Associations between item-location binding and hippocampal subregions in 4- to 8-year-old children

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Introduction

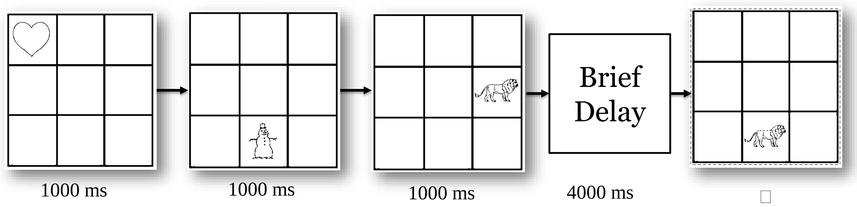
- Memory requiring the binding of contextual details relies on the hippocampus (e.g., Eichenbaum et al., 2007).
- Research indicates marked improvement in binding from middle childhood through young adulthood (e.g., Lorsbach & Reimer 2005) that may result from development of the hippocampus (e.g., Lee et al., 2016).
  - Although age-related differences in these associations exist across the longitudinal axis (e.g., DeMaster et al., 2013; Riggins et al., 2015).
- Relations between binding and hippocampal volume during early childhood remains unexplored.
- **Purpose:** Examine relations between hippocampal volumes and item-location binding in children ages 4-8 years.

Methods

Participants

- 200 children, 4-8 years (M_{age}= 6.21 years, SD=0.107) participated as part of a larger longitudinal study examining the development of episodic memory.
- 186 children provided useable behavioral and neuroimaging data
- "Young" and "Old" age groups were formed using a median split.

Behavioral Memory Measure

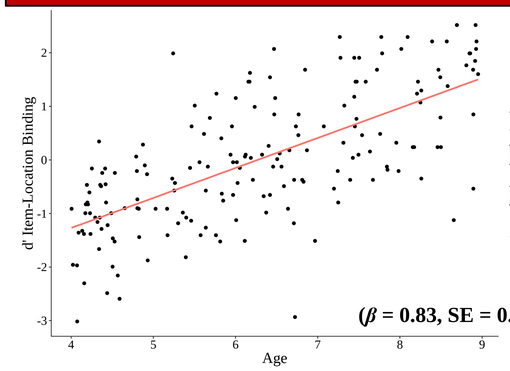


- Three black-and-white common object line drawings shown successively in three different locations on a 3 × 3 grid.
- Participants were tested on their memory for an item's location after a 4 second interval.
- Test items were displayed until the participant gave a "yes"/"no" response (Lorsbach & Reimer, 2005).
- Performance was measured using d` (Snodgrass & Corwin, 1988).

Structural MRI Data

- A T1-weighted structural MRI scan (.9 mm^3) was obtained using a Siemens 3T scanner with a 32-channel coil one week later.
- Hippocampal volumes were extracted via Freesurfer v5.1 (Fischl, 2012) and adjusted using Automated Segmentation Adapter Tool (ASAT, Wang et al., 2011).
- Hippocampal subregions were defined using standard anatomical landmarks (Weiss et al., 2005; DeMaster et al., 2012; Riggins et al., 2015) and adjusted for ICV, age, and sex (Riggins et al., 2018).

Results: Age-Performance



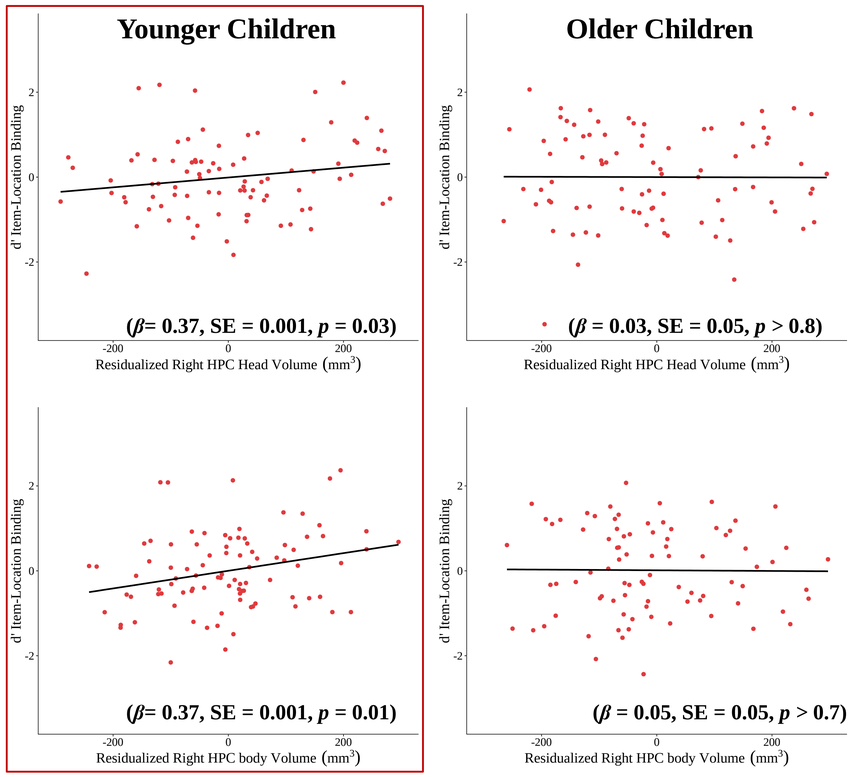
Performance on the item-location binding task was predicted by age controlling gender

Results: Brain-Age

- Positive relations were observed between age and hippocampal head volume in both right (β =0.29, SE = 13.52, $p < 0.01$) and left (β =0.34, SE = 13.46, $p < 0.01$) hemispheres, left tail (β = 0.15, SE = 8.01, p = 0.042), and right body (β= 0.137, SE = 9.21, p > 0.06) after accounting for gender.

Results: Brain-Performance

- d' was positively related to right hippocampal head volume and right hippocampal body volume in younger, but not older, children



Discussion

- This study is one of the first to examine relations between item-location binding and hippocampal subregion volume in early childhood (4-8 years).
- Results suggest relations between item-location binding and volume of right head and body of the hippocampus in younger but not older children.
  - These findings are consistent with previous reports that suggest age-related differences in relations between memory and hippocampal subregion volumes during development (e.g., Riggins et al., 2015).
- Future work will explore component parts of d', to explore whether relations in younger children are related to hits or false alarms (Lloyd et al., 2009)

Take-Home Message

Results suggest age-dependent relations between binding and hippocampal volume in early childhood.

References

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