Relations between autobiographical memory and hippocampal subregion volume in early childhood

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INTRODUCTION

- Autobiographical memory is a specific subtype of episodic memory that refers to the recall of details concerning one's own life events.
- Autobiographical memory rapidly develops during early childhood.
  - Specifically, the amount of details recalled and the coherence of autobiographical narrative improves drastically (Pillemer, Picariello, & Pruett, 1994; Peterson & McCabe, 1983).
- In addition, the hippocampus, which has been shown to support autobiographical memory, also undergoes protracted developmental change during this period (e.g., DeMaster & Ghetti, 2013, Gogtay et al., 2006)
  - Recent findings suggest there is both structural and functional specialization along the longitudinal axis of the hippocampus (e.g., head, body, and tail; Poppenk & Moscovitch, 2011).
- However, associations between autobiographical memory and the hippocampus in children remain unknown.
- This study examined associations between autobiographical memory and volume of subregions (head, body, and tail) of the hippocampus in left and right hemispheres during early childhood (ages 4 to 8 years, n = 60).

METHODS: AUTOBIOGRAPHICAL INTERVIEW

Participants

- 63 children aged 4-8 years (M= 6.72, SD = 1.47 years, 35 females, 28 male) completed the autobiographical interview.
  - 60 children provided useful MRI data
- Participants were part of a larger study examining the development of memory in early childhood.

Autobiographical interview and Coding

- Parents were asked to identify two unique events their child had experienced within the last several months.
  - They were asked to provide two details about each event and the date they occurred.
- The experimenter then conducted a semi-structured interview with the child, as outlined below.
  - **Free Recall** – "What can you tell me about X ?"
  - **Cued Recall** – The child was then asked about a specific detail about the event that was given by the parent/guardian.
  - **Questioned Recall**- This was followed by 7 questions (what else, when, where, why, how, who) about the event.

Narrative Coherence Coding Scheme was used to evaluate the coherence and recall of the autobiographical narratives (Reese et al., 2011).

- The coding manual assessed the dimensions below on a 4-point scale ranging from 0 to 3 .
  - **Context** – The time and location of the autobiographical event.
  - **Chronology** – The temporal order of actions in the narrative.
  - **Theme** – The child's ability to report the meaning and resolution.

METHODS: MRI DATA COLLECTION

MRI Data Collection

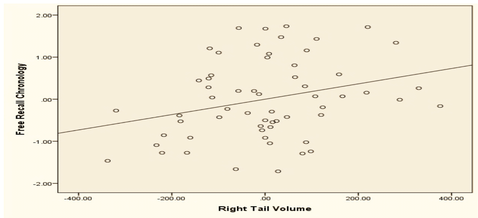
- Approximately, one week later, children returned to the lab for an MRI scan.
- T1-weighted high resolution $^{(1mm3)}$ anatomical images were acquired from a Siemens 3T scanner with a 32-channel coil at the Maryland Neuroimaging Center using a standard structural MRI scan sequence (MPRAGE).

MRI Data Processing and Analysis

- Freesurfer v5.1 (surfer.nmr.mgh.harvard.edu; Fischl, 2012) was used to derive hippocampal and amygdala volumes.
- Automatic Segmentation Adapter Tool (ASAT, nitrc.org/projectssegadapter; Wang et al., 2011) was used to refine hippocampal volumes.
- Hippocampal subregions were manually identified using standard anatomical landmarks (Weiss et al., 2005; Riggins et al., 2015).
- Volumes were adjusted for total brain size (Raz et al., 2005). FSL was used to compute intracranial Volume (ICV).

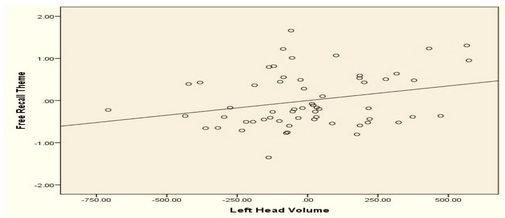
RESULTS

- Children's ability to recall the temporal order, Chronology, of the autobiographical events in free recall was positively correlated with the volume of the right hippocampal tail, controlling for IQ and age.
  - Chronology in prompted recall was also positively correlated to the volume of the right hippocampal tail.



$r(60) = .288$, $p < .05$

- Children's ability to report the meaning and resolution, Theme, of an autobiographical event in free recall was positively correlated with volume of the left hippocampal head, controlling for IQ and age.



$r(60) = .272$, $p < .05$

DISCUSSION

- The results of the study revealed a relation between autobiographical memory and volume of hippocampal subregions.
  - Chronology was positively correlated with the volume of the right hippocampal tail.
  - Theme was positively correlated with the volume of the left hippocampal head.
- This is consistent with previous research and current theories/models on long-axis specialization along the hippocampus Poppenk et. al. (2013).
  - Coarse, global representations of memory in the anterior hippocampus transitions to fine-grained, local representations in the posterior hippocampus
    - Chronology encompasses fine-grained, local representations of the event, which is associated with the posterior hippocampus.
    - Autobiographical details about general and lifetime events, which confer meaning, Theme, is more associated with the anterior hippocampus.
- Future research should adapt the coding manual to observe if there is a correlation between context and the volume of hippocampal subregions.

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