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Age-related Changes in Relational Encoding

INTRODUCTION

Reduced episodic encoding is a cognitive hallmark of an aging brain (Benedetti et al., 2001). Episodic encoding involves a collaboration of both prefrontal cortex (PFC) and medial temporal lobe (MTL; Simons & Spiers, 2003). Converging evidence has shown the inferior frontal gyrus (IFG) to have increased co-activation with decreased activation in the MTL during episodic encoding in older adults. This may be consistent with posterior-anterior shift in aging (PASA) model (Davis et al., 2007) where older adults show increase in IFG (anterior of PFC) activity related to reductions in the hippocampus/parahippocampus (posterior of brain).

Many studies have shown age-related changes in the functional activation of the MTL (including hippocampus/parahippocampus) and in frontal regions such as the IFG. Hence, it would be informative to evaluate the functional relationship of IFG and MTL if a PASA phenomenon is seen between the young and old adults. The present aging study utilized a functional MRI task sensitive to relational processing/encoding in young and old adults to evaluate age-related changes, shown in functional neuroimaging.

AIM

To examine the difference in brain activation between young and old adults while performing a relational discrimination task after adjusting for age-related structural brain atrophy.

To investigate the presence of PASA phenomenon using IFG and MTL regions of interest (ROIs).

METHOD

Participants

23 healthy young adults (12 females, 2 left-handed) mean age = 23.3 (SD = 2.2) MNSQ mean score = 29.3 (SD = 0.3)

17 old adults (9 females, 2 left-handed) mean age = 56.6 (SD = 6.5) MNSQ mean score = 29.1 (SD = 0.3)

Task

All participants performed a series of episodic encoding tasks (Figure 1).

For Novel and Repeating Pictures tasks: Participants discriminated the stimuli as indoor/outdoor scenes.

All participants performed a series of episodic encoding tasks (Figure 1).

RESULTS

IMAGING RESULTS

For imaging data analyses: General Linear Model analyses applied on novel > scrambled task contrast per subject was submitted for group level random effects analysis. ROI analyses with IFG and MTL bilateral mask confirmed the presence of only left IFG activation (Figure 5a and b) had increased activation in the young > old adults contrast. No increased activation was observed in the old > young adults contrast.

CONCLUSION

The young showed both IFG and MTL activations and the old adults only had MTL activations for relational encoding, partially supporting our first hypothesis. When RT was adjusted, only the young adults showed IFG and MTL activations during relational encoding. This suggested a possible relationship between increased IFG and decreased MTL activations in old adults.

In addition, young adults showed increased left IFG activations compared to the old counterparts, failing to support the hypothesized PASA effect. The failure to show the PASA effect in the current study may be due to the use of the grey matter density maps to adjust for atrophy in normal aging that was not applied in the past studies.