Comparing Working Memory Capacity for Sensory vs. Abstract Information

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Introduction

- **Performance on working memory (WM) tasks predicts individual differences in fluid intelligence (*Gf*)** (e.g., Kane et al., 2004).
- **N-back and complex span tasks are the most commonly used measures of WM, but are only weakly correlated with one another and account for unique variance in *Gf*** (Kane et al., 2007).
- **We hypothesize that n-back tasks rely more on the ability to derive and maintain abstract relations in WM than complex span tasks and that this differential involvement of abstract vs. sensory WM accounts for unique variance in *Gf* ability** (Carpenter, Just & Shell, 1990).

Questions of Interest

- **Do n-back tasks depend more on abstract WM, while complex span tasks depend more on sensory WM?**
- **Does abstract WM capacity predict *Gf* independent of sensory WM capacity?**

Methods

- Experiment 1:
  - N = 24 participants (10 male)
    - *M* age = 21, *SD* = 3.6
- Experiment 2:
  - N = 24 participants (8 male)
    - *M* age = 19.5, *SD* = 1.2
- Data Analysis:
  - Partial correlations were used to examine the relationship between abstract (Relation) and sensory (Item) WM and N-back, Symmetry Span, and BOMAT (*Gf*) performance

Complex Span Task

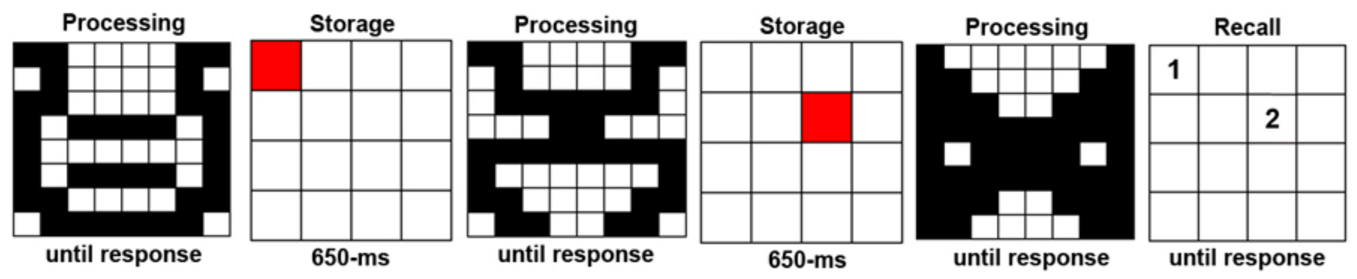


Figure 1. Example Symmetry Span trial. Participants were required to maintain the location and order of red squares, while performing an interleaved symmetry judgment task.

N-back Task

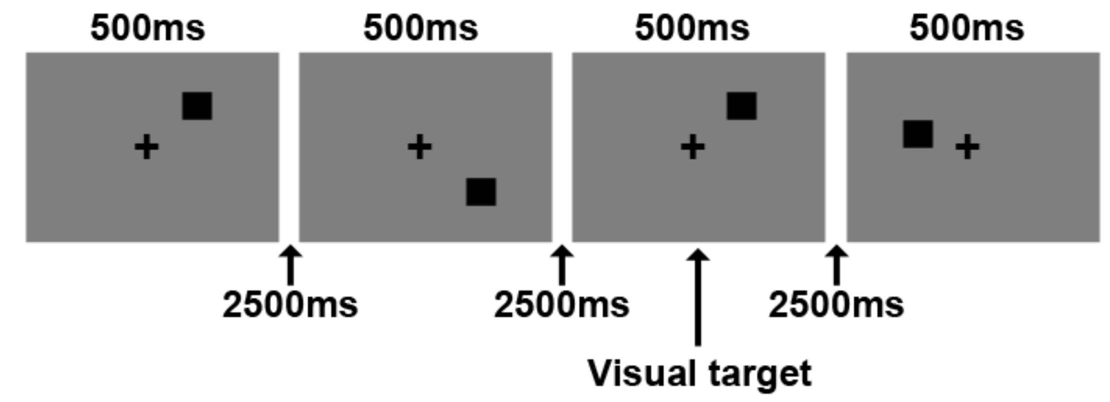


Figure 2. Example 2-back trial. Participants indicated if the current square was in the same location as the square 2 before.

Experiment 1: Abstract vs. Sensory Magnitude

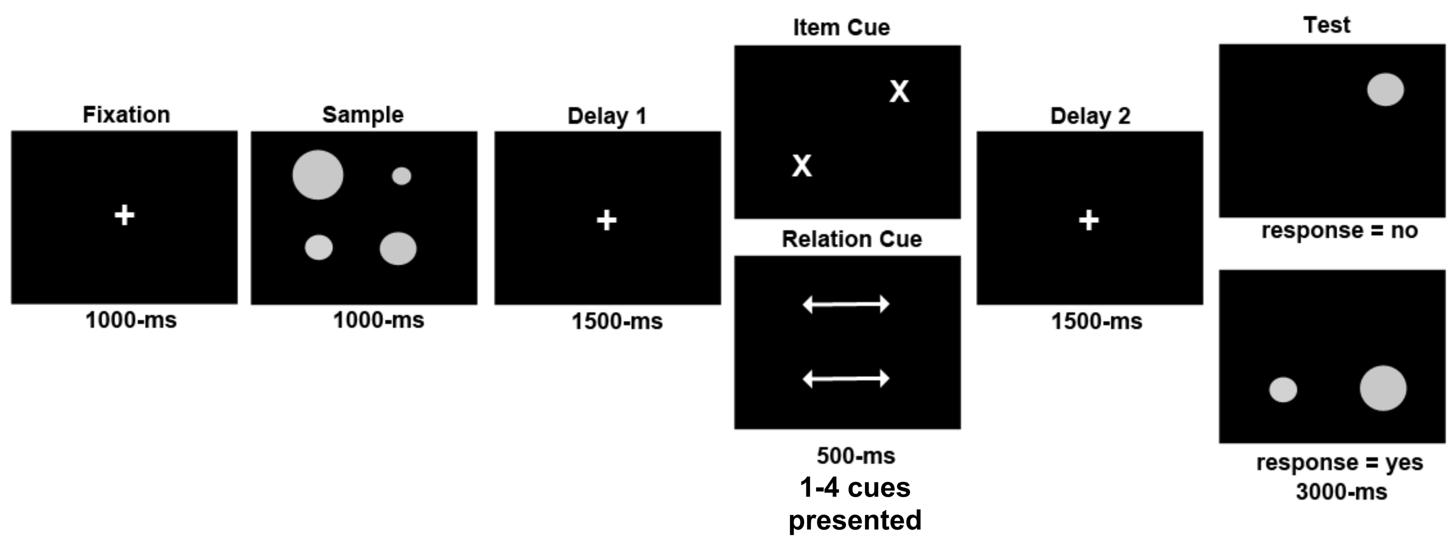
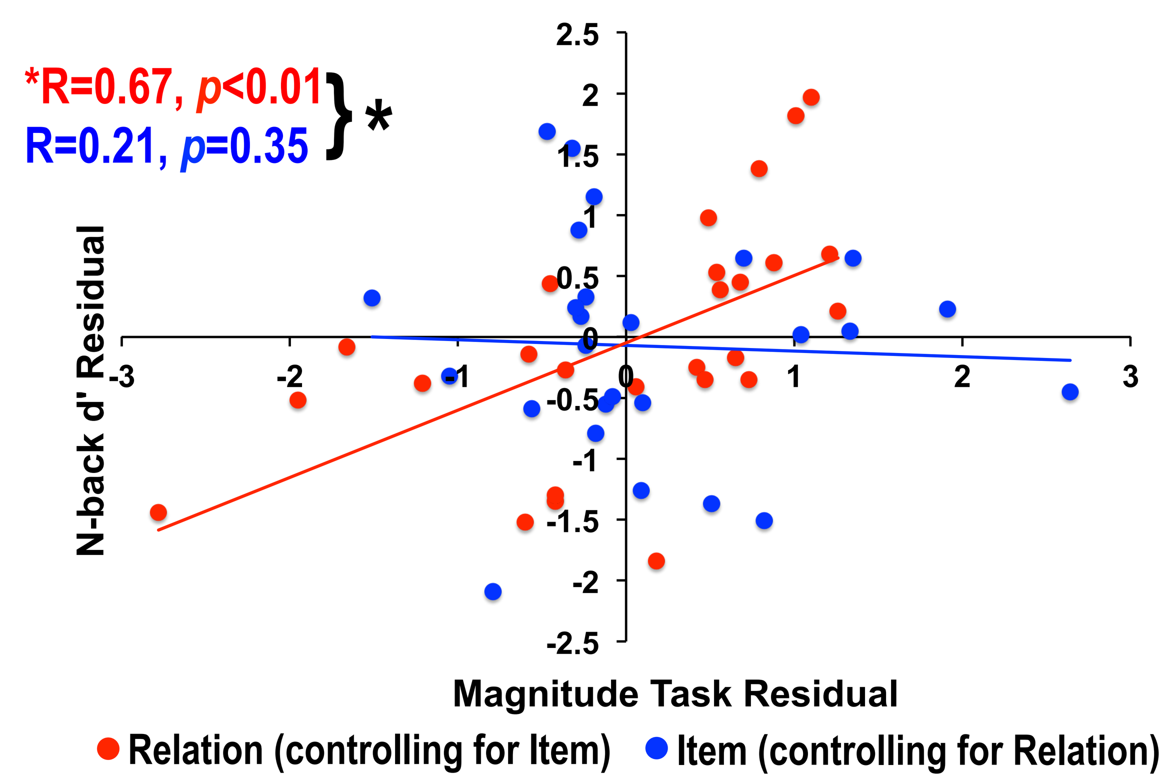
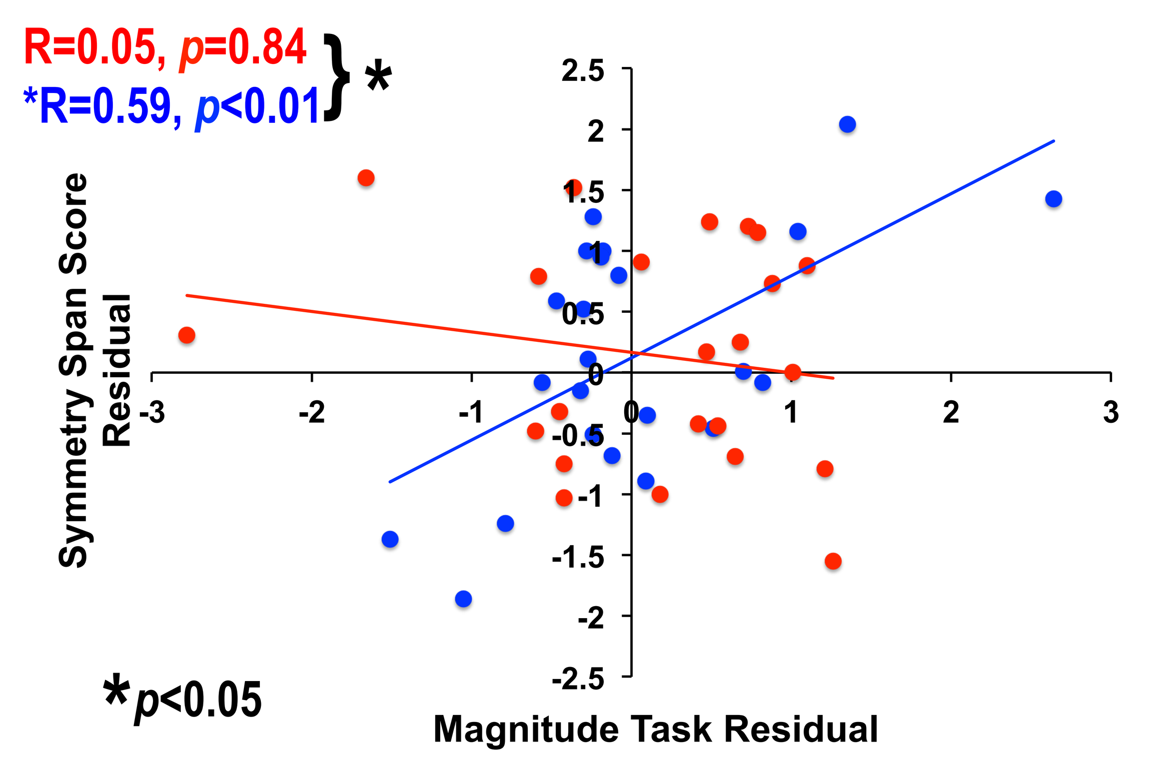


Figure 3. (Above) Participants encoded 4 circles and after an initial delay were cued to either maintain the absolute size(s) (Item) or the relative sizes of a pair(s) (Relation). **(Below)** Partial correlation plots showing that Relation, but not Item, accuracy correlated with n-back performance and Item, but not Relation, accuracy correlated with symmetry span score.





*$p<0.05$

Experiment 2: Abstract vs. Sensory Spatial

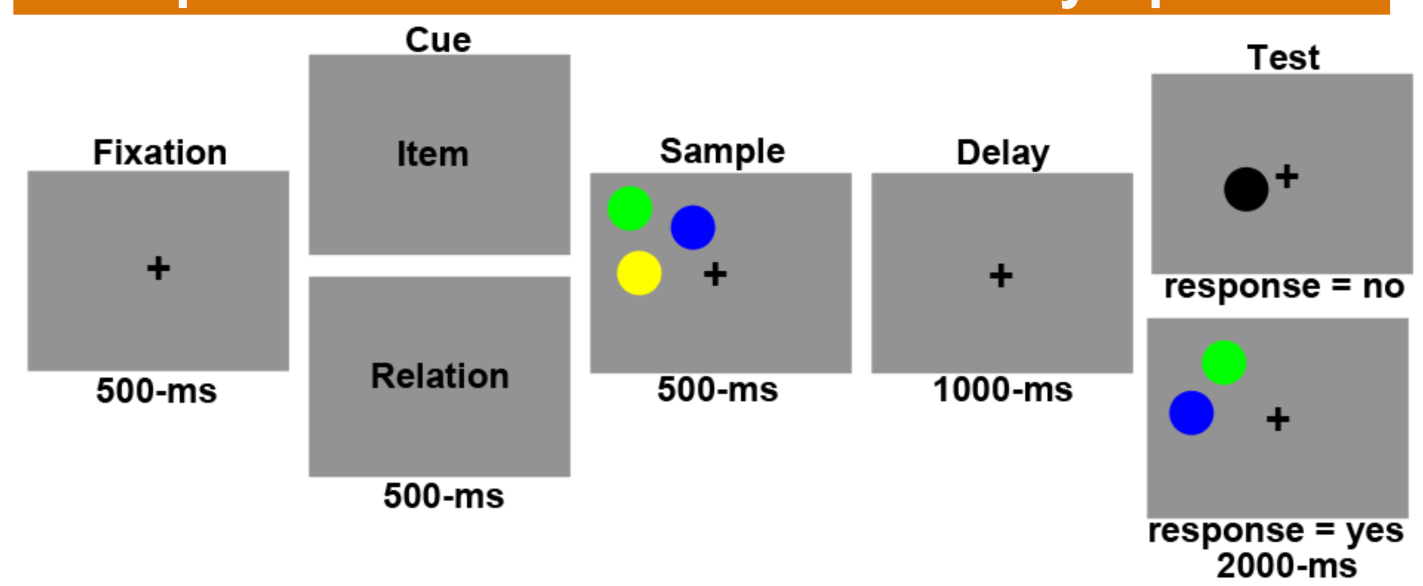
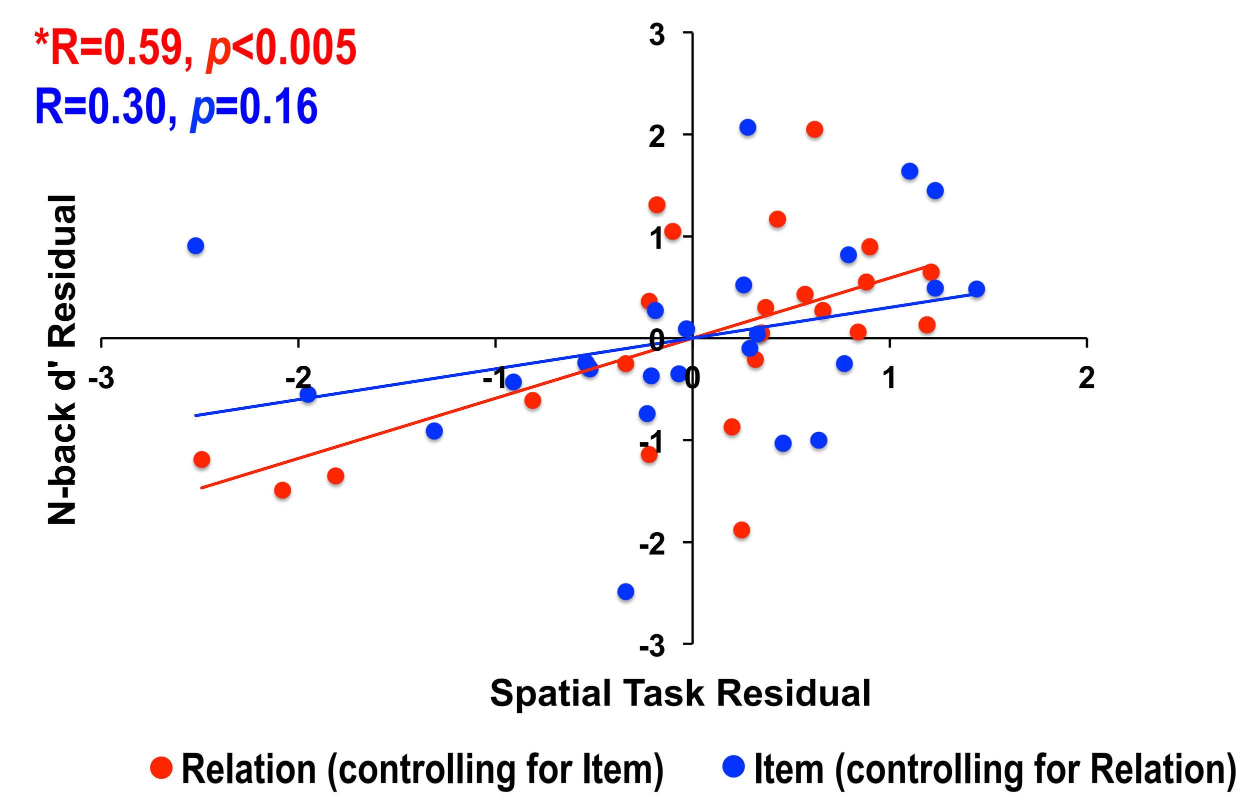
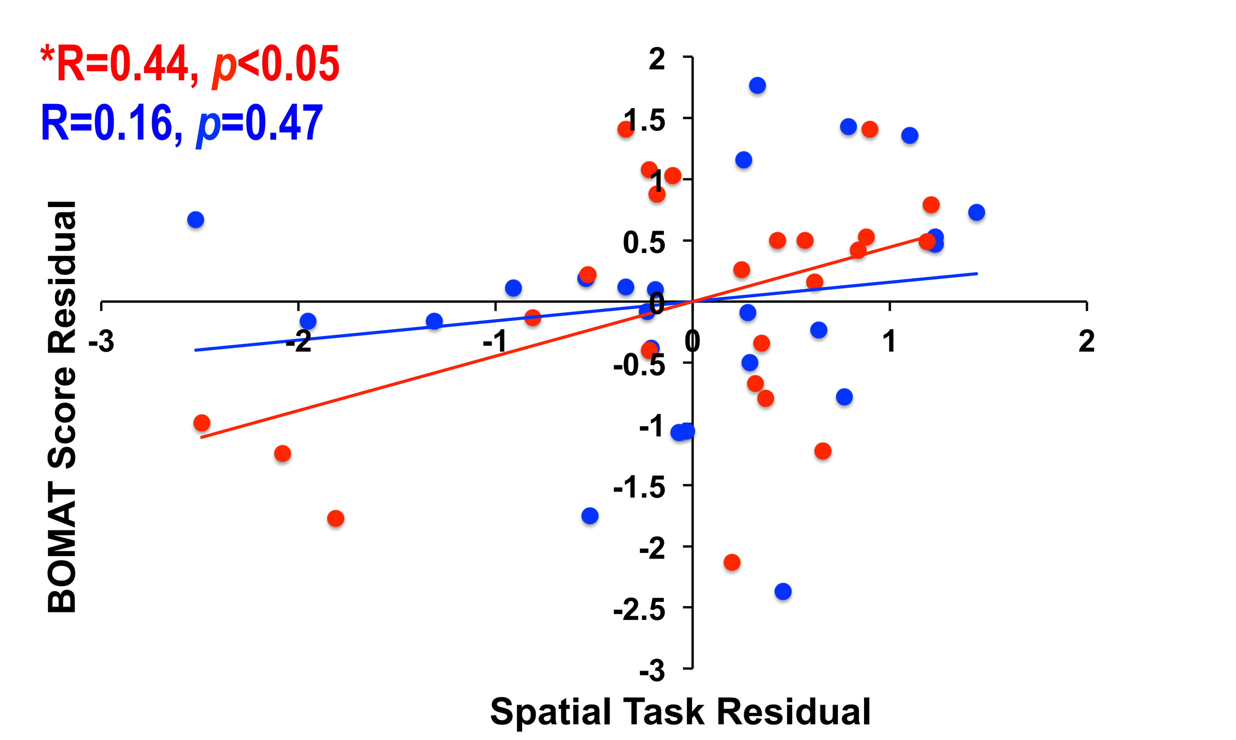


Figure 4. (Above) 3 vertical relationships *(Relation)* or 3 spatial locations (*Item*) were encoded from the sample and compared to a test array. **(Below)** Partial correlation plots showing a significant correlation between Relation, but not Item, accuracy and n-back performance. Relation, but not Item, accuracy was also correlated with *Gf*, as measured by the BOMAT. Symmetry span was not significantly correlated with Item or Relation in this Exp.





Results Summary

- **Both Experiments demonstrated that performance on our novel abstract WM task was significantly correlated with n-back performance, whereas sensory WM was not correlated with n-back.**
- **Exp 1 showed that sensory WM, but not abstract WM, performance was significantly correlated with complex span score.**
- **Exp 2 demonstrated that abstract WM performance also significantly correlated with a measure of *Gf*.**

Conclusions

- **N-back tasks may rely more on abstract WM, whereas complex span tasks may rely more on sensory WM.**
  - **This distinction may explain the unique portion of variance in *Gf* accounted for by these two WM tasks.**
- **Supports the notion that the ability to derive and maintain abstract relations in WM may underlie individual differences in *Gf*.**
  - **Has implications for the potential mechanism underlying previous results showing transfer effects from n-back to *Gf*** (e.g., Jaeggi et al., 2008).

References

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