Robust Visual Working Memory for object features in 2.5-year-olds

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Background

VWM precision increases over development, into later childhood (Burnett Heyes et al., 2012). Remembering multiple objects reduces VWM precision, in 18-month-olds (Zosh et al., 2012).

However, toddlers' VWM precision for multiple objects is not well understood.

Here, we manipulated the shared features (color or shape) and complexity of to-be-remembered objects in a Delayed Match Retrieval paradigm (Kaldy et al., 2016) in 2- to 3-year-old toddlers. In the task, toddlers were encouraged to look back to the *correct location* of the Match card. To succeed, toddlers need to remember ***object-location bindings.***

We had hypothesized that more complex, more similar objects would be more confusable, decreasing memory performance.

Method

Toddlers participated in two eye-tracking studies (Tobii T120).

Exp.1: UNIQUE OBJECTS

Stimuli

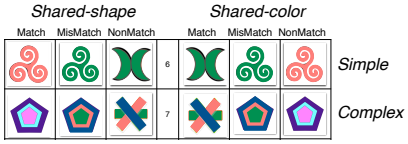
3 hard-to-name objects were presented as the memory set on each trial; one was a *Match* to the *Sample*, the other two were *NonMatch* cards.

Participants: *N=44, M_{age} = 30.3 m (range = 23.8 - 38.3 m)*

Exp.2: SHARED FEATURES

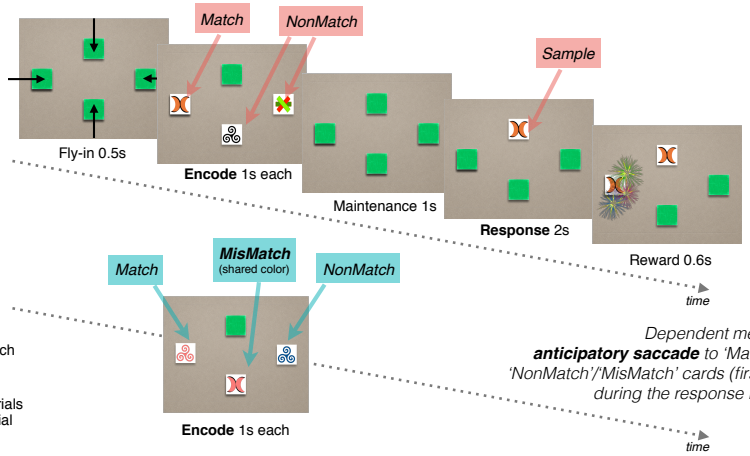
Exp. 2 was identical to Exp. 1, except that besides the *Match* and a *NonMatch*, there was now a '*MisMatch*' card which shared either color or shape with the Match. Also, objects varied in complexity.

Participants: N=52, M_{age} = 30.7 m (range = 24.5 - 37.8 m)



We compared:

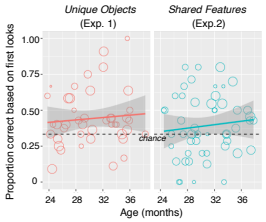
- MisMatch vs. NonMatch
- Shared-shape vs. Shared-color trials
- Simple vs. Complex trials
- Also, temporal & spatial location of the *Match*.



Dependent measure:
anticipatory saccade *to 'Match' vs. 'NonMatch'/'MisMatch' cards (first look) during the response interval*

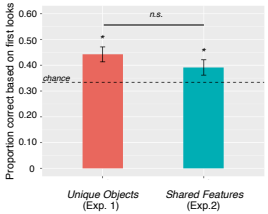
Results

Overall performance



No effect of age

Over this range, performance did not increase as a function of age with either *Unique objects* (Exp.1) or with *Shared-feature objects (Exp. 2)* ($p > 0.47$).

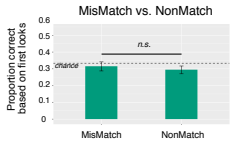


Toddlers were successful at 3-card DMR

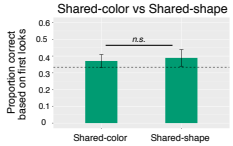
Toddlers' performance in both experiments was significantly above chance ($p < 0.001$; $p = 0.029$). Performance did not differ between the two experiments ($p = 0.22$).

Shared Features (Exp 2)

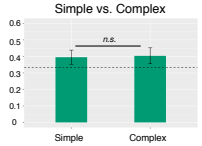
Memory performance was not affected by shared features or object complexity



We did not find a significant bias toward MisMatch vs. the NonMatch ($p = 0.61$).

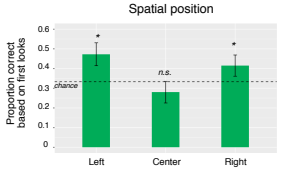


We did not see a difference in performance when the MisMatch shared its *shape* with the Match vs. sharing its *color* ($p = 0.77$).

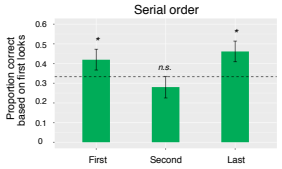


We did not find a significant difference with complex vs. simple objects ($p = 0.89$).

*Memory performance was affected by **spatial position** and **serial order** of the Match*



Toddlers performed better when the Match was shown *left* or *right*.



Toddlers showed a *primacy* and a *recency* effect.

Conclusion

- 2.5 year olds succeeded in a three-card Delayed Match Retrieval task.
- Contrary to our expectations, performance was not significantly impaired when objects in the memory set shared a feature (color or shape) or had increased complexity: memory precision seemed to be sufficient for object discrimination.
- Success in DMR requires remembering both *what* and *where* information. The robustness to feature-sharing/complexity, along with an observed spatial position bias, suggests that memory for *location* may be the limiting factor on performance.

Acknowledgement & References

This project was supported by NIH #1R15HD086658.

Burnett Heyes et al., 2012, Developmental Science
Kaldy et al., 2016, *Developmental Science*
Zosh et al., 2012, Journal of Experimental Child Psychology

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