Developmental differences in relations between episodic memory and hippocampal subregion volume during early to middle childhood

Elizabeth Mulligan, Sarah L. Blankenship, Katherine Leppert, Stephanie Merwin, Lea R. Dougherty, & Tracy Riggins

University of Maryland, College Park

Neurocognitive Development Lab

Introduction

- The hippocampus has been shown to be fundamental for episodic memory ability in school-aged children and adults (Ghetti & Bunge, 2012).
- Previous research suggests that age-related differences in episodic memory may be related to developmental differences in hippocampal structure along the longitudinal axis (anterior to posterior) during middle childhood (DeMaster et al., 2014).
  - Volume of left tail predicted memory in 8- to 11-year-old children but smaller right head and larger bilateral body predicted memory in adults.
- The role of the hippocampus in episodic memory in younger children is relatively under-investigated (cf. Riggins et al., under review).
  - This is unfortunate, as episodic memory shows rapid change during early childhood (Drummey & Newcombe, 2000; Riggins, 2014).
- In the current study, we sought to bridge this gap by collecting volumes of the hippocampal head, body, and tail, and measures of subjective and objective episodic memory in children ages 5-10 years, and examining relations between hippocampal subregion volumes and memory performance between early and middle childhood.

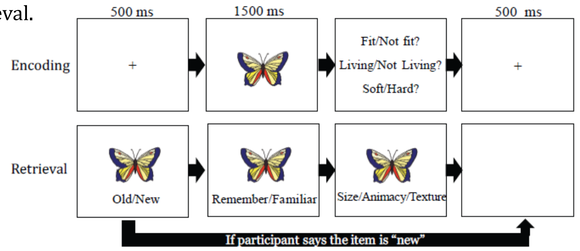
Methods

Participants

- A total of 63 children completed the imaging session and memory task. Data from all 63 participants aged 5-10 years (M= 7.19 ± 0.9 years, 32 females) were included in the present analyses.
- Participants were part of a larger study examining effects of maternal depression. Of the 63 children included in these analyses 20 were from the comparison group with no history of maternal lifetime depressive disorder (MDD) and 43 were from the group with a history of MDD.

Memory Assessment

- Episodic memory was assessed using a computerized, laboratory-based measure that required children to recall items and previously made objective semantic judgements regarding those items. Children also made a subjective recollection/familiarity judgement at retrieval.

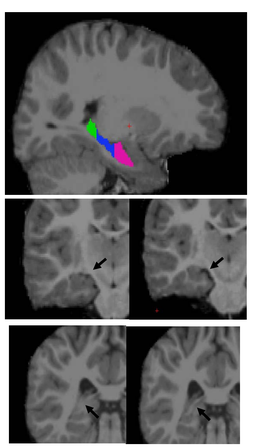


MRI Data Collection

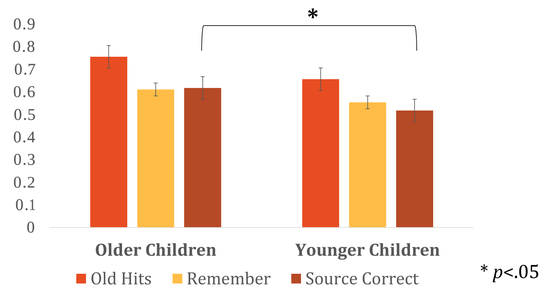
- Anatomical data were collected at the Maryland Neuroimaging Center using a 12-channel coil in a Siemen's 3T Scanner. Volumetric data were derived from MPRAGE scan (1mm^3 voxel).

MRI Data Processing & Analysis

- Freesurfer was used to identify the border of the hippocampus.
- The uncal apex and fornix were identified manually to calculate volumes of hippocampal subregions (head, body, and tail).
- To examine differences in associations between hippocampal subregion volumes and memory performance in early versus middle childhood, children were grouped into younger (5-7.08 years, n=32) and older (7.08-10 years, n=31) age groups using a median split.
- Correlation coefficients were computed separately for younger and older children between bilateral hippocampal head, body, tail, and whole volumes and memory performance using total gray matter volume, age at time of memory testing and delay between memory test and scan as covariates.



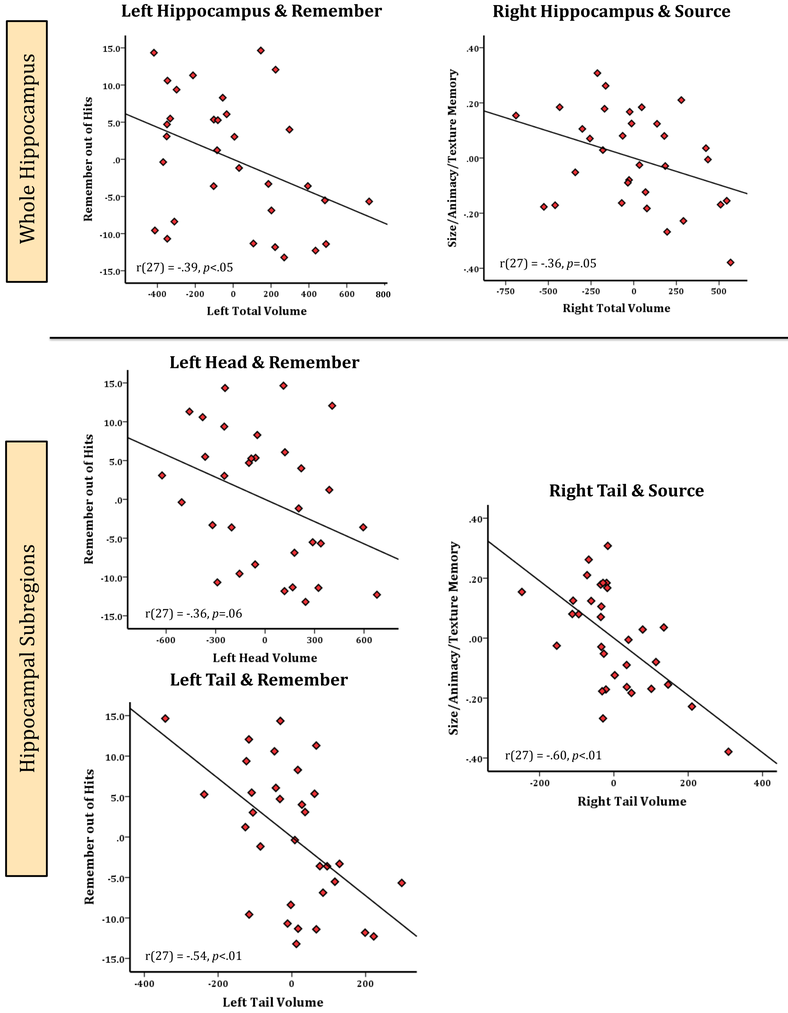
Results – Memory Performance



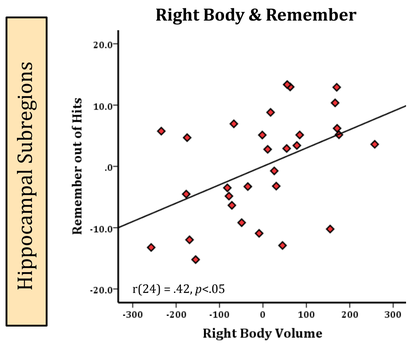
* p<.05

Volumetric Results – Early Childhood (5-7 years)

- Whole hippocampus: Better subjective and objective episodic memory performance was associated with smaller bilateral hippocampal volumes.
- Hippocampal subregions: Better subjective and objective episodic memory ability was associated with smaller left head, left tail, right body, and right tail volumes.



Volumetric Results – Middle Childhood (7-10 years)



- Better subjective episodic memory performance was associated with larger right hippocampal body.
- All other relations between memory and hippocampal volumes in older children were not significant.

Discussion

- In younger children (5-7 years), smaller bilateral volumes of whole hippocampus and hippocampal tail predicted better subjective and objective episodic memory performance.
- In older children (7-10 years), a different association emerged in which larger right hippocampal body volume predicted better subjective episodic memory performance.
- These results are consistent with the hypothesis that age-related episodic memory improvements early in life may be attributed to the development of specific hippocampal subregions.
- These results align with previous literature that suggests that development of the hippocampus is heterogeneous (DeMaster et al., 2014; Gogtay et al., 2004; Poppenk & Moscovitch, 2011; Poppenk et al., 2013).
  - However these results differ in terms of the nature and direction of the effects. (see DeMaster et al., 2013).
    - These differences may be due to differences in boundaries or ages or behavioral task. Additional research is needed to address this question.
- Future analyses will also examine the role of experience, particularly exposure to parental depression and familial liability for depressive disorder, on relations between memory and hippocampal subregion volume across development.

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Contact information for Elizabeth Mulligan: emulliga@umd.edu