Evidence for adult-like hippocampal pattern similarity across shared contexts in early childhood

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Introduction

Hippocampus (HPC) supports discrimination between similar features of events

Overlapping events spark 'repulsion' or disambiguation in HPC representations and behavioral discrimination[1,2,3]

Hippocampal structure undergoes protracted development throughout childhood[4,5,6]

Behavioral data suggests that the ability to make similar representations distinct develops late in childhood[7]

There is a developmental transition from primarily extracting generalized knowledge to specificity of events[7]

Functional development of HPC and other medial temporal lobe (MTL) regions remains unknown

How do representations of related experiences in MTL regions differ between childhood and young adulthood?

Methods

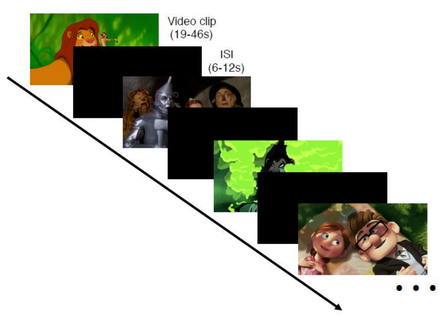
Adults (n = 20); age: 20 – 44 (*M* = 26.65)
Children (n = 25); age: 4 – 10 (*M* = 7.36)

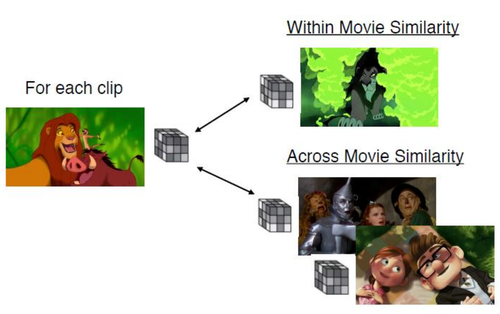
Watched 16 movie clips while in fMRI scanner (1 positive & 1 negative from each movie)
- Collapsed across valence for all analyses

Rated familiarity for each movie

Low familiarity:
- "never seen it"
- "seen only parts"

High familiarity:
- "seen it once or twice"
- "watch it often"

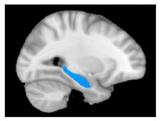




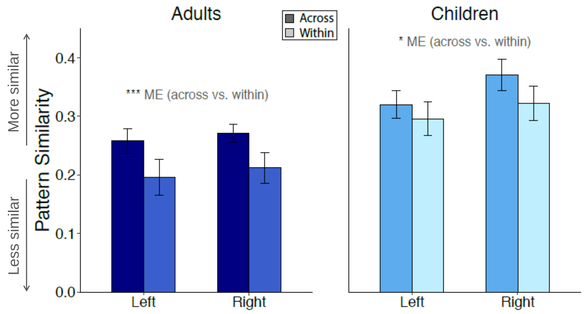
Representational Similarity Analysis (RSA) used to compare pattern similarity within (***related***) and across (***unrelated***) movies

Decreased pattern similarity for related (*within*) events

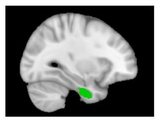
Hippocampus



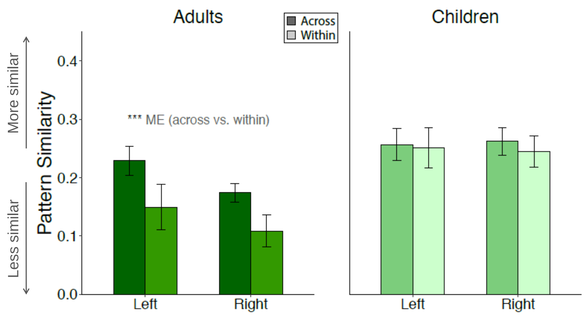
Less HPC pattern similarity to ***related*** movie clips in adults and children



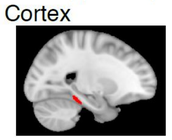
Perirhinal Cortex



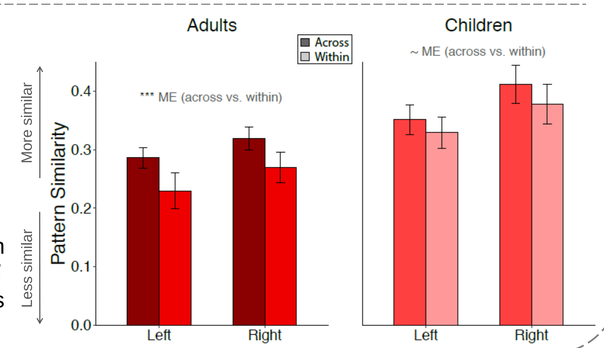
Less perirhinal cortex (PRC) pattern similarity to ***related*** movie clips only in adults



Parahippocampal Cortex

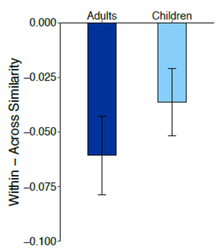


Less parahippocampal cortex (PHC) pattern similarity to ***related*** movie clips in adults and children



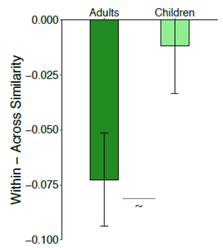
No age differences in HPC and PHC pattern similarity

Hippocampus



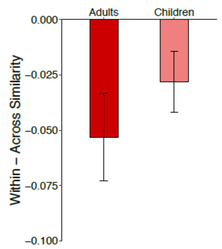
No age difference in HPC similarity

Perirhinal Cortex



Children show marginally ***less*** PRC similarity to ***related*** clips than adults

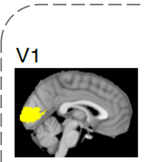
Parahippocampal Cortex

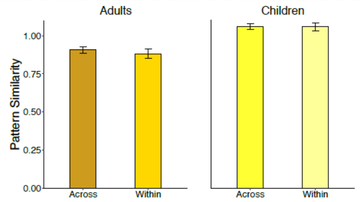


No age difference in PHC similarity

No changes in similarity across age in children in any region (all *p*'s > .49)

V1

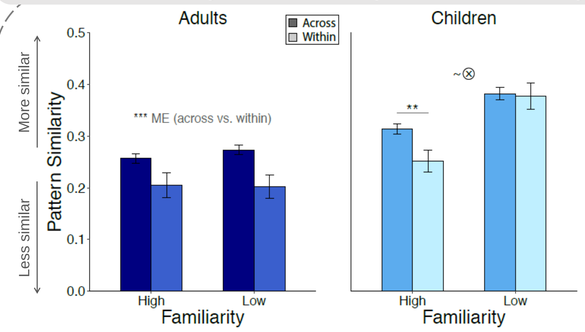




Pattern similarity differences to related and unrelated movie clips are ***MTL-specific***

~ $p < .1$
* $p < .05$
** $p < .01$
*** $p < .001$

Familiarity influences pattern similarity in children

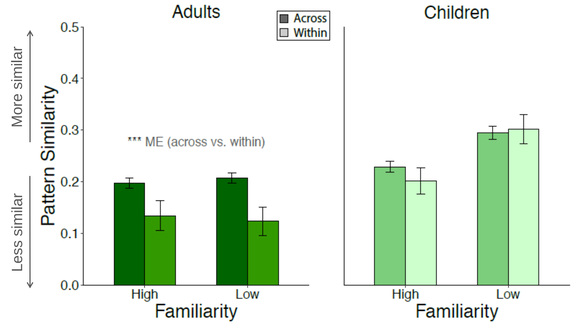


Hippocampus

Children show ***less*** HPC pattern similarity to ***related*** clips only when they are ***familiar*** with the movie

Perirhinal Cortex

Familiarity ***does not influence*** PRC pattern similarity in children or adults



Parahippocampal Cortex

Children show ***less*** PHC pattern similarity to ***related*** clips only when they are ***familiar*** with the movie

Discussion

Adults show less pattern similarity to related events across MTL regions, suggesting discrimination rather than integration of similar representations

Children show this pattern in HPC and PHC at an adult-like level only when they are highly familiar with the event

Evidence that some hippocampal mechanisms may reach adult-like levels in young children

Development of event representation discrimination in PHC may progress similarly to HPC

Pattern separation-like processes may develop earlier than expected but may not be fully mature until later in childhood; memory data is needed to confirm

References

1. Favila et al. (2016). *Nat Commun*. **2.** Chanales et al. (2017). *Curr Biol*. **3.** Chanales et al. (2020). *bioRxiv*. **4.** Pfluger et al. (1999). *Epilepsia*. **5.** Lavenex & Banta Lavenex. (2013). *Behav Brain Res*. **6.** Canada et al. (2019). *Cereb Cortex*. **7.** Keresztes et al. (2018). *Trends Cogn Sci*.