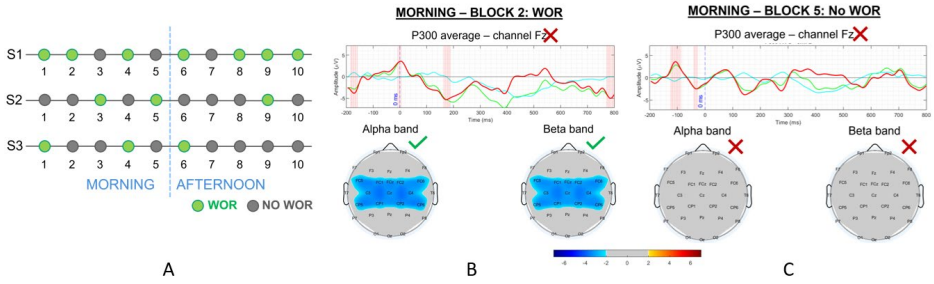

Figure1. *A-WoRs observed (green) for each participant within the EEG monitoring. B, C-Morning session, subject 1, WoRs evaluation examples: in panel B (block 2), despite the lack of a visible P300 response, a WoR was accounted through the presence of a significant desynchronization of the sensory-motor rhythms both in alpha and beta bands. On the contrary, in panel C (block 5,) no WoR was identified due to the lack of either a visible P300 response, or significant desynchronizations of the sensory-motor rhythms.*

Discussion: Our preliminary results showed the presence of a fluctuation in P300 and SMR responses to the presentation of an oddball and a motor command task respectively. We speculate that, the probability of a successful interaction with the patient by means of a BCI in the WoR time slot would be higher than in the non-WoR slots.

Significance: Development in BCI field has been devoted to instantiate communication of patients with no other way of communication. These preliminary results represent the starting point in reversing the BCI perspective by focusing on the identification of the best moment to propose a BCI for communication to the MCS patients (WoR).

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References

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