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Adaptation of Brain Functional and Structural Networks in Aging

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Abstract

The human brain, especially the prefrontal cortex (PFC), is functionally and anatomically reorganized in order to adapt to neuronal challenges in aging. This study employed structural MRI, resting-state fMRI (rs-fMRI), and high angular resolution diffusion imaging (HARDI), and examined the functional and structural reorganization of the PFC in aging using a Chinese sample of 173 subjects aged from 21 years and above. We found age-related increases in the structural connectivity between the PFC and posterior brain regions. Such findings were partially mediated by age-related increases in the structural connectivity of the occipital lobe within the posterior brain. Based on our findings, it is thought that the PFC reorganization in aging could be partly due to the adaptation to age-related changes in the structural reorganization of the posterior brain. This thus supports the idea derived from task-based fMRI that the PFC reorganization in aging may be adapted to the need of compensation for resolving less distinctive stimulus information from the posterior brain regions. In addition, we found that the structural connectivity of the PFC with the temporal lobe was fully mediated by the temporal cortical thickness, suggesting that the brain morphology plays an important role in the functional and structural reorganization with aging.

Introduction

Converging evidence from task-based functional magnetic resonance imaging (fMRI) studies suggests pronounced aging effects on functional activities in the prefrontal cortex (PFC). Older adults exhibit more PFC activity ipsilaterally or bilaterally as compared to their younger counterparts in various tasks [1–3]. The age-related increase in bilateral frontal activation seemed to suggest that older adults were working harder and engaging in more distributed brain regions. Moreover, frontal processing in older adults appeared to be less specialized through a tendency to engage additional frontal regions, while frontal processing in young adults only involved