Development of Visual Working Memory in 13- to 16-month olds in an anticipatory looking task

Chen Cheng, Zsuzsa Kaldy, Erik Blaser
Developmental and Brain Sciences, University of Massachusetts Boston, Boston, MA

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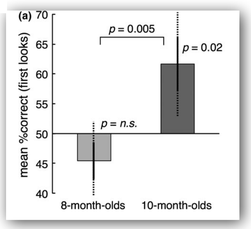
Research question

What factors drive developmental increases in visual working memory performance?

Background & Goal

We used the *Delayed Match Retrieval* (DMR) paradigm to assess VWM in the second year of life.



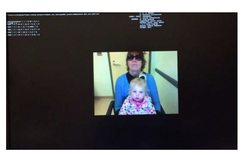
DMR has revealed VWM developmental from 8- to 10-months (Kaldy, Guillory & Blaser, 2015).

If there are developmental trends in this age range, how much of this is caused by increases in attention and task engagement, as opposed to an increase in memory capacity per se?

We address this through video coding of task engagement and pupillometry.
Task-evoked pupil responses reflect the 'intensive aspect' of attention (Kahneman, 1973; Laeng et al, 2012). This is true for children too, e.g. Blaser et al., (2012) showed that 2-year-olds with greater pupil responses did better in visual search.

Participants & Analyses

T120 Tobii Eye Tracker



Video Coding Interface

Participants
Younger: 13-14.1 months (N=13); *Older*: 14.5-16.5 mo (N=14). Only infants who completed 3 or more test trials were analyzed.

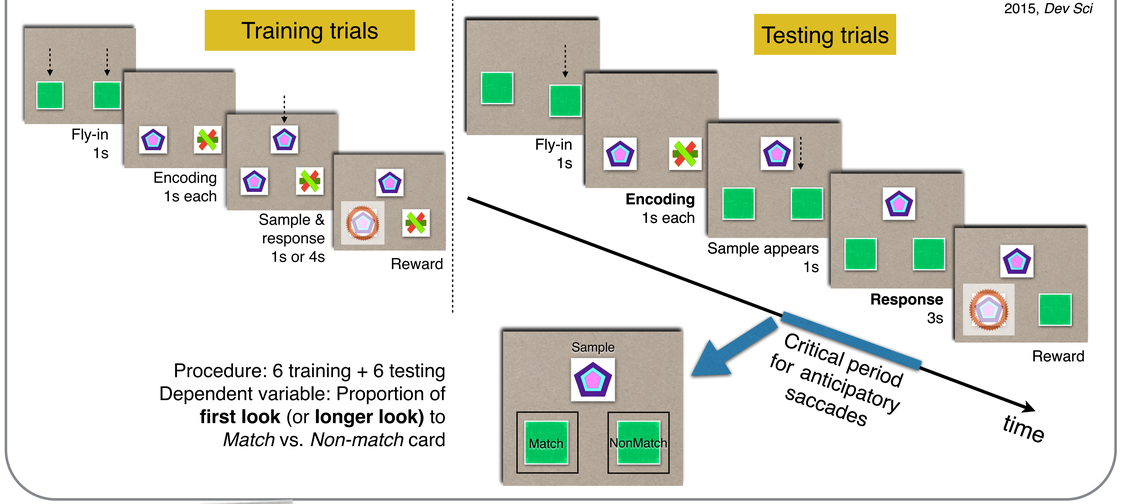
Video Coding of Engagement
Three coders tracked infants' behavior (blinded; without viewing eye trace or trial) and noted any disengagement.

Pupillometry
Pupil diameter was averaged between the two eyes, baseline corrected (tonic levels before each trial were subtracted out), and smoothed. Within and between participants, median phasic pupil responses for certain critical periods (e.g. *encoding*) were then calculated.

Methods

Delayed Match Retrieval (aka 'Memory Game')

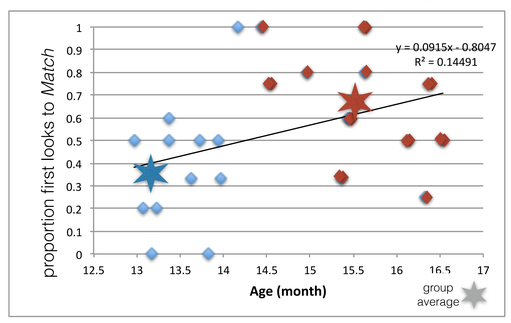
Kaldy, Guillory, & Blaser, 2015, *Dev Sci*



Procedure: 6 training + 6 testing
Dependent variable: Proportion of **first look** (or **longer look**) to *Match* vs. *Non-match* card

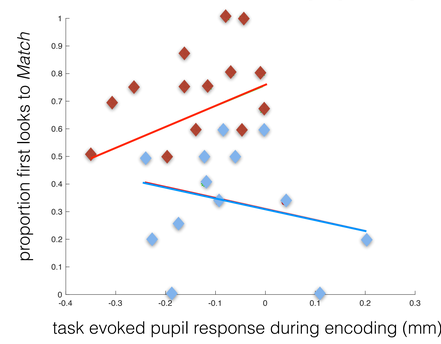
Results (Behavioral)

Performance as a function of age



Performance showed a significant developmental trend (r=0.45; p = .023). Overall, older children significantly outperformed younger based on both first look (F(1,26)=7.16, p =.013) and longer look (F(1,26) =5.2, p = .031).

Performance as a function of pupil response



Pupil response showed a positive correlation with performance in older (r=0.35; p=0.23) but not younger children (r=-0.26; p=0.40). A median split based on pupil response highlights the impact on performance: older children with higher than median pupils achieved 77% correct vs. 57% correct with lower than median pupils.

Performance as a function of engagement

There was no correlation found between disengagement (from video coding) vs. performance overall, or within age groups. In general, disengagement was rare (14% of trials) and short-lived (<2 s).

Discussion

15 month-olds had better performance in a *Delayed Match Retrieval* visual working memory task, compared with 13 month-olds.

There were no group differences on video coded measures of infants' engagement. Engagement was not correlated with performance.

A suggestive positive relationship was found between task evoked pupil response (a measure of effort and focused attention) and performance, but only in the older group.

Since the effort expended by older infants seemed to advantageously boost performance, but did not in younger infants, this may point to a difference in task understanding between groups, as opposed to a difference in overall effort or capacity per se.

Acknowledgement & Reference

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Blaser, E., Eglington, L., Carter, A. S., & Kaldy, Z. (2014). Pupillometry reveals a mechanism for the Autism Spectrum Disorder (ASD) advantage in visual tasks. *Scientific reports, 4.*
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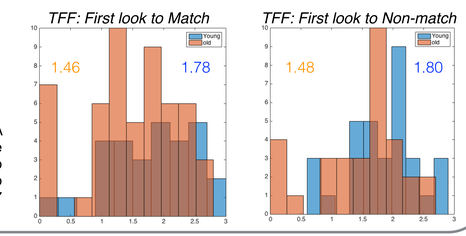
Kaldy, Z., Guillory, S. B., & Blaser, E. (2015). Delayed Match Retrieval: a novel anticipation-based visual working memory paradigm. *Developmental science.*
Laeng, B., Sirois, S., & Gredebäck, G. (2012). Pupillometry a window to the preconscious? *Perspectives on psychological science, 7(1), 18-27.*
For more info, please contact (chen.cheng001@umb.edu); or (erik.Blaser@umb.edu).

Comparison to Kaldy et al. (2015)

	Kaldy, Guillory, & Blaser, 2015, *Dev Sci*	Current Study
Age	8- and 10-mo	13- and 15-mo
Trial Number	4 training trials; 12 testing trials	6 training trials; 6 testing trials
Exposure time	2.5 s each; 1.5s face down	1s each;1s face down
Response time	4s	3s
Dependent Var	longer look; first look	longer look; first look



One-way ANOVA showed no significance in age groups (TFF to M: p = .115, TFF to NM: p=.137