

The human brain has an incredible ability to adapt and is constantly changing over lifespan. Acquisition of new skills e.g. learning to juggle, playing the instrument or acquiring a new language can lead to changes in brain structure and function. Increasingly, a special training tools are used to improve our cognitive functioning, prevent the age-related cognitive decline or help patients following brain injuries.

Working memory training is one of the most frequently tested forms of cognitive training. Working memory is a skill crucial for human daily functioning - it allows to hold and manipulate information in short period of time. By studying the brain using neuroimaging methods before and after working memory training, researchers showed that this training may change both its structure and function. However, the analysis of standard task-related brain responses revealed that functional plasticity changes may have a non-linear character. In fact, these changes do not simply grow in time. At the beginning of the acquisition of a new skill, brain activations increases, and subsequently decreases back to baseline when the ability is fully mastered. Therefore, it is extremely important to study brain functioning not only before and after training, but multiple times over the training period. Such approach will allow us to investigate plastic changes occurring at all stages of learning.

The aim of the project is to investigate how functional connectivity in the human brain changes gradually during training and which factors may influence the dynamics of this changes over time. Twenty healthy volunteers participating in the study will be scanned in a functional magnetic resonance (fMRI) scanner four times over the period of working memory training - before training; and after 1 week, 2 weeks and 3 weeks of training. This will allow estimating how functional connectivity changes occur over time of cognitive training. Furthermore, in order reveal which factors may be important for the dynamics of functional plasticity changes, the participants will be tested with psychological tests. The fMRI results of the working memory trained participants will be compared to the results of 20 participants not trained in any task, also scanned four times in the fMRI scanner.

The study of functional connectivity using fMRI, is one of the most dynamically developing method with potential to measure plastic changes over time. It turns out that even when we do not perform any tasks, the functionally connected brain areas work in a synchronized manner. Based on this simultaneous activity we may infer about the existence of connections between these regions and create a map of functional connections covering the whole brain - the so-called functional connectome. Functional connectome can be easily altered by learning and therefore it is a suitable method for studying dynamical plastic changes occurring during cognitive training.

However, there is still no research that would clarify how functional connections may change gradually in the course of cognitive training such as working memory training. Likewise, we still do not know which factors may be related to the course of the functional connectivity changes during training. What is the role of the pre-existing structure of our functional connections? Can our level of intelligence, temperament or personality traits modify the dynamics of these changes? This project was created to answer these questions.