The role of recollection in source memory paradigms during early childhood: Evidence from event-related potentials

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Introduction

• Improvements in children's memory, particularly 3-6-years-olds stem from
1) increases in the ability to identify previously encountered items,
2) improvements in the ability to recalling contextual details associated with these items (e.g., location)
3) decreases in false recognition of new items as previously encountered (i.e., committing false alarms, FA)

• The adult literature has argued that recall-to-reject processing subserves the rejection of contextually associated novel items (Rotello & Heit, 2000). Thus, recollective processes which support memory for contextual details likely play a role in FA resistance (Yonelinas, 2002).

•In children and adults, FA rates are higher to novel items contextually associated with previously encountered items (Baker-Ward, Gordon, Ornstein, Larus, & Clubb, 1993; Lindsay, Johnson, & Kwon, 1991; Lloyd, Doydum, & Newcombe, 2009; Rotello & Heit, 2000).

•The aim of the current investigation was to use ERPs and behavior to examine how false alarms to contextually associated and unassociated items were related to memory for contextual details. We hypothesize that recollection underlies memory for contextual details and resistance to committing FA.

•We predicted a positive relation between children's resistance to committing false alarms and memory for a contextual detail (i.e., location). Additionally, we investigated whether individual differences in false alarms are related to the prevalence of episodic memory effects (EM) in the ERP waveform.

Methods

Participants

- Behavioral and ERP data were collected from **44 children** (22 boys and 22 girls, mean age = 5.6 ± .31 years, range = 5.04 - 6.43). Children were sorted into groups based on a median split of false alarm performance. Five children were excluded due to poor EEG quality, and 8 children were excluded because they fell on the median.
  - **16 participants in the high FA group** (M = 5.59 years, SD = .31, 8 males) and **15 participants in the low FA group** (M = 5.69 years, SD = .35, 7 males).
  - There were no age or gender differences between the high and low FA groups (ps > .05).

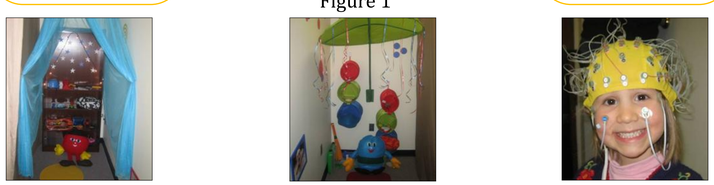
Behavioral Assessments

Session 1: Encoding
• 30 items in each location (See Fig. 1) performed with a typical action(e.g., read a book)
•Child was required to imitate the experimenter

Delay:
• 5 – 9 days
(M = 6.64, SD = .74)

Session 2: Retrieval
•ERPs
•Behavioral memory assessment
•60 previously viewed items and 30novel distracters
• Old/new
• Location

Figure 1



Event-Related Potentials (ERPs)

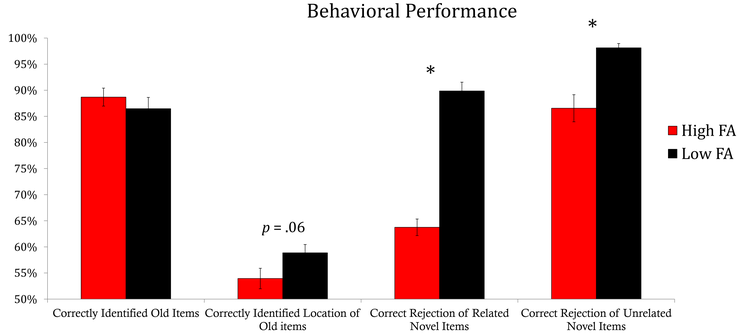
- EEG was recorded with a sampling rate of 512 Hz (BioSemi Active 2) from 64 active Ag-AgCl scalp electrodes and two vertical and two horizontal electrooculogram (EOG) channels.
- EEG data were re-referenced offline to the linked mastiod configuration using Brain Electrical Source Analysis (BESA) software (MEGIS Software GmbH, Gräfelfing, Germany).
- Ocular artifacts were corrected applying the Ille, Berg, & Scherg (2002) algorithm.
- ERPs were sorted based on memory performance on the behavioral paradigm. Conditions and their associated trial numbers included recollected items*(*High FA *M*=41; Low FA *M*=40), familiar *(*High FA *M*=31; Low FA *M*=25), and correctly rejected new items *(*High FA *M*=31; Low FA *M*=33).

Results

Behavioral Data

- Overall, children performed well on the task remembering the location of previously encountered items significantly more than chance t(30) = 4.76, $p < .01$.
- Children overall committed more false alarms to a larger proportion of associated (M = .24) than unassociated (M = .08) novel items, $t(30) = 6.48$, $p < .05$ (this effect was also present for each group separately).

Figure 2
Behavioral Performance



- The regression model below accounted for 30% of the variance associated with children's memory for contextual details, F(3, 27) = 3.865, p < .05.

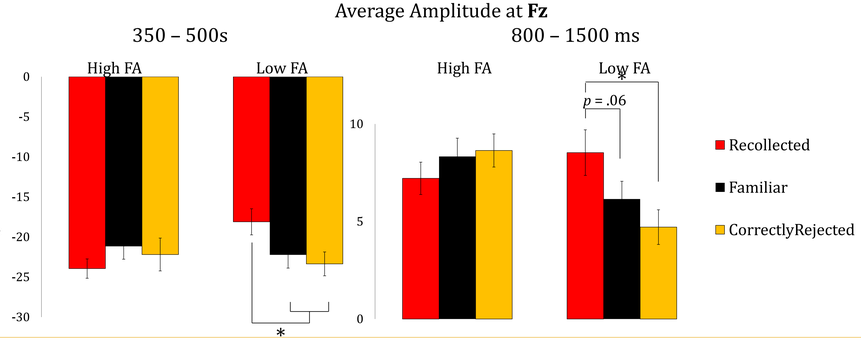
Variable	B	SE(B)	B	t	p
Old Percent Correct	.274	.159	.282	1.724	.096
Correct Rejection of Related Novel Items	.224	.091	.478	2.469	.02*
Correct Rejection of Unrelated Novel Items	.013	.12	.022	.112	.912

ERP Data

- Mean ERP amplitudes were assessed using repeated measures ANOVAs at midline (AFz, Fz, FCz, Cz, CPz, Pz) and lateral (F3/F4, C3/C4, P3/P4) electrode sites. No effects were lateralized so only midline results are presented.

- For the 350-500 ms window there was a Condition x Coronal Plane x Group interaction, $F(10, 290) = 3.22$, p < .01. No condition effects were present in the High FA Group. However, for the Low FA Group there was a significant main effect of Condition, , $F(2, 28) = 5.04$, p < .05. There was also a marginal Condition x Coronal Plane interaction , $F(10, 140) = 2.98$, p = .05. Follow-up analyses showed these effects were maximal over the frontal leads. For example, at Fz ERPs generated to recollected items (-18.1 μV) were more positive than familiar (-22.23 μV) and correctly rejected novel items (-23.36 μV).

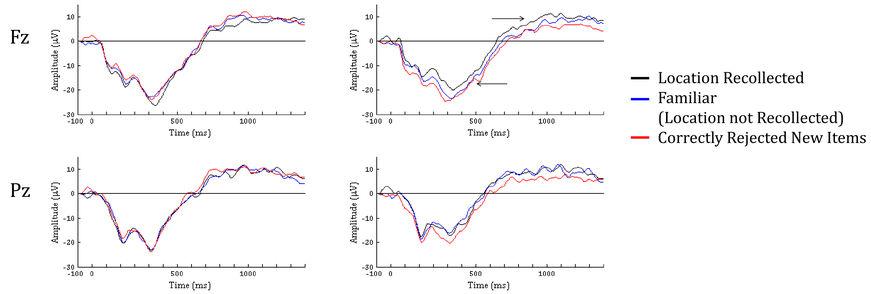
Figure 4
Average Amplitude at **Fz**



ERP Data cont.

- For the 800 – 1500 ms window there was a Condition x Group interaction, $F(2, 58) = 7.75$, p < .01. No condition effects were present in the High FA Group. However, for the Low FA Group there was a significant main effect of Condition, , $F(2, 28) = 7.33$, p < .01 ERPs generated to recollected items (9.4 μV) were more significantly more positive than correctly rejected novel items (5.51 μV), and amplitude to familiar items fell in between (7.74 μV).

Figure 3



Discussion

- False alarms and Recollection
  - The present results support recall-to-reject processing in childhood. Children were better able to reject novel items that were not associated with previously encountered items . Furthermore, children with more accurate recollective abilities (as indexed by higher memory for location) were better able to reject items associated with previously encountered items.
  - Future studies should use designs that allow for the assessment of ERP differences to recollected, familiar, novel, and falsely recognized items.
  - Studies could also assess ERP differences between associated/unassociated novel items to determine the neural correlates of recall-to-reject processing,

- Development
  - Future studies should investigate the relation between false recognition resistance and memory for contextual details across development, particularly between 3-6 years when children's memory for details shows a disproportionate increase compared to memory for individual items. Thus, rejection of unrelated novel items may show less of an increase in comparison to rejection of related novel items.

- Validity of Recall-to-Reject Paradigms
  - Paradigms that tap recall-to-reject processing in childhood may be as valid measures of recollection as source memory paradigms. Children committed some false alarms, but were still above chance at rejecting related novel items.

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