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Title: Brain Functional Connectivity of Motivated States: A Computational Analysis

Our movements depend on our motivational states. However, our understanding of how our engagement varies, or how our degree of motivation reflects both on neural brain activity and on the interconnectivity across brain areas, it all remains poorly understood. For example, when human participants perform a decision-making task between reaching movements, their movement parameters and their selection between movements is clearly different when playing solo than when playing in the company of another partner, irrespective of whether they were instructed not to compete among themselves. Specifically, the participants' aiming error decreased alongside the skill of their partner, and their selection of motor movements adjusted consistently with a devaluation of effort and an overvaluation of reward. This is corroborated by a theoretical assessment of the subjects' behaviour. Although this supports the influence of social pressure on our concern for reward, causing a re-scaling their overall motivated state, and confirming the social relativity of their internal reward valuation system, we do not know this occurs in the brain.

During these experiments, we recorded surface Electro-Encephalographic (EEG) signals from each part of the cortex. Preliminary analyses of these recordings have shown that different mental states, associated to different mental states associated to motivation may be identified via machine learning techniques, such as k-means or logistic regression. The question remains, whether specific changes of functional connectivity may formally recognise from this dataset.

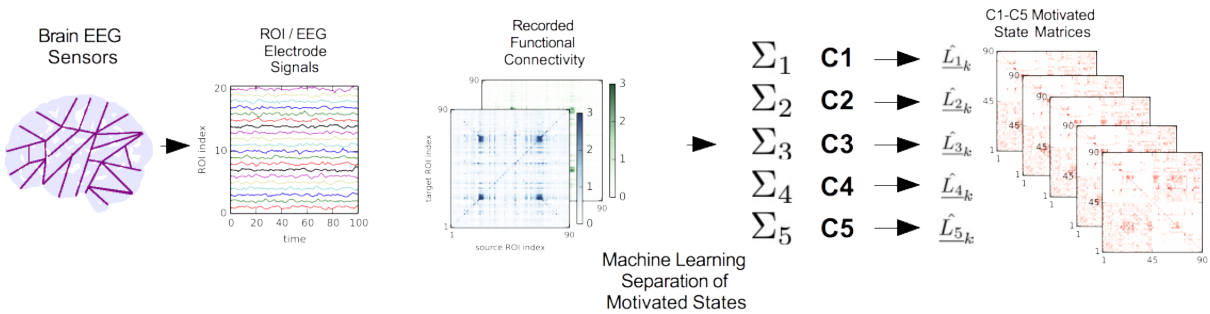

Figure 1 A. Schematic for the extraction of Functional and Effective Connectivity Metrics from EEG recordings during the different motivated states Σ_i stands for the Effective Connectivity (EC) matrices to be extracted at regular time intervals, providing a dynamic signature of neural states related to each experimental condition (C1-C5).

In summary, the project we propose aims at the following goal: if we transform the EEG signals from sensory to source space (Hindriks et al., 2017), can we identify differences in functional/effective brain connectivity as a function of the motivated state?

The student's goal would be that of developing computational models of the brain, to identify and quantify differences of neural connectivity across brain areas as a function of the person's level of task engagement (motivated state). The student will also be at charge of the preparation of scientific manuscripts for publication and of presenting these results at scientific conferences.

References:

Gilson M, Moreno-Bote R, Ponce-Alvarez A, Ritter P, Deco G (2016) Estimation of Directed Effective Connectivity from fMRI Functional Connectivity Hints at Asymmetries of Cortical Connectome. PLoS Comput. Biol. 12

Hindriks R, Schmiedt J, Arsiwalla XD, Peter A, Verschure PFMJ, Fries P, Schmid MC, Deco G (2017) Linear distributed source modeling of local field potentials recorded with intra-cortical electrode arrays. PLOS ONE 12:e0187490