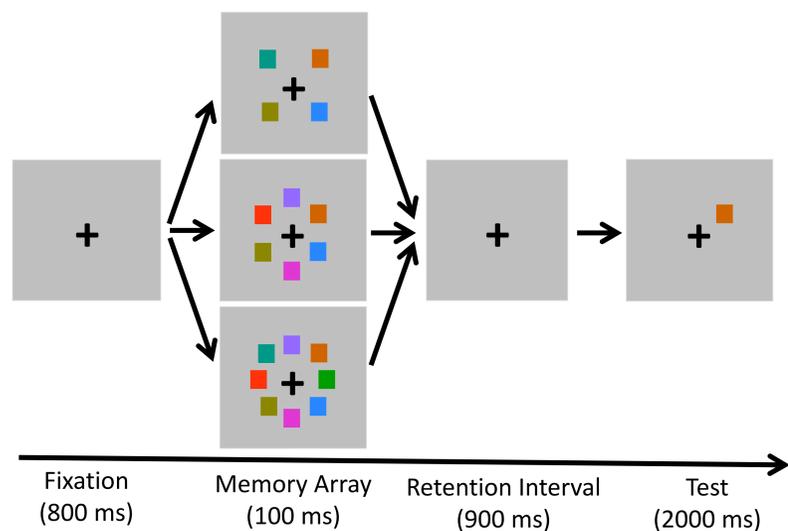


Introduction

Visual working memory (VWM) allows us temporarily hold images in our minds and manipulate them. As an example, you can remember a face you just saw, or try to imagine how a room would look with a different arrangement of furniture. Previous studies have shown that individuals with low VWM capacity (able to remember only a few visual items) are much more susceptible to distraction than high VWM individuals (e.g., Poole & Kane, 2009). Nevertheless, it is unclear whether their inability to avoid distraction occurs because their spatial attention is easily captured by distractions (**the capture hypothesis**) or because they have difficulty disengaging attention from distractions (**the disengagement hypothesis**). *The present study tested between these two hypotheses.*

VWM Measures

First, VWM capacity was measured for each participant with a change-detection task (see below). Either 4, 6, or 8 colored squares (the “setsize,” randomly selected on each trial) were shown for 100 ms. After a retention interval of 900 ms, participants were asked whether a colored square was the same as the one that appeared in that location earlier. We measured hit and false alarm rates.



Hit : Correctly identified the same-color square as “same”
False Alarm: Incorrectly identified a different-color square as “same”

K-Value: Followed Cowan (2001), we calculated K values as an index of VWM span and then classified each participant as high or low.

$$K = \text{setsize} \times (\text{Hit Rate} - \text{False Alarm Rate})$$

High VWM Group: K value > median value

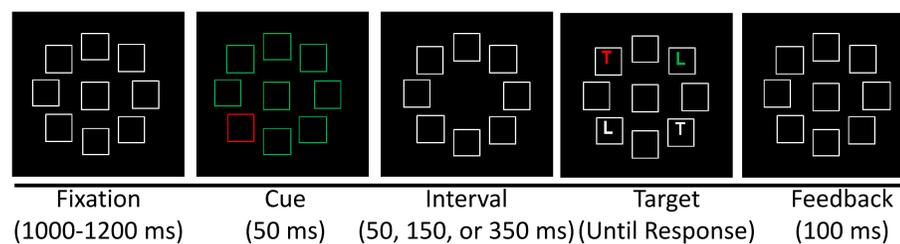
Low VWM Group: K value < median value

Capture vs. Disengagement

To measure each participant’s sensitivity to capture and their ability to disengage, we used a cuing paradigm. A cue display immediately preceded the target display. The interval between cue and target onset was 50, 150, or 350 ms, intermixed within blocks.

Cue Display: The cue was always a color singleton (a unique color), whose location was non-informative (25% valid vs. 75% invalid). Thus, there was no incentive to direct attention to them. The cue could contain the target color (relevant cue) or the distractor color (irrelevant cue), intermixed within blocks.

Target Display: Half of the participants identified the red letter (L or T), and the other half identified the green letter, then pressed the key labelled “L” or “T”.



Dependent Measures

Capture: Capture by an irrelevant cue was assessed by measuring the *cue validity effect*: whether response time (RT) was shorter when the target appeared in the same location as the cue (valid trials) than when it appeared in a different location (invalid trials).

$$\text{Cue Validity Effect} = \text{Invalid} - \text{Valid}$$

Disengagement Time: The time required to disengage attention from the cue was based on how the cue validity effect declined across all cue-target intervals.

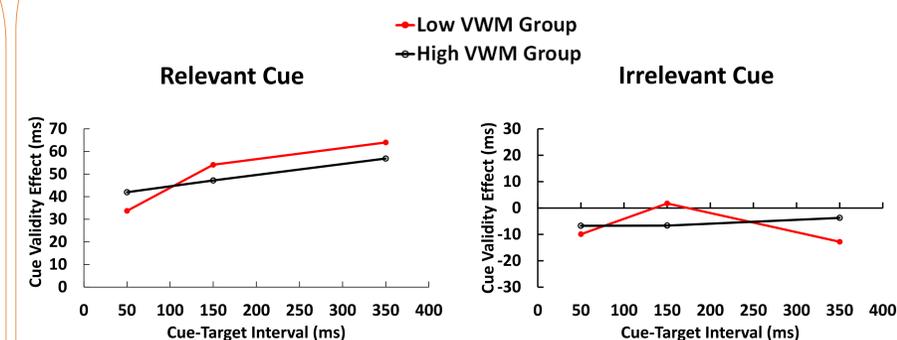
Predictions

The capture hypothesis predicts larger cue validity effects for the low VWM group than the high VWM group, especially for the irrelevant (non-target color) cue. The difference in cue validity effects between groups should be similar for all cue-target intervals (i.e., additivity).

The disengagement hypothesis predicts similar cue validity effects at short cue-target intervals for both high and low VWM groups, but the difference in cue validity effects between groups should increase as cue-target interval increases (i.e., underadditivity).

Results (N=30)

High VWM group N=15; Low VWM group N=15



The cue validity effect was large for the relevant cue (50 ms) but was negligible for the irrelevant cue (-6 ms), $F(1, 28)=36.87$, $p<.0001$. This finding supports the contingent capture view that attention capture is primarily driven by top-down goals (i.e., what you are currently looking for), not by stimulus salience (e.g., salient, unique objects).

For both relevant and irrelevant cues, the main effect of group was non-significant, $F_s<1.0$. The cue validity effect was similar for both groups across all cue-target intervals, $F_s<1.0$. Further analyses revealed no significant difference in cue validity effects between groups at each cue-target interval in each cue condition, $|t_s|<1.0$. These findings suggest that capture and disengagement were similar for low and high VWM individuals.

Discussion

We examined whether low VWM individuals are more susceptible to distraction than high VWM individuals and whether such susceptibility is due to inability to avoid capture or to the difficulty of disengagement. Not only did we find no evidence that low VWM individuals are more susceptible to capture by irrelevant objects, we also found no evidence that they have more difficulty disengaging from irrelevant cue locations. Overall, the present study suggests that VWM may not be the primary determinant of attention capture, contrary to some previous studies.

References:

- Cowan, N. (2001). The magical number 4 in short-term memory: A reconsideration of mental storage capacity. *Behavioral Brain Sciences*, 24, 87-114.
- Poole, B. J., & Kane, M. J. (2009). Working-memory capacity predicts the executive control of visual search among distractors: The influence of sustained and selective attention. *Quarterly Journal of Experimental Psychology*, 62, 1430-1454.
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