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**

**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**

- **Stimuli**
  
  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.

**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 see a difference in performance when the MisMatch shared its shape with the Match vs. sharing its color (p = 0.77).

- **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.

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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