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<td>Author(s)</td>
<td>Leow, Dayton Wei Yang</td>
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**INTRODUCTION**

Reduced episodic encoding is a cognitive hallmark of an aging brain (Braak 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-to-anterior shift in aging (PASA) model (Davis et al., 2007) where older adults show increase in IFG (anterior of brain) activation to compensate for age-related reduction of activity in the hippocampal/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.

1. 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.
2. To investigate the presence of PASA phenomenon using IFG and MTL regions of interest (ROIs).

**AIM**

1. IIFG and MTL activations would be observed in both age groups during relational encoding task.
2. Older adults would show greater IIFG activities compared to the young counterparts.
3. IFG and MTL activations would be observed in both age groups during relational encoding task.

**METHOD**

1. **Participants**
   - 23 healthy young adults (12 females, 2 left-handed)
     - Mean age = 23.3 (SD = 2.0)
     - Males: 11 females: 12
   - 17 old adults (9 females, 2 left-handed)
     - Mean age = 56.6 (SD = 6.5)
     - Males: 6 females: 11

2. **Task**
   - All participants performed a series of episodic encoding tasks (Figure 1).
   - For Novel and Repeating Pictures task: Participants also intramorphic stimuli as indoor/outdoor scenes. For Scrambled Picture task: Participants identified the scenes as non-identical.
   - Relational encoding process: Novel – Scrambled Pictures task contrast.

3. **Image acquisition and pre-processing**
   - All participants underwent functional magnetic resonance imaging (fMRI) in a 3 T MRI scanner (EPI parameters: TE = 24 ms, TR = 2000 ms, FOV = 32 mm, matrix = 64 x 64, slice thickness = 3 mm, 39 axial slices with 0.75 mm spacing).
   - Pre-processing was carried out using statistical parametric mapping (SPM) on MATLAB 7.9 with diffeomorphic anatomic registration through exponentiated Lie algebra (DARTEL) tool to obtain individual grey matter probability maps.

4. **Data analyses**
   - For behavioral performance: 2 (age group) x 2 (task type) analysis of variance (ANOVA) were separately performed accuracy (ACC) and reaction time (RT) measured during the scan, and on ACC measured during post-test after the scan for evaluating incidental encoding. Significant level was set at p < .05.
   - For imaging data: General Linear Model analyses applied on novel > scrambled task contrast per subject was submitted for group level random effects analysis. Group level analyses were performed via biological parametric mapping (BPM) on MATLAB 7.9 to control for age-related brain atrophy using individual grey matter probability covariant. Suprathreshold level was set at p < .001 (uncorrected) threshold at k > 20.

Bilateral IIG and MTL masks were extracted from WFU PickAtlas and applied for subsequent ROI analyses.

**RESULTS**

1. **Behavioral results**
   - Accuracy performance during scan: Only significant age main effect of age was found (p < .05).
   - Reaction Time: Performance during scan. Presence of significant interaction, task and age main effects were found (p values < .05).
   - Signal-to-noise ratio: Presence of significant interaction, task and age main effects were found (p values < .05).

**Project Title:** Healthy Aging in the Brain

**Supervisor:** A/P Chen Shen-Hsing Annabel

**Co-supervisor:** Dr Jo Archer

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**Category:** School of Humanities and Social Sciences

**Student:** Leow Wei Yang Dayton

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