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<th><strong>Title</strong></th>
<th>Age-related differences in functional connectivity during scene encoding</th>
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Introduction

- The functional network underlying episodic encoding involves both the prefrontal cortex (PFC) and medial temporal lobe (MTL). Episodic encoding differs in terms of the stimuli and the types of events.
- Past neuroimaging studies have found both the parahippocampus in the MTL and inferior frontal gyrus (IFG) in the PFC to be activated for scene encoding. In addition, when scenes are encoded based on their meaningfulness (i.e., relational encoding), the hippocampus will be activated for relational binding of the stimuli.
- In general, there is converging support for both the IFG and MTL (hippocampus/parahippocampus) to be functionally connected and work in tandem during relational encoding of scenes.
- Older adults performing relational encoding and scene encoding exhibited increased frontal ventral activation than young adults to meet their increased cognitive demand.

Specifically, an increased frontal ventral activity was shown to compensate for the decreased medial temporal activity.
- The posterior-to-anterior shift in aging (PASA) model could potentially be used to account for this temporal-medial to frontal compensatory shift in brain activation.

Aims & Hypotheses

Aims
1. To examine the difference in IFG-MLT functional connectivity between young and older adults while performing relational encoding of scenes.
2. To use the present findings to extend support for the PASA model.

Hypotheses
1. Both young and older adults are expected to show increased functional connectivity between IFG and MTL during relational encoding of scenes.
2. Older adults are expected to show reduced functional connectivity between IFG and MTL during relational encoding of scenes compared to the young.

Method

Participants
16 healthy old adults (9 F, 2 left-handed)
mean age = 66.2 (SD = 6.5)
MMSE mean score = 29.3 (SD = 0.7)
23 healthy young adults (12 F, 2 left-handed)
mean age = 23.3 (SD = 2.2)
MMSE mean score = 29.9 (SD = 0.3)

Task
Relational encoding of scenes: Non-scrambled novel (N) vs scrambled novel scenes (S) task contrast.

Accuracy (ACC) and reaction time (RT) during scan were recorded; post-scan recall was tested for unintentional encoding.

Image acquisition and preprocessing

All participants’ brain images were acquired in a 3.0 T MRI scanner (EP I: TE 30 ms, TR 3000 ms, FOV 192 mm, matrix 64x64, slice thickness 3 mm, 39 axial slices with 0.75 mm gap).

Preprocessing was carried out using statistical parametric mapping 8 (SPM 8) on MATLAB 7.9, following the diffeomorphic anatomic registration through exponentiated lie algebra (DARTEL) pipeline.7

Data analyses

- Behavioral data: 2 (Age) x 2 (Task) analysis of variances (ANOVAs) were performed on ACC and RT recorded during the scans, and on post-test ACC. Post-hoc multiple pair-wise comparisons were performed for significant interaction or main effects, with p < .05.
- Imaging data: General Linear Model analyses for N vs S contrast were performed for subject-level brain activation map using SPM8, before submitting for group-level random effects IFG-MLT ROI analyses with gray matter probability and RTs adjusted using biological parametric mapping (BPM), with p < .001 (uncorrected), k > 20. Later, ROI-to ROI (IFG-MLT) functional connectivity analyses for N vs S task contrast were conducted for subject-level and group-level, using CONN toolbox v.11b,9 with p < .05 (FDR corrected). Left and right IFG and MTL ROI masks were created using WFU PickAtlas 2.4. Intra-cranial brain volumetric decline and RTs for both conditions were adjusted.

Results

Behavioral results
(a) ACC during scan, (b) RT during scan and (d) post-test ACC. RTs for both conditions were submitted as covariates for between-groups IFG-MLT functional connectivity analyses.

Imaging results
Activation analyses

Connectivity analyses

Conclusion

- Older adults responded slower than young adults for both conditions, with reaction time being slower for scrambled novel scenes than non-scrambled condition.
- Only older adults showed functional connectivity between IFG and MTL during relational encoding of scenes, while young adults had connectivity between left and right MTL, partially supporting the first hypothesis.
- Contrary to the second hypothesis, no age-related difference in IFG-MLT functional connectivity was found to suggest a PASA phenomenon. However, the present finding showed increased functional connectivity between left and right MTL in the elderly compared to the young when performance and brain atrophy are controlled. For these results could be generalized to the CRUNCH model10 that suggests a functional compensation in aging.

References