Electrophysiological correlates of intentional source memory retrieval in early childhood

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Introduction

Children's episodic memory abilities follow a protracted developmental trajectory.

Previous behavioral research suggests that there is large improvement in source memory between 5-7 years of age (e.g., Riggins, 2014).

Prior developmental cognitive electrophysiology work has demonstrated age-related difference in event-related potentials (ERPs) during *incidental* retrieval of source information in children between 3-6 years of age (Riggins & Rollins, 2015).

However, it remains unknown if age-related differences exists in ERPs during *intentional* retrieval of source information in early childhood. This question is important to address as recent research has shown important differences in the ERP response between incidental and intentional retrieval of source information during childhood (Robey & Riggins, 2015).

The goal of the current study is to address whether age-related differences exist in ERP responses during intentional retrieval of source information.

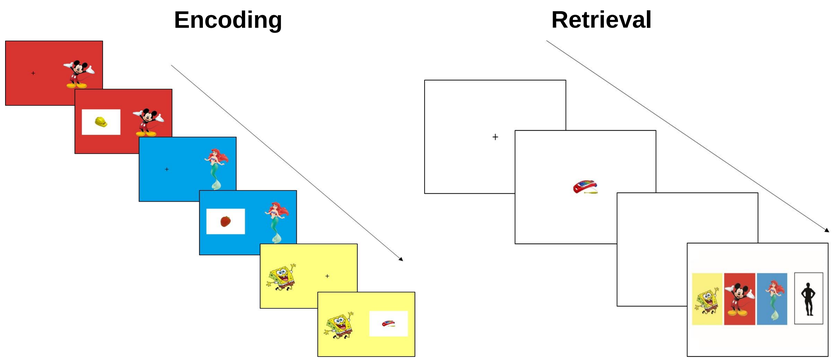
Methods

Participants

- N=49; 4- to 8-year-old children (M_{age}=5.53, SD_{age}=1.22) *n's vary across analyses
  - Two groups created using a median split (Mdn_{age}=5.14)
    - Young: n=24 (M_{age}=4.54, Range=4.02-5.07)
    - Old: n=25 (M_{age}=6.49, Range=5.20-8.29)

Procedure

- Item and source memory paradigm with encoding and retrieval phase.
- EEG recorded during retrieval with a sampling rate of 512 Hz (BioSemi Active 2) from 64 active Ag-AgCl scalp electrodes and two vertical and two horizontal electrooculogram (EOG) channels.
- ERP data utilized an average reference and was included if participants provided a minimum of 10 trials per condition.



*Repeated within each character "block" of 25 items

Encoding
Viewed 75 items paired with 1 of 3 sources and instructed to remember to which character each item belonged

Delay
~30 minute delay for capping

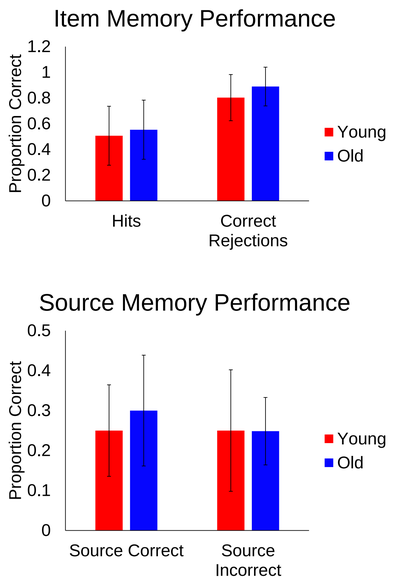
Retrieval
Viewed 75 old and 25 new items and made item/source memory judgements

Behavioral Results

Item Memory

- Differences were observed between the young and old groups in their ability to discriminate old items from new items, suggesting that older children performed better than younger children.
  - Young d'=-0.12, SD=0.97
  - Old d'=0.50, SD=1.11
  - $F(1, 47)$=4.30, p=.04

*This pattern was similar to that found in the subset of participants that provided useable ERP data.

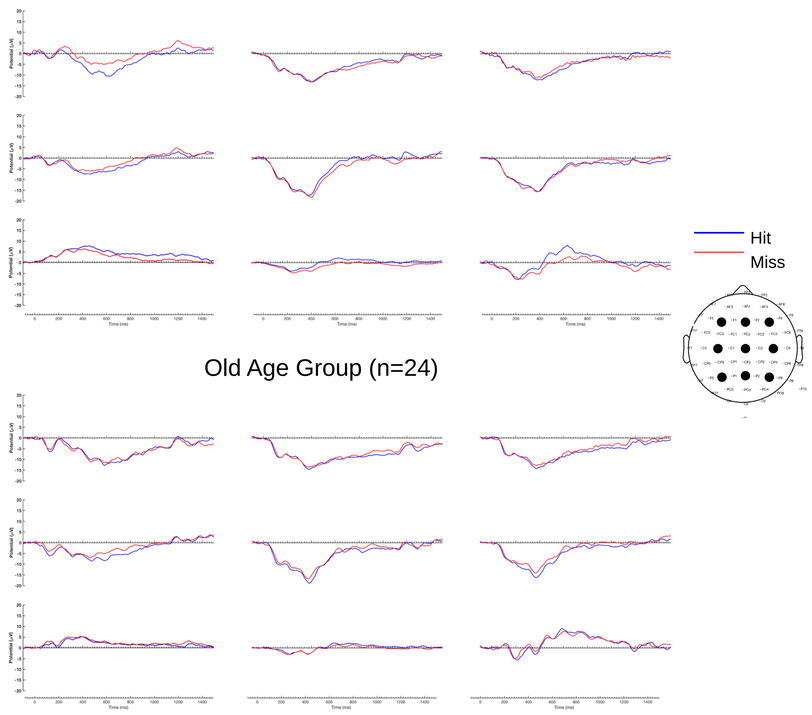


Source Memory

- Source memory was correlated with age across all participants ($R(1,47)$=0.29, p=.04).
- Differences in source memory, as indexed by source correct percentage, were not observed between age groups ($F(1,47)$=2.02, p=.16).

Item Memory ERP Results

Young Age Group (n=22)

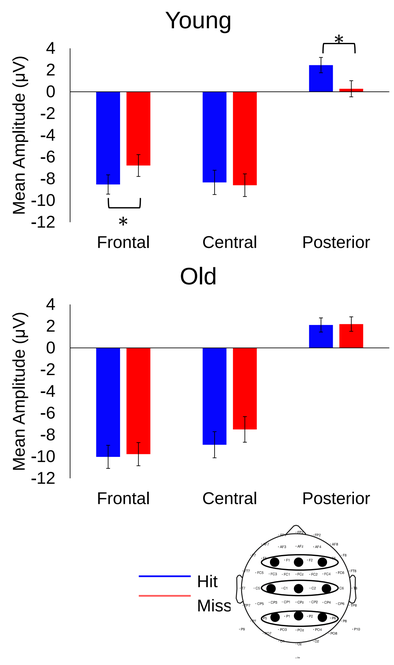


Old Age Group (n=24)

2 Condition (Hit, Miss) x 3 Coronal (Frontal, Central, Posterior) x 3 Sagittal (Left, Middle, Right) x 2 Age Group (Young, Old) RM-ANOVAs were conducted on averaged amplitudes in each time window.

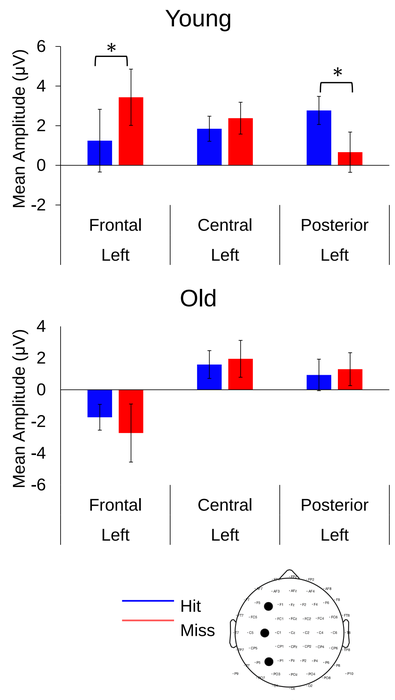
Hits are items correctly recalled as old. Misses are items incorrectly identified as new.

Negative Component (Nc; 250-700ms)



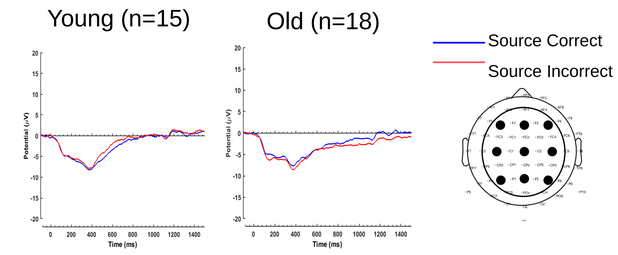
- Significant Condition x Coronal Plane x Age Group ($F(1,2)$=6.20, p=.003) interaction.
- Significant Condition x Coronal Plane interaction in younger group ($F(1,2)$=11.41, p<.001), but not in the older group($F(1, 2)$=1.64, p=.21).
- Main effect of Condition in the frontal region ($F(1,1)$=8.48, p=.008) and posterior region ($F(1,1)$=20.98, p<.001), but not the central region ($F(1,1)$=0.20, p=.66), in the younger group.

Late Slow Wave (LSW; 1100-1500 ms)



- Significant Condition x Coronal Plane x Sagittal Plane x Age Group interaction ($F(1,4)$=3.66, p=.008).
- Significant Condition x Coronal Plane x Age Group ($F(1,2)$=4.02, p=.02) interaction in left hemisphere.
- Driven by an interaction between Condition x Coronal Plane in the younger group ($F(1,2)$=4.22, p =.03).
- Main effect of Condition for LSW in the left posterior region ($F(1,1)$=5.22, p=.03), but not frontal ($F(1,1)$=2.95, p=.10) or middle ($F(1,1)$=0.31, p=.58) regions.

Source Memory ERP Results

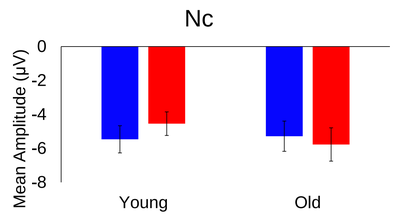


2 Condition (Source Correct, Source Incorrect) x 3 Coronal (Frontal, Central, Posterior) x 3 Sagittal (Left, Middle, Right) x 2 Age Group (Young, Old) RM-ANOVAs were conducted on averaged amplitudes in each time window.

Source correct items are items correctly recalled as old, and subsequently attributed to the correct source. Source incorrect items are items correctly recalled as old, and subsequently attributed to the wrong source.

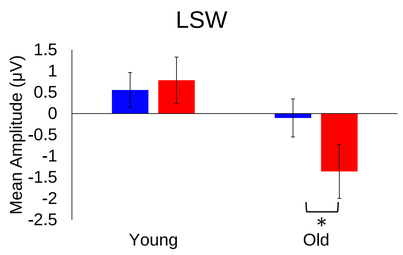
Negative Component (Nc; 250-700ms)

- Marginally significant Condition x Age Group ($F(1,1)$=3.26, p=.08) interaction.
- Follow-up testing did not yield significant results of Condition in either age group.



Late Slow Wave (LSW; 1100-1500 ms)

- Significant Condition x Age Group ($F(1,1)$=4.68, p=.04) interaction.
- Significant main effect of Condition in the older group ($F(1,1)$=9.12, p=.008), however this effect was not found in the younger group ($F(1,1)$=0.16, p=.69).



Discussion

Overall, in the younger group, brain activity (as measured by ERPs) differentiated between items that were correctly remembered versus subsequently forgotten. This is interesting because even when participants were engaged in an intentional source memory task (in which they were asked a source question following each item), recorded brain activity only differentiated between items they recognized as old versus those they labeled as new.

Comparatively, in the older group, brain activity did not differentiate between hits and misses, but instead differentiated between items recalled with the correct source (source correct) versus those items that were recalled but were attributed to the incorrect source (source incorrect).

These results are particularly interesting in light of the fact that source memory performance did not differ significantly between the younger and older groups. Despite similar levels of accuracy on the source memory portion of the task, the older group had a more specific response to items that were correctly recalled. This level of specificity in the older age group is consistent to what would be expected in adult responses (See Ghetti et al., 2010 for similar finding with fMRI in hippocampus).

Acknowledgements

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References

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