



FUNCTIONAL CONNECTIVITY OF IMPLICIT PROBABILISTIC SEQUENCE LEARNING IN AGING

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INTRODUCTION

IMPLICIT PROBABILISTIC SEQUENCE LEARNING, an acquired sensitivity to regularities without explicit awareness, requires a high level of functional integration among underlying neural networks.

AGE-RELATED DECLINES in discrete brain regions (e.g. striatum) can influence interactive neural networks that are required to perform a given task

FUNCTIONAL CONNECTIVITY, the temporal correlation of activation between distinct brain regions as modulated by a psychological variable, has rarely been applied to the studies of aging and implicit learning

AIM

- To identify age differences in functional connectivity during implicit probabilistic sequence learning

METHOD

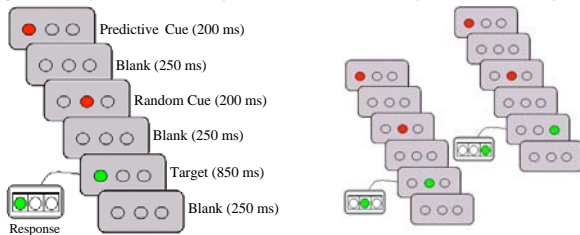
PARTICIPANTS

Group	Sample Size (# female)	Age (SD)	Education (SD)	MMSE (SD)	Digit Span (SD)
Young	10 (5 female)	18.8 (.6)	12.2 (.4)	30.0 (0.0)	20.2 (4.7)
Old	11 (8 female)	67.6 (3.3)	17.1 (2.5)	29.3 (.8)	21.2 (3.9)

EVENT-RELATED TRIPLETS LEARNING TASK

- Series of discrete, three-event sequences or 'triplets'
 - 2 cues (predictive, then random) and 1 target per trial
 - Respond only to target event (1 of 3 locations) with right hand
 - Cue and target location counterbalanced
- Unbeknownst to participants, 1st cue location probabilistically predicts target location

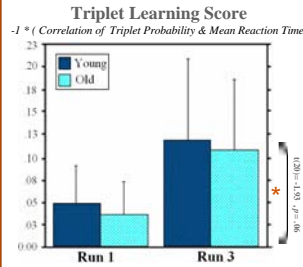
High Probability (HP) Event (80% of trials) Low Probability (LP) Events (20% of trials)



fMRI PARAMETERS AND ANALYSIS

- 3T Siemens Magnet, T2* sensitive gradient EPI acquisition (TR = 2500 ms, TE = 30ms, 90° flip angle, FOV = 256, 42 axial slices; voxel size = 4.0 x 4.0 x 3.7 mm)
- Three 6.5 minute runs; 152 images/run
- Data Analysis in SPM5 (Realignment, Normalization to MPRAGE, Smoothing {8mm})
- Random-effects group averaging: HP - LP contrast for Runs 1 and 3
- Functional connectivity assessed using psychophysiological interaction (PPI) tool
 - BOLD signal time course extracted from hippocampus (Run 1) and caudate (Run 3)
 - Highest peak voxel from HP - LP contrast of GLM analysis (+2mm VOI)
 - PPI analysis: Interaction term created between BOLD time course in given regions and the TLT learning events (i.e. HP and LP events)
- Brain-wide search for voxels where BOLD significantly positively correlates with PPI interaction term
- Intra-subject connectivity maps created before submitting to second-level analysis
- p < .005, k = 5

BEHAVIORAL LEARNING



PREVIOUS fMRI ANALYSES

p < .01, k = 5	Analysis	Young	Old
Run 1: Hippocampus	One sample T-test (High > Low)		
	Correlation with Triplet Learning Score		
Run 3: Caudate	One sample T-test (Low > High)		
	Correlation with Triplet Learning Score		

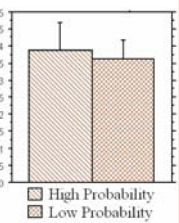
NO EXPLICIT AWARENESS

FOLLOW-UP STUDY

- 9 young adults
- Same version of TLT (performed outside scanner)
- Similar behavioral learning

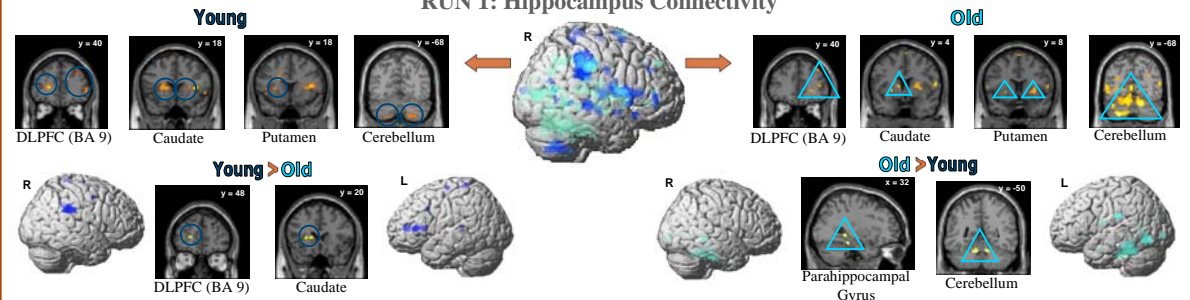
RECOGNITION MEASURES

- Recognition paradigm:
 - Equal recognition of HP and LP triplets (p > .78)
- Post-experiment interview:
 - No subject accurately described the regularity or predictable relationships

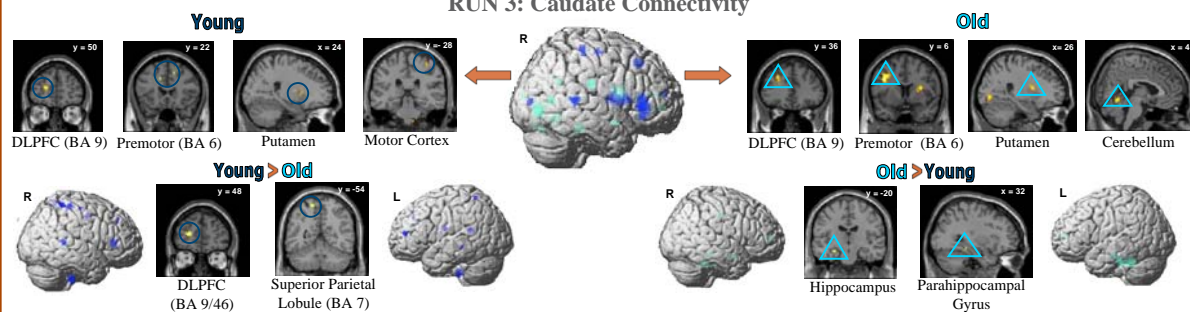


FUNCTIONAL CONNECTIVITY RESULTS

RUN 1: Hippocampus Connectivity



RUN 3: Caudate Connectivity



RESULTS SUMMARY AND DISCUSSION

- ### BEHAVIOR
- No age differences in accuracy (mean ~98%; F(1,19) = .063, p > .05) or triplet learning scores (F(1,19) = .034, p > .05)
- ### NEUROIMAGING
- Similar behavioral outcomes do not imply that supporting functional brain networks are the same
 - Brain activity positively covarying with hippocampal (Run 1) or caudal (Run 3) activity
 - Age Similarities: Many overlapping functional networks, though often to a different extent in young and old adults
 - Age Differences: Old adults have stronger connectivity with medial temporal and cerebellar structures than young adults
 - These findings might reflect age-related compensation, given behavioral similarity accompanied by some functional brain differences

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