Functional Parcellation of Cerebellum Based on Resting-State fMRI and Singular Value Decomposition

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Introduction

In previous functional MRI researches, less attention was paid on the cognitive functions of the cerebellum and the connection between the cerebellum and cerebrum. However, more and more studies pointed out that cerebellum takes part in many other brain activities and even in high cognitive functions. In this study, we tried to parcel out the functional assemblies in spatial domain and in power spectrum within cerebellum and their corresponding connections to cerebrum regions based on one combined process of data-driven singular value decomposition (SVD) and seed-selected method.

Method

Data of resting-state fMRI scan acquired from fifty-six participants (f/m=26/30) was separated into 28 anatomical regions in cerebellum according to the structure based on the Spatially Unbiased Infra-Tentorial template. And the SVD method was applied into the data to extract the useful fluctuations that have eigenvalue above noise-level. All the selected singular vectors were used to investigate the functional networks between cerebellum and cerebrum. Then all the significant BOLD correlation maps were separated into several groups based on the similarity among individual singular vectors and correlation maps. The fALFF of the singular vectors in power-spectrum was calculated among those groups.
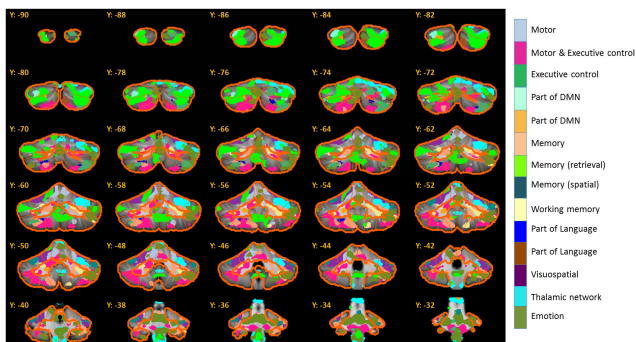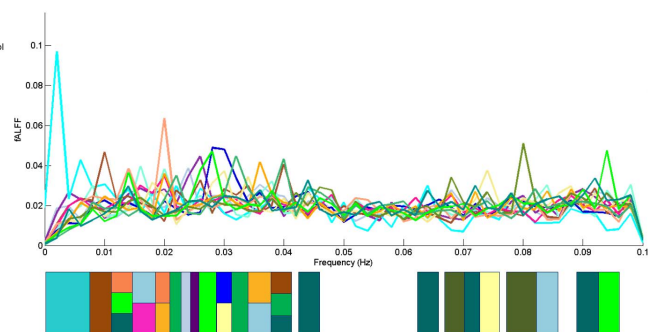

Figure 1.

Figure 2.

Result

Fourteen significant functional connectivity patterns (p<0.05 with FDR correction and cluster is 50 voxels) were demonstrated (Figure 1). In the power spectrum, functional patterns show peak value in different distribution (Figure 2). According to the previous research, most patterns have the higher power in the location (0.02-0.04 Hz and 0.06-0.09 Hz) that correlated to the theta and gamma ranges of EEG except for the pattern of thalamic network (<0.01 Hz).

Conclusion

According to the result, we could conclude that cerebellum indeed take part in many cognitive processes more than the function of motor and executive control. And the separation in frequency domain shows the characteristic among the functional patterns, and it could provide one valuable reference for the further investigation about resting-state MRI.

Reference

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