Memory-Based Attention Capture when Multiple Items Are Maintained in Visual Working Memory

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Abstract

Efficient visual search requires that attention is guided strategically to relevant objects, and most theories of visual search implement this function by means of a target template maintained in visual working memory (VWM). However, there is currently debate over the architecture of VWM-based attentional guidance. We contrasted a *single-item-template hypothesis* with a *multiple-item-template hypothesis*, which differ in their claims about structural limits on the interaction between VWM representations and perceptual selection. Recent evidence from van Moorselaar, Theeuwes, and Olivers (2014) indicated that memory-based capture during search—an index of VWM guidance—is not observed when memory set size is increased beyond a single item, suggesting that multiple items in VWM do not guide attention. In the present study, we maximized the overlap between multiple colors held in VWM and the colors of distractors in a search array. Reliable capture was observed when two colors were held in VWM and both colors were present as distractors, using both the original van Moorselaar et al. singleton-shape search task and a search task that required focal attention to array elements (gap location in outline square stimuli). In the latter task, memory-based capture was consistent with the simultaneous guidance of attention by multiple VWM representations.

Attention is biased toward objects that match the current contents of visual working memory (VWM) (e.g., Hollingworth, Matsukura, & Luck, 2013; Olivers, Meijer, & Theeuwes, 2006; Soto, Heinke, Humphreys, & Blanco, 2005). Although the relationship is well established, there is currently debate over the architecture of this interaction. According to the *single-item-template hypothesis* (Olivers, Peters, Houtkamp, & Roelfsema, 2011), multiple VWM representations can be maintained simultaneously in pre-frontal brain regions, but there exists a gating mechanism, such that only one of these items is capable of interacting with visual sensory processing to bias perceptual selection. In contrast, we have argued that multiple items in VWM can guide attention simultaneously (Beck, Hollingworth, & Luck, 2012). This *multiple-item-template hypothesis* derives from evidence that VWM maintenance depends on distributed activity within visual-sensory cortex (Harrison & Tong, 2009; Serences, Ester, Vogel, & Awh, 2009) for several remembered items (Emrich, Riggall, LaRocque, & Postle, 2013). If multiple representations are active in visual cortex, then it should be possible for them to guide selection simultaneously. Resolving this issue is critical for understanding the top-down processes supporting goal-directed vision, as almost all models of attention and visual search implement strategic guidance from a template representation maintained in VWM. In addition, it is critical for understanding the architecture of working memory more generally, with major theories distinguished by whether the “active” component of working memory is limited to a single item (Oberauer, 2002) or spans multiple items (Cowan, 1999).[1]

The issue was first tested by Beck et al. (2012). Participants searched for a target defined

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[1] Note that we do not claim that *all* items in VWM guide attention. There do indeed appear to be states of VWM that allow for accurate retention without direct effects on perceptual selection. For example, Hollingworth and Hwang (2013) showed that one of two colors, deprioritized for retention in VWM, failed to interact with perceptual selection, even on trials when a continuous report procedure confirmed that the color had been remembered accurately (see also van Moorselaar et al., 2014). Thus, the two views differ not in terms of the distinction between “active” and “passive” items in VWM, but rather in terms of the number of items that can be maintained in an active state that guides selection.

by two color values under instructions to search items in the two colors sequentially or simultaneously. In the sequential condition, there was a saccade latency cost associated with switching color templates. However, in the simultaneous condition, participants frequently shifted back and forth between colors, with no switch cost, suggesting that both colors controlled selection simultaneously. Recently, this topic was re-examined in a study by van Moorselaar et al. (2014), who probed the effect of VWM set size on guidance in a capture paradigm. Participants searched for a diamond target among circle distractors. One of the circle distractors was filled by a color, and this color sometimes matched a color held in VWM for a concurrent memory task. When memory set size was one, a VWM-matching distractor significantly impaired search, the standard VWM-based capture effect. However, when memory set size was greater than one, there was no reliable capture, which they interpreted as evidence that attention cannot be guided simultaneously by multiple VWM representations.

Although the van Moorselaar et al. (2014) results are inconsistent with the multiple-item-template hypothesis, they are also not predicted by the single-item-template hypothesis. In that view, as the number of items in VWM increases, the probability that the single colored distractor happens to match the single active template item will decrease, but not to zero; the capture effect should be reduced but not eliminated. Similarly, under the multiple-item template hypothessis, increasing memory set size will reduce memory quality for individual items (e.g, Bays & Husain, 2008), leading to less efficient guidance, potentially by reducing the proportion of neural resources in visual cortex availble to represent each item (Emrich et al., 2013). Given that both hypotheses predict attenuation rather than elimination of the capture effect with increasing memory set size, the results of van Moorselaar et al. pose something of a puzzle.

In the present study, we had two goals. First, we examined the same question as van

Moorselaar et al. (2014) but with modifications designed to maximize sensitivity to VWM-based capture. Second, we implemented a direct test of the single- versus multiple-item-template hypotheses. The design of the Experiment is illustrated in Figure 1. Participants first saw either one (*Mem-1*) or two (*Mem-2*) colored squares for the VWM task. Then, they searched for a target among distractors. Finally, memory was tested for one color. In the search array, there were either no colored items (*No color*) or two colored distractors. When there were two colored distractors, neither distractor (*Match-0*), one distractor (*Match-1*), or both distractors (*Match-2*) matched the color category of a remembered color. VWM-based capture was indexed by an increase in search response time (RT) for the Match-1 and Match-2 conditions relative to the Match-0 baseline, which controlled for the presence of colored distractors.

The critical modification from van Moorselaar et al. (2014) was the presentation of two colored distractors rather than one, which allowed us to maximize overlap between memory content and the distractors for memory-set-size 2. In addition, we limited the memory set sizes to one and two, which is sufficient to test competing predictions of the two hypotheses while supporting increased power. Finally, we implemented two different search tasks in two sub-experiments. In the first, the target was defined by gap location within outline-square stimuli. This task produces relatively inefficient search (slope >35ms/item) and robust VWM-based capture (Hollingworth & Hwang, 2013; Hollingworth & Maxcey-Richard, 2013). The second method was modeled on the singleton-shape task of van Moorselaar et al., allowing us to compare results across studies. We expected that the the former search task might be more sensitive to VWM-match effects given the need to direct attention focally to multiple array elements.

We tested the single- and multiple-item-template hypotheses by means of a comparison between the capture effects generated in two key conditions: Mem-1/Match-1 and Mem-2/Match-2. For memory-set-size one, there is clearly only one color in VWM that will interact with perceptual selection. For memory-set-size two, under the single-item-template hypothesis, there is also only one color that will interact with perceptual selection: whichever color is maintained in the active template state. Thus, the single-item-template hypothesis holds that there could never be a larger capture effect for Mem-2/Match-2 than for Mem-1/Match-1. In both cases, there would be one active template item and one distractor in the array matching that item. The capture effect for Mem-2/Match-2 could be larger than the effect for Mem-1/Match-1 only if both colors in VWM interacted with perceptual selection.

Method

Participants. Two groups of 24 University of Iowa undergraduates participated.

Stimuli and procedure. The trial events and timing for each of the two search tasks are displayed in Figure 1. The memory array contained one color square (Mem-1) or two color squares from different categories (Mem-2). There were four possible categories (red, green, blue, and yellow), and the specific color was chosen from three similar values within each category. CIE values are listed in the supplementary materials.

For the gap-location task, the target square (gap left/right) was displayed among seven distractors (gap top/bottom). For the singleton-shape task, the target (diamond) and seven distractors (circles) each contained a horizontally or vertically oriented bar, and participants reported bar orientation within the diamond.

In the No-Color condition, all search items were drawn in white. In all remaining conditions, two distractors were either drawn in color (gap-location task) or filled with color (singleton-shape task). Neither, one, or both of the colored distractors matched the category of a remembered item (Match-0, Match-1, and Match-2, respectively). When there was a color match in the search array, it was either exact or inexact. For inexact matches, the color was selected from the remaining two colors in the category. Inexact matches became the foil color in the test display. Thus, the color of a matching item provided no information relevant to the memory test response, thereby generating no incentive to selectively attend to matching items during search. None of the analyses of interest was influenced by exact/inexact match, and this factor was collapsed.

A single memory color was probed in a within-category test. One color alternative matched the memory color. The foil color was either the inexact match color in the search display or was selected from the remaining two values in the category.

Participants made a speeded left-right response to indicate the search target attribute (gap location, bar orientation) and an un-speeded left-right response to indicate the matching test color. Error feedback was provided for both responses. A search error led to immediate trial termination. Participants were informed that colored search items were never targets.

Participants completed one practice block implementing only the color-memory task (6 trials) and another implementing the full dual-task design (12 trials). There were two experiment blocks, with trials from the seven conditions randomly intermixed (Table 1 lists the distribution of trial types). For each trial, values on all other variables (e.g,, memory color, target location, target attribute, matching test-color location) were selected randomly.

Stimuli were presented on a 100-Hz LCD monitor at a viewing distance of 88 cm against a gray background with 0.33º-diameter fixation dot. Responses were collected with a button box. The experiment was controlled by E-prime software.

Results

Color memory accuracy was higher for Mem-1 than for Mem-2 in both sub-experiments [84.6% and 68.4% for gap-location, $t(23)=14.2, p<.001$; 81.7% and 65.7% for singleton-shape, $t(23)=11.5, p<.001$]. Search accuracy was near ceiling in both search tasks (gap-location=98.3%, singleton-shape=96.1%). Supplementary materials include a complete analysis of memory accuracy and search accuracy data.

The RT results for the gap-location and singleton-shape tasks are reported in Figures 2 and 3. As memory set size is increased, there will be a larger proportion of trials on which participants fail to maintain an accurate representation of one of the colors, reducing the opportunity for capture. Thus, we conducted the analyses over trials on which memory performance was correct, increasing the probability that the RT results reflected trials on which the matching color was retained accurately. Analyses over all trials produced the same pattern of results and are reported in the supplementary materials. RTs more than 2.5SD from a participant's mean in a condition were eliminated as outliers (gap-location=2.3%, singleton-shape=2.9%). For each memory set size, VWM-based capture was calculated as the RT difference between the baseline Match-0 condition and the Match-1 and Match-2 conditions, respectively.

Gap-location RT. For memory-set-size 1, there was a reliable memory-based capture effect for Match-1 of 68ms, $t(23)=4.27, p<.001$. For set-size 2, there were reliable memory-based capture effects both for Match-1 (44ms, $t(23)=2.30, p=.03$) and Match-2 (124ms, $t(23)=5.90, p<.001$). Thus, we found robust capture when participants maintained more than one color in VWM, in contrast with the results of van Moorselaar et al. (2014). Critically, the capture effect for Match-2 at set-size 2 (124ms) was larger than the capture effect for Match-1 at set-size 1 (68ms), $t(23)=2.36, p=.034$. As discussed in the Introduction, this indicates that multiple colors interacted with perceptual selection. Finally, for Match-1 trials, capture was not significantly greater for memory-set-size 1 (68) than for memory-set-size 2 (44 ms), *t*(23)=0.99,*p*=.35, although the numerical pattern was consistent with the attenuation of capture with increasing memory load, predicted by both hypotheses.[2]

Singleton-shape RT: For memory-set-size 1, there was a reliable memory-based capture effect for Match-1 of 58ms, *t*(23)=3.91,*p*<.001. For set-size 2, the memory-based capture effect was not significant for Match-1 (6ms, *t*(23)=0.37,*p*=.72), replicating van Moorselaar et al. (2014). However, there was a reliable capture effect for Match-2 at set-size 2 (51ms, *t*(23)=3.14,*p*=.005), consistent with the results from the gap-location task. There was no difference between the capture effect for Match-2 at set-size 2 (51ms) and Match-1 at set-size 1 (58ms), *t*(23)=0.37,*p*=.72. Finally, for Match-1 trials, capture was significantly greater for memory-set-size 1 (58ms) than for memory-set-size 2 (6 ms), *t*(23)=2.97,*p*=.007 (see also Soto, Greene, Chaudhary, & Rotshtein, 2012).

Discussion

Robust capture was observed when one color was maintained in VWM, consistent with many previous reports. The key data came for the memory-set-size 2 conditions. When two colors were maintained in VWM and there were two matching distractors, both search tasks produced robust VWM-based capture. Thus, increasing memory set size above one item does not

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[2] One notable feature of the gap-location results is the absence of capture generated by the mere presence of colored distractors: Searches were no slower in the Match-0 condition than in the No Color condition, for either memory-set-size 1, *t*(23)=1.34,*p*=.20, or memory-set-size 2, *t*(23)=1.09,*p*=.29. This could reflect the nature of the search task. Search for gap location depends on the maintenance of a specific target template and cannot be performed by monitoring for the presence of a singleton feature. That is, the task may have engaged feature-search mode, which has been shown to reduce the costs associated with salient distractors (e.g., Bacon & Egeth, 1994). In addition, the presence of two colored distractors may have reduced the salience of the colored items in the search display (they were not singletons, as in a standard additional singleton task). Of course, these factors clearly did not minimize the effects associated with memory match. In contrast, the singleton-shape task (Figure 3) produced a reliable effect of mere color presence, both for memory-set-size 1, *t*(23)=4.26,*p*<.001, and memory-set-size 2, *t*(23)=3.43,*p*=.002.

necessarily eliminate guidance from VWM. The key difference between our paradigm and van Moorselaar et al. (2014) was the inclusion of a condition with two matching distractors, allowing us maximize overlap between multiple items in VWM and the distractor colors in the search array. The importance of this difference is demonstrated clearly by the fact that, in the singleton-shape task modeled on van Moorselaar et al., reliable VWM-based capture was observed at set-size 2 when there were two matching distractors but not when there was only one matching distractor, with the latter null effect replicating the van Moorselaar et al. results.

In general, the gap-location task was more sensitive to VWM-based capture than the singleton-shape task. In the former, capture was observed at set-size two for *both* Match-2 and Match-1. Whereas the singleton-shape search can be conducted efficiently, an inefficient search task, such as gap-location discrimination, may introduce multiple opportunities for memory-based capture as attention is shifted to multiple items in the display. Although overall RTs in the two tasks were similar, a substantial proportion of RT in the singleton-shape task will have been devoted to discriminating line orientation after the target had been found. Whatever the nature of the differences between the search tasks, it is important to stress again that memory-based capture at set sizes greater than one can be observed using *either* task when the overlap between the memory colors and distractor colors is maximized.

An interesting feature of the capture results was the fact that for memory-set-size 2, the capture effect for Match-1 (partial match to the memory colors) was under-additive relative to the capture effect for Match-2 (full match to the memory colors). The pattern is reminiscent of under-additivity in priming effects for partial feature repetition in the object-file literature (Hommel, 1998; Kahneman, Treisman, & Gibbs, 1992) and, as in that literature, it is likely to reflect the storage of items in VWM as part of a composite representation. Items in VWM interact with each other (Lin & Luck, 2009), and information from multiple items is structured by higher-level representations of spatial configuration (Hollingworth, 2007; Jiang, Olson, & Chun, 2000) and ensemble statistical properties (Brady & Alvarez, 2011, 2015). Thus, the present results raise the intriguing possibility that capture by VWM content is not implemented solely at the level of individual features but is driven also by higher-level representations that integrate information from multiple items.

In the gap-location task, we observed results consistent with the simultaneous guidance of attention by multiple working memory representations. Mem-2/Match-2 produced greater capture than Mem-1/Match-1. Under the single-item-template hypothesis, Mem-2/Match-2 should be limited to a single active template color and thus a single functional match in the search display. Therefore, capture magnitude should not have exceeded capture magnitude in the Mem-1/Match-1 condition (also one active template item and one functional match). The results therefore indicate that both colors in VWM interacted with perceptual selection, consistent with the multiple-item-template hypothesis. This effect was not observed singleton-shape task. The reason is not entirely clear, except for the overall lower sensitivity to memory-based capture in that method. However, evidence for multiple-item guidance in a subset of tasks is sufficient to demonstrate that there is unlikely to be a hard architectural constraint on the number of VWM representations that interact with perceptual selection.

Although the present capture results support the multiple-item-template hypothesis, generally, we think this issue is better addressed in paradigms that probe attentional guidance directly rather than indirectly via capture. Capture paradigms, by design, are limited to guidance that that is contrary to observer intentions, and thus may not provide a comprehensive test of the capabilities of guidance mechanisms under normative conditions, when template representations are used to guide attention strategically to task-relevant objects. Two recent experiments using direct tests of guidance have provided results consistent with the multiple-item-template hypothesis. As reviewed in the Introduction, Beck et al. (2012) found that participants efficiently switched between two template colors during search, with no observable switch cost. Similar evidence was obtained by Grubert and Eimer (2014) in an event-related-potential design. The latency of the N2pc component was only minimally delayed when participants were forced to switch template colors compared with when they could apply the same template color across two searches, and this effect held when the target colors changed on each trial and VWM was needed to maintain the template representation (Grubert, Carlisle, & Eimer, 2015). In sum, the results from the present capture method and from methods probing the strategic deployment of attention provide converging support for the broad idea that the architecture of VWM guidance is not limited to a single template item. Instead, multiple VWM representations can interact simultaneously with perceptual selection.

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Tab1e 1. Distribution of trials in the seven conditions created by the combination of memory set size and distractor color match. Note that in each search task, the proportion of trials with colored distractors was equated, to a close approximation, between the two memory-set-size conditions. In addition, within each set-size condition, the probability of each of the match conditions was equated. Finally, the absolute number of trials in each match condition was equated across the two memory set sizes.

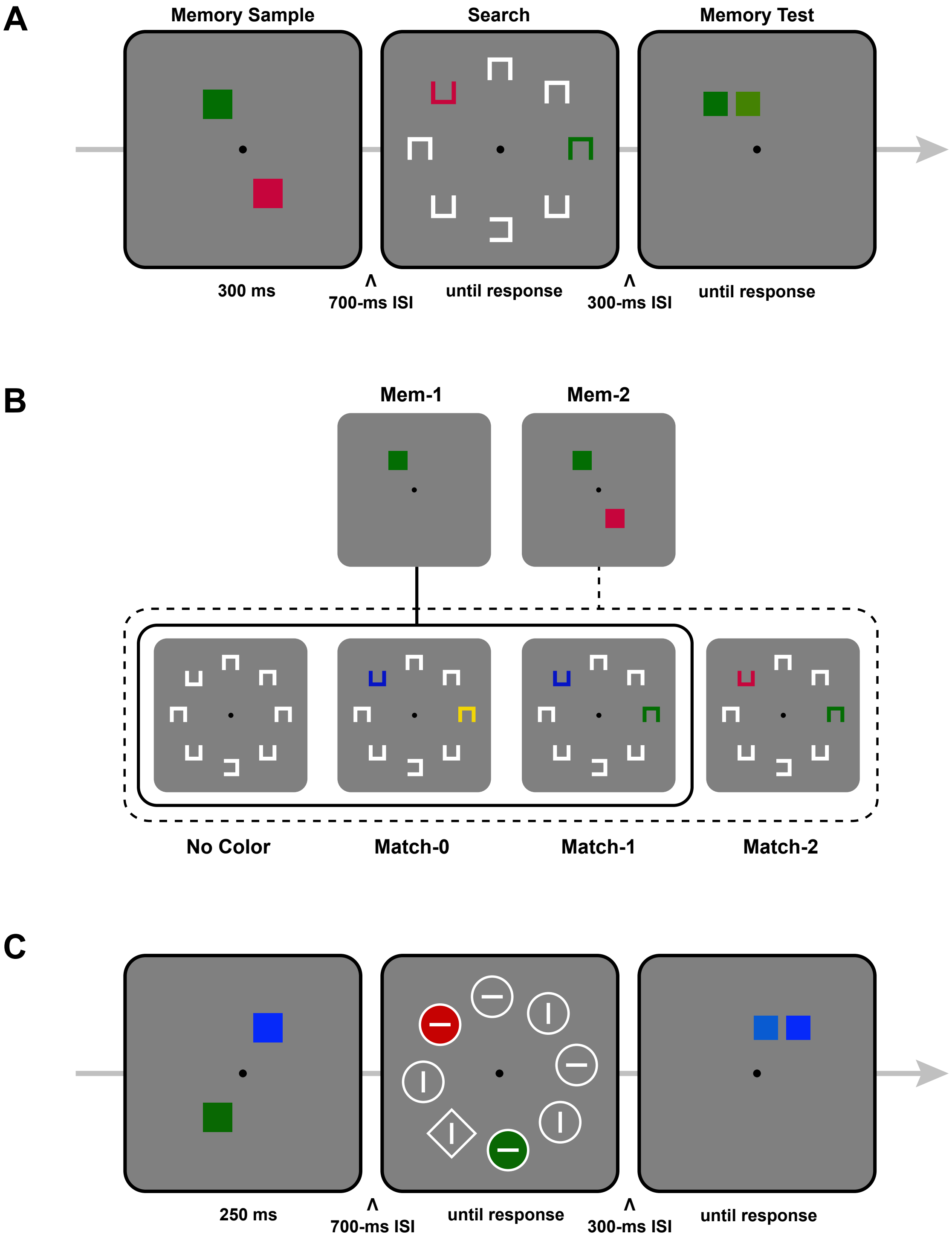
Memory Set Size	Distractor Color Match	Gap-location task	Singleton-shape task
One (Mem-1)		136 (40%)	154 (40.1%)
	No-Color	56 (42%)	58 (38%)
	Match-0	40 (29%)	48 (31%)
	Match-1	40 (29%)	48 (31%)
Two (Mem-2)		204 (60%)	230 (59.9%)
	No-Color	84 (41.2%)	86 (37%)
	Match-0	40 (19.6%)	48 (21%)
	Match-1	40 (19.6%)	48 (21%)
	Match-2	40 (19.6%)	48 (21%)
Total trials		340	384

Figure Captions

Figure 1. A) *Gap-location search task*. Participants began the trial by repeating aloud a set of four randomly chosen digits (not pictured) to suppress verbal encoding. After pressing a pacing button, there was a delay of 500 ms, followed by the depicted events. One or two color squares (1.32º X 1.32º) were presented in the memory sample display, with the first color location chosen randomly on a 2.34º-radius virtual circle and the second (if present) displayed opposite the first. The search array consisted of eight squares with one side missing (0.88º X 0.88º, 0.15º line width), distributed evenly on a virtual circle (radius 3.66º) with a random angular offset. Participants reported the gap location of the target (left/right) among distractors (top/bottom). The memory test contained two colored square alternatives (1.10º X 1.10º) presented 0.73º to the left and right of the original location of the corresponding memory square. **B)** Illustration of the seven conditions created by the combination of memory set size and distractor color match. **C)** *Singleton-shape search task*. The search array consisted of one outlined diamond (2.93º X 2.93º, 0.11º line width) and seven outlined circles (2.77º diameter, 0.11º line width) distributed evenly on a virtual circle (radius 5.22º) with a random angular offset. A horizontal or vertical white bar (0.18º X 1.28º) was presented in the center of each object, and participants reported the bar orientation for the target diamond

Figure 2. Mean correct reaction time for the gap-location search task as a function of memory set size and distractor match condition (* $p < .05$, ** $p < .01$, *** $p < .001$). Error bars are condition-specific, within-subject 95% confidence intervals (Morey, 2008).

Figure 3. Mean correct reaction time for the singleton-shape search task as a function of memory set size and distractor match condition (* $p < .05$, ** $p < .01$, *** $p < .001$). Error bars are condition-specific, within-subject 95% confidence intervals (Morey, 2008).



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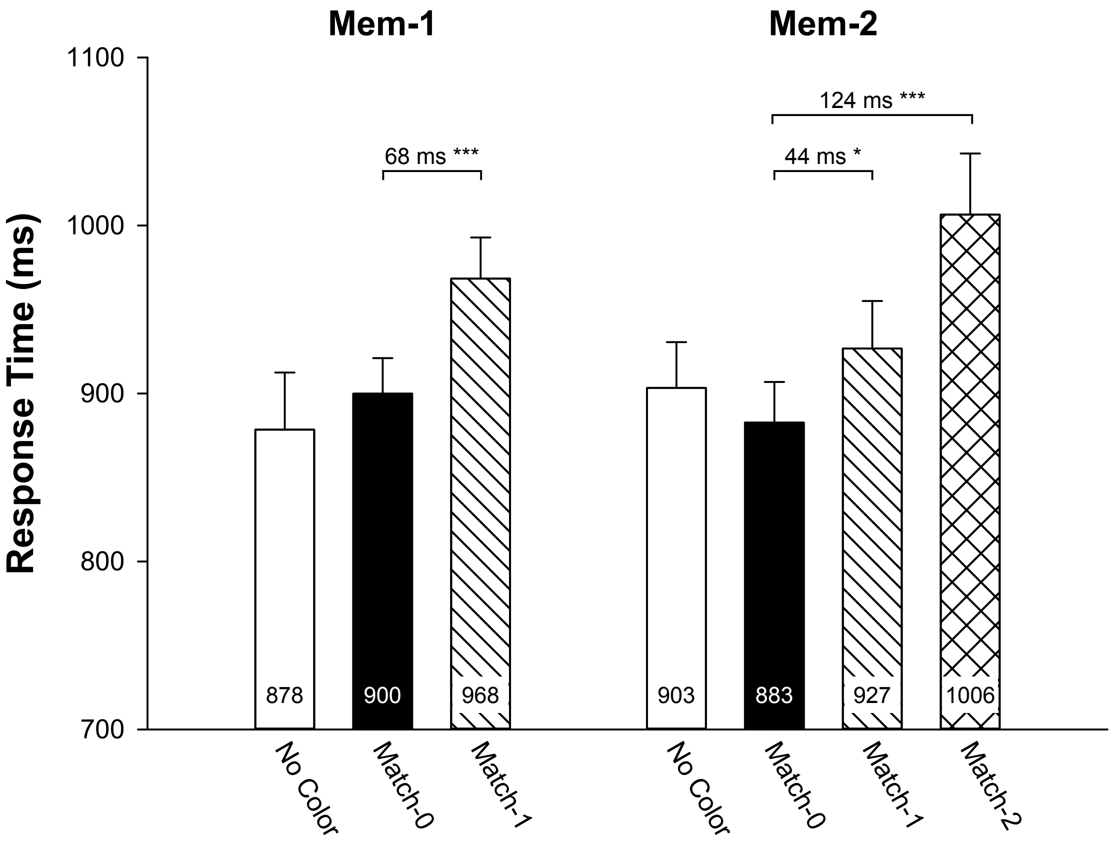

Figure 2. Mean correct reaction time for the gap-location search task as a function of memory set size and distractor match condition (* $p < .05$, ** $p < .01$, *** $p < .001$). Error bars are condition-specific, within-subject 95% confidence intervals (Morey, 2008).

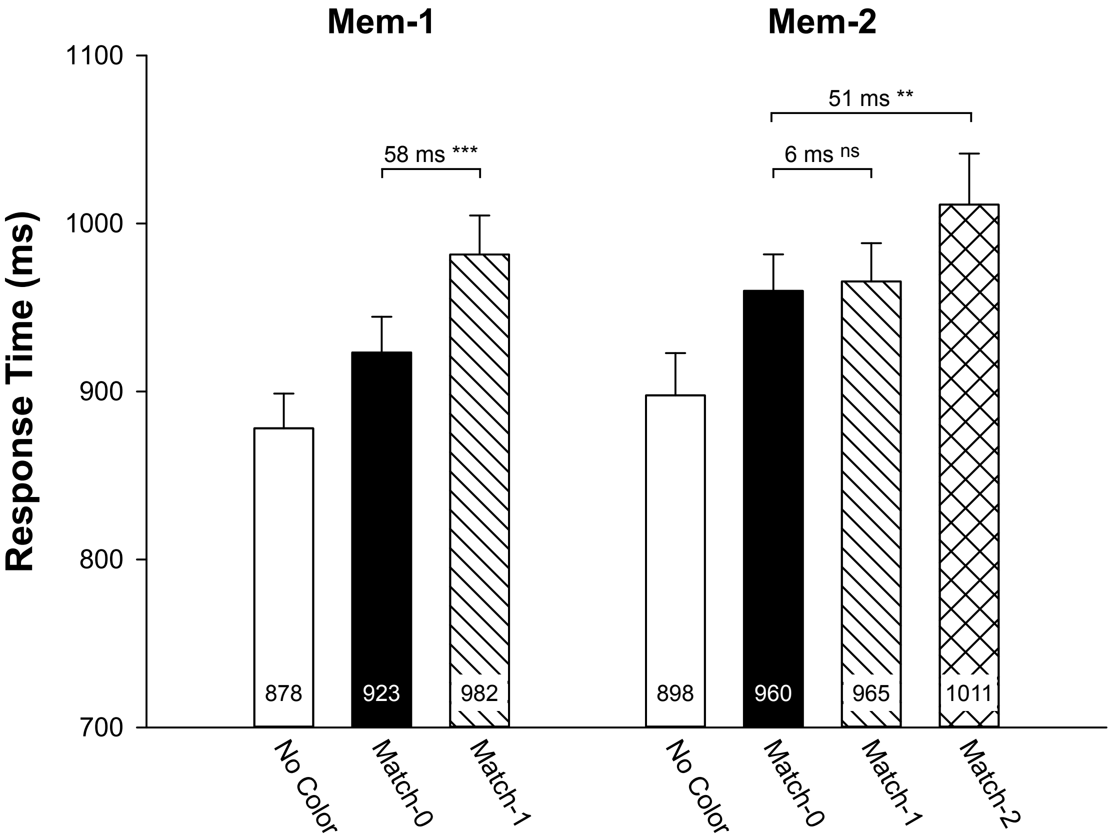

Figure 3. Mean correct reaction time for the singleton-shape search task as a function of memory set size and distractor match condition (* $p < .05$, ** $p < .01$, *** $p < .001$). Error bars are condition-specific, within-subject 95% confidence intervals (Morey, 2008).

Supplementary Materials

Methods

There were three color values in each of four color categories. The 1931 CIE color coordinate system values (x, y, and luminance) were measured using an X-rite I1 Pro spectrophotometer. The three reds were x = 0.63, y = 0.33, 48.1 cd/m^2; x = 0.60, y = 0.31, 22.8 cd/m^2; x = 0.62, y = 0.33, 31.3 cd/m^2. The three greens were x = 0.31, y = 0.60, 30.9 cd/m^2; x = 0.27, y = 0.45, 46.0 cd/m^2; x = 0.31, y = 0.61, 57.5 cd/m^2. The three blues were x = 0.17, y = 0.10, 53.5 cd/m^2; x = 0.15, y = 0.05, 28.5 cd/m^2; x = 0.17, y = 0.12, 28.4 cd/m^2. The three yellows were x = 0.39, y = 0.49, 170.3 cd/m^2; x = 0.42, y = 0.47, 152.0 cd/m^2; x = 0.38, y = 0.50, 147.5 cd/m^2.

Results

Gap-Location Task

Additional memory accuracy and search accuracy analyses. Within each memory set size, there was no reliable effect of memory match condition on memory accuracy [set-size 1: F<1, set-size 2: F(3,69)=2.12,p=.09]. The trend toward an effect of memory match for set-size two was driven by marginally lower accuracy in the match-2 condition. Note that because the search task was self-paced, conditions with longer search times also had longer memory retention times, which could account for this trend, as the match-2 condition had the longest search times. Accuracy on the search task was near ceiling (98.3%) and did not differ as a function of memory set size, t(23)=.36,p=.72. For set-size 1, there was a reliable effect of memory-match condition on search accuracy, F(2,46)=3.25,p=.05, although the absolute differences in performance were minimal (see Supplementary Table 1). For set-size 2, there was no effect of memory match on search accuracy, F<1.

Search RT analyses conducted over both correct and incorrect memory trials. The RT analyses including incorrect memory trials produced the same pattern of results as the analyses conducted over correct trials only. For memory set-size 1, there was a reliable memory-based capture effect for Match-1 of 72ms, *t*(23)=4.50,*p*< .001. For set-size 2, there were reliable memory-based capture effects both for match-1 (40 ms, *t*(23)=2.47,*p*=.03) and match-2 (111ms, *t*(23)=7.00,*p*<.001). The difference between Mem-2/Match-2 and Mem-1/Match-1 approached reliability, *t*(23)=1.93,*p*= .07. Finally, for Match-1 trials, capture was not significantly greater for memory-set-size 1 (72ms) than for memory-set-size 2 (40 ms), *t*(23)=1.48,*p*=.15, although the numerical pattern was consistent with the attenuation of capture with increasing memory load, predicted by both hypotheses.

Singleton-Shape Task

Additional memory accuracy and search accuracy analyses. For memory set-size 1, there was a reliable effect of memory-match condition on memory accuracy, *F*(2,46)=6.10,*p*=.004. Memory accuracy was higher in the no-color condition (84.9%) than in the match-0 (81.0%) and match-1 conditions (78.5%). As in the gap-location task, conditions with longer average search times had lower memory performance. For memory set-size 2, there was no effect of memory-match condition, *F*(3,69)=1.41,*p*=.25. Accuracy on the search task was 96.1% and did not differ as a function of memory set size, *t*(23)=1.74,*p*=.10. There was no effect of memory match on search accuracy at either set-size 1 or 2, *F*s<1.

Search RT analyses conducted over both correct and incorrect memory trials. The RT analyses including incorrect memory trials produced the same pattern of results as the analyses conducted over correct trails only. For memory set-size 1, there was a reliable memory-based capture effect for match-1 of 65ms, *t*(23)=3.97,*p*<.001. For set-size 2, there was no memory-based capture effect for match-1 (-1ms, *t*(23)=0.07,*p*=.94) but a reliable effect for match-2 (45 ms, *t*(23)=3.68,*p*=.001). Finally, the difference between Mem-2/Match-2 and Mem-1/Match-1 was not reliable, *t*(23)=1.46,*p*=.16. Finally, for Match-1 trials, capture was significantly greater for memory-set-size 1 (65ms) than for memory-set-size 2 (-1 ms), *t*(23)=3.56,*p*=.002.

Supplementary Tab1e 1. Mean color memory accuracy and search accuracy (percentages) in the seven conditions created by the combination of memory set size and distractor color match.

Memory Set Size	Distractor Color	Gap-location Task		Shape-singleton Task	
	Match	Memory Accuracy	Search Accuracy	Memory Accuracy	Search Accuracy
One (Mem-1)					
	No-Color	84.8	99.0	84.9	96.8
	Match-0	84.2	98.3	81.0	96.6
	Match-1	84.5	97.8	78.5	96.3
Two (Mem-2)					
	No-Color	69.5	98.4	66.4	96.3
	Match-0	68.0	97.9	66.2	95.9
	Match-1	69.5	98.3	63.2	95.2
	Match-2	65.1	98.5	66.8	95.3