The Background Brain Network Plays a Compensatory Role in Patients with Amnestic Mild Cognitive Impairment

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Background: Memory deficits were identified as the core symptom in amnestic mild cognitive impairment (aMCI). Recent study has demonstrated visuospatial associative memory impairment may be one of the earliest changes predicting cognitive impairment by using multimodal MRI methods [1]. Investigating the topologic reorganization of the working memory network in aMCI patients during a visuospatial working memory task may provide more information to reveal the mechanism of aMCI.

Methods: In this study, the fMRI of 17 aMCI patients and 19 age, gender and education matched elderly controls (HC) were acquired while they performing a visuospatial working memory task (Figure1). The working memory network was identified by using general linear model and the background brain activity of the working memory network, which derived from the residual of the general linear model, was used to assess the cognitive state of participants maintained the task [2]. The regions of interest (ROIs) were selected based on Power's 264 putative functional regions [3], and 29 10mm-diameter-spherical ROIs in the task-related activated regions were retained for the background network analysis (Figure2). Average time course of the retained ROIs were extracted and a weighted-undirected network was constructed based on Pearson correlation. The network efficiency based on graph theory approaches was used to investigate the organization of the background functional brain network.

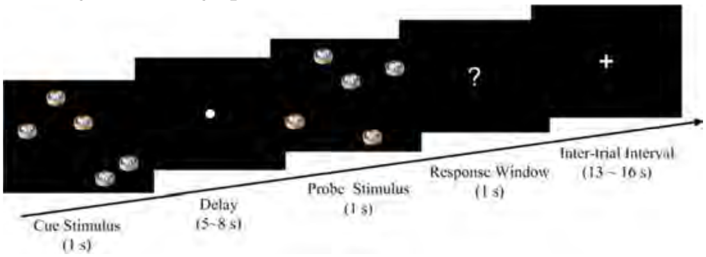

Figure 1 The visuospatial working memory task

Results: The results showed significantly increased local efficiency in patients with aMCI compared to normal controls (Figure 3). In addition, the local efficiency showed a significant correlation with Alzheimer's Disease Assessment Scale-Cognitive Subscale (ADAS-Cog) sacores ($r = 0.49$, $p = 0.004$) and Delayed Recall scores ($r = -0.40$, $p = 0.02$) cross the groups. A trend of negative correlation between local efficiency and forward Digit Span scores was also found ($r = -0.30$, $p = 0.086$).

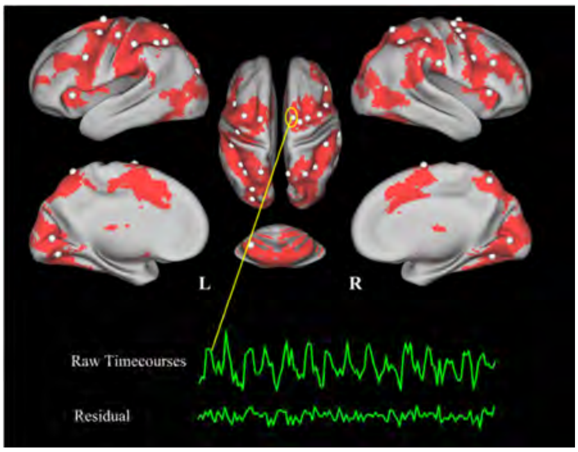

Figure 2 Analysis pipeline for the working memory background network analysis.

Discussion and Conclusion: The aMCI group showed a significantly increased local efficiency compared to the HC group, which indicated the reorganization of the background working memory network in aMCI. In addition, we found the local efficiency showed a significantly positive correlation with the ADAS-Cog scores and negative correlation with the Delayed Recall scores across the subjects. A negative trend was also found between local efficiency and forward Digit Span scores. These findings suggest that this increased local efficiency may reflect the deficits of cognitive function, especially the working memory impairment. The increased background local efficiency may indicate patients with aMCI have to pay more effort to complete the task due to memory impairment and suggest the compensatory property of the background network.

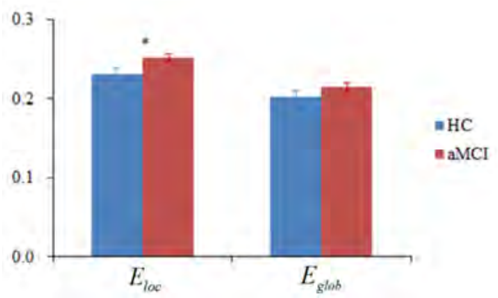

Figure 3. The network efficiency of the background network for aMCI and HC groups.

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