DESCRIPTION FOR THE GENERAL PUBLIC

In our daily life, we continuously rely on cognitive processes in order to adapt to changing environments by detecting relevant information and selecting the most appropriate behaviour. One of these vital processes is the human ability to detect and resolve conflict. But what actually is a conflict? A general answer to this question would be - it is a situation with opposing or incompatible actions, objectives, or ideas. A neuroscientist would be more specific and reply that response conflict occurs when there is a competition between mutually exclusive response options. Based on this definition, it can be tracked by the prolonged reaction times and higher error likelihood. There are several experimental paradigms designed to evoke response conflict. The first one is a well-known Stroop Test. In the test, subject is presented with words, usually names of the colours, which are printed with various inks. When asked to name the colour of the ink, the Stroop Effect occurs. That is, it takes longer and reaction is more prone to error when the colour of the ink does not match the name of the colour. Another paradigm for conflict is the Simon Task. In the task, subject is presented with lateralized stimuli, which represent either left or right button response. The Simon effect refers to the finding that reactions are faster and more accurate, when the stimulus occurs in the same relative location as the response it represents. Thus, these tasks introduce two types of stimuli: congruent (with no assumptions about the conflict) and incongruent (conflict trials). In most cases, the latter have longer reaction times than the former.

Neuroscientists using various neuroimaging techniques were always interested whether there is one particular brain region responsible for detecting and resolving the response conflict. Studies using electroencephalography (EEG) and functional magnetic resonance imaging (fMRI) techniques compared brain activation in case of congruent and incongruent trials. Consistently, they revealed that the brain region, which shows increased activity for incongruent trials in comparison to congruent ones, is a medial frontal cortex. Recently, it has been shown that the activity of the medial frontal cortex increases with processing demands of any stimuli, even those with no assumptions about the conflict. This linear increase of fMRI signals as a function of reaction time has been referred to as a time on task effect and observed in conflict-related brain activation evoked by the Stroop task. Neural indicators obtained in conflict tasks may be particularly prone to this effect, due to fact that researchers compare congruent and incongruent trials, which, by definition, differ in average reaction times. However, another conflict-related EEG marker observed in the Simon task proved independent of these changes.

Thus, the aim of the study is to verify whether neural markers of response conflict are sensitive to time on task. Considering different theoretical framework of Stroop and Simon effects, we hypothesize that brain activity observed in the Stroop tasks is prone to the time on task effect, whereas brain activity evoked by the Simon task is not prone to the time on task effect. In the study, we plan to use a novel method of simultaneous EEG-fMRI recordings, which enables to address both the dynamic variability of cognitive functions and the relationship between its hemodynamic and electrical signatures. Moreover, and of particular advantage in this project, participants perform the task only once, thus the problem of within-subject behaviour fluctuations across separate recording sessions is avoided.