

Resting-state fMRI changes induced by real-time fMRI neurofeedback

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Introduction

In patients with mild cognitive impairment (MCI), hippocampal hyperactivity is associated with poor memory performance. Using real-time fMRI neurofeedback, participants in our study learned to downregulate hippocampal activity, which improved their memory performance. Here, we examined whether hippocampal downregulation is associated with changes in resting-state brain activity and whether these changes relate to mental strategies participants reported using during neurofeedback.

Methods

We acquired resting-state fMRI before and after two sessions of neurofeedback. Standard preprocessing was applied using the CONN-toolbox. We then compared voxel-wise functional connectivity between the hippocampus and the rest of the brain before and after neurofeedback. In addition, voxel-wise ALFF was compared between visits. Finally, we correlated neurofeedback-induced functional brain changes with changes in memory performance.

Results

Data were available for 43 participants (11 with MCI and 32 healthy). Following neurofeedback, we observed increased hippocampal functional connectivity with the lateral occipital cortex and temporal fusiform cortex, as well as decreased connectivity with the left superior frontal gyrus. ALFF increased in the precuneus, right supramarginal, middle frontal, and angular gyri, as well as in the bilateral superior frontal gyrus. Significant positive correlations were found between memory performance changes and connectivity changes in occipital, but not frontal, regions. No significant correlations were observed between ALFF changes and task-related performance improvements.

Conclusions

Neurofeedback may lead to network reorganization to support memory performance. We found that hippocampal downregulation was associated with increased connectivity to occipital regions, likely reflecting visual imagery strategies, and with ALFF increases in the default mode network, which is often disrupted in MCI. These findings indicate that strategy use and strengthening of the default-mode network may underlie neurofeedback-related improvements.

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