Learning Induced Changes in Cortical Resting-State and Task-Related EEG During and After Virtual Tool-use Training

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Abstract

We examined whether resting-state and task-related EEG power over centro-parietal and frontal brain regions were changed by virtual tool-use training and whether such changes were associated with learning, sense of agency and ownership. Thirty-four young adult participants learned to use a virtual tool for grasping an object in augmented reality. Training was organized in 4 blocks of 60 trials each. Vibrotactile feedback was applied to thumb and index fingers through a CyberTouch II when the tool touched the object. Resting state EEG was collected at pre-test, between training blocks, and at post-test, and resting state power spectra between and after learning were compared with baseline. EEG was collected during all training blocks and analyzed as task-related (de)synchronization relative to the resting period preceding the respective training block. We expected increased resting state beta power over central electrodes to be associated with faster tool-use acquisition and embodiment (Özdenizci, et al, 2017). However, no change in resting state power was revealed in our data. For task-related (de)synchronization we expected enhanced alpha suppression and gamma synchronization over fronto-parietal regions associated with increased control over the virtual tool. In addition, we explored in how far task-related gamma and alpha synchronization over various brain regions was associated with increasing sense of agency and ownership. These data are currently analysed. Finally, EEG correlates of sense of agency and sense of control in a virtual tool-use training paradigm will be discussed.

Keywords: Tool-use training, learning, augmented reality, power spectra activity, resting state EEG, Sense of agency and ownership