Neural Resources of Cognition

Your (day) dream of a Master´s thesis in Systems Neuroscience becomes true

We all know the experience that during a monotonous task our thoughts can drift away. The phenomenon to become aware of episodic memory content is also known as mind-wandering (MW) (1), (2). Since MW increases behavioral errors (3), off periods during waking are potentially harmful (4). For example, if thoughts drift away in challenging situations as driving through traffic, the survival in general would be endangered if the brain´s need for rest is met entirely during waking (5) at the expense of the ability to flexibly shift attention to key features in the environment.

A critical question is how to efficiently grasp a volatile concept like MW. Given that MW reflects internally oriented processes that often lack robust behavioral signatures, reliable detection of MW calls for neural measures that directly capture this dynamic mental process. Recently, it has been shown that MW is associated with an increased alpha amplitude (AA) during stimulus processing (6). But whether AA is causal for MW is not clear. In previous studies we primarily relied on randomly presented thought sampling as a measure of MW. That is, in 20-30% of experimental trials participants were asked about their momentary focus. To closer look into a causal role of alpha, we plan to apply real-time analysis of electrophysiological data to detect instances of AA increases. The detection of this spectral feature in individual subjects will allow to present targeted thought probes in a form of neurofeedback. A causal role of alpha would be supported by a clear association of MW ratings with high AA instances.

In the master project, the student initially starts with developing an algorithm to detect increases of AA at relevant sensor locations. We provide MEG data from 30 human subjects with different levels of MW each with a total recording time of ~ 1h, which can be used for initial investigations to replicate the AA modulation reported in (6) during MW and algorithm evaluation. The main task in the project is to implement the detection algorithm such that it can be applied in real-time to produce targeted thought sampling and evaluate the implementation with a sufficiently large cohort of subjects.

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