

## **Effectiveness of mental imagery strategy in controlling an activation of the left middle frontal gyrus: Biofeedback study based on the real-time fMRI**

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**Background:** Biofeedback based on the real-time fMRI is a promising tool for a conscious control of a particular brain region. However, one difficulty of such studies is a common strategy for controlling of the brain region activation. In our experiment we challenged whether subjects can control activation of the Left Middle Frontal Gyrus (LMFG) by using a common strategy. This region was proven to be activated by performing of a mental imagery task and a working memory task. Therefore, the subjects were instructed to use mental imagery techniques in order to up-regulate the activation of the LMFG. In our study we show that the suggested strategy allowed all subjects to control the activation of the selected area.

**Methods:** Ten right-handed healthy subjects participated in the experiment. First, they were instructed to imagine auditory and visual stimuli in a block-design fashion during the 8 min fMRI scanning. The obtained fMRI data were analyzed on-line by means of the Turbo-BrainVoyager software and the parametric maps were generated. The auditory and visual imagery conditions were contrasted separately against the baseline where subjects were instructed to count back. Based on these maps a responsive area in the LMFG was selected as a region for the further biofeedback control. Second, the subjects performed four biofeedback sessions. Each session consisted of 9 baseline and 8 feedback blocks. Each block lasted for 30 sec. During the feedback blocks subjects were instructed to up-regulate their activation. As a visualization of the activation level we used horizontal bars.

**Results:** In the offline analysis we found that in all subjects the selected region of interest for the biofeedback was located in the LMFG (BA 46). Group analysis of fMRI data based on the GLM revealed that the subjects were able to up-regulate the activation level of the selected region of interest by using mental imagery strategy (Fig. 1). Post-hoc talk revealed that the most effective strategy concerned imagine of rather familiar either visual or auditory objects, especially when the subjects were concentrating on the details of them. The group analysis of the change of the fMRI signal across the session revealed a presence of the learning effect – subjects were able to increase the difference in activation level between the baseline and the up-regulation conditions.

**Discussion:** Present study provides an insight on an effective strategy for controlling the activation level of the LMFG. We suggest here that mental imagery techniques can be used as an effective strategy for controlling of this region. Further, we plan to compare whether other strategy, for example including working memory task, can help controlling the activation level of the LMFG.

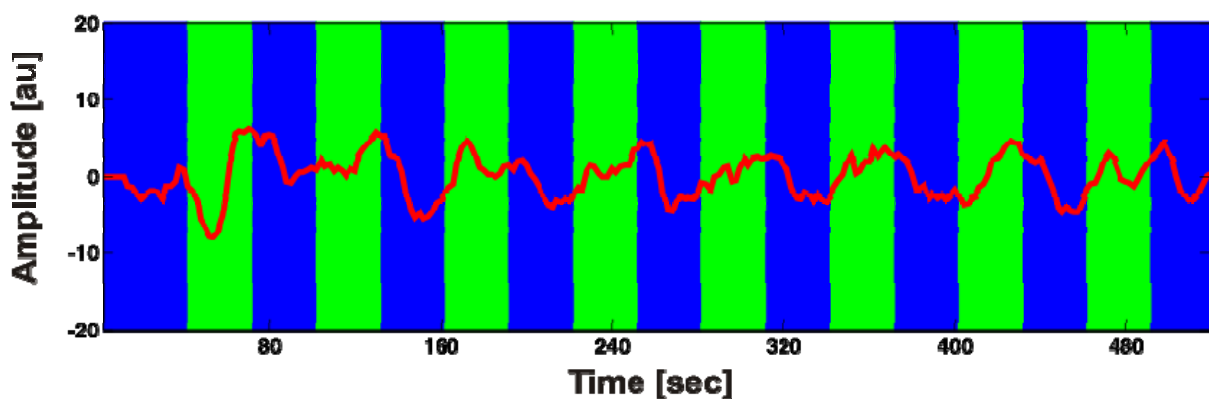


Figure 1. The activation level of the LMFG during the biofeedback session (one representative subject). Blue stripes represent a baseline condition and the green stripes are an up-regulation condition.