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Visual short-term memory load strengthens selective attention

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Abstract

Perceptual load theory accounts for many attentional phenomena; however, its mechanism remains elusive because it invokes underspecified attentional resources. Recent dual-task evidence has revealed that a concurrent visual short-term memory (VSTM) load slows visual search and reduces contrast sensitivity, but it is unknown if a VSTM load also constricts attention in a canonical perceptual load task. If attentional selection draws upon VSTM resources, then distraction effects – which measure attentional 'spill-over' – will be reduced as competition for resources increases. Observers performed a low perceptual load flanker task during the delay period of a VSTM change detection task. We observed a reduction of the flanker effect in the perceptual load task as a function of increasing concurrent VSTM load. These findings were not due to perceptual level interactions between the physical displays of the two tasks. Our findings suggest that perceptual representations of distractor stimuli compete with the maintenance of visual representations held in memory. We conclude that access to VSTM determines the degree of attentional selectivity; when VSTM is not completely taxed, it is more likely for task-irrelevant items to be consolidated and consequently affect responses. The 'resources' hypothesized by load theory are at least partly mnemonic in nature due to the strong correspondence they share with VSTM capacity.

Complex visual scenes necessitate a mechanism to bias processing toward behaviorally relevant stimuli and away from irrelevant stimuli to successfully interact with the environment. Visual attention serves as that mechanism (Desimone & Duncan, 1995; Bundesen, 1990). Of the many factors that influence visual attention, perceptual load (*p*-Load) has been shown to set the *selectivity* of attention (Lavie & Tsal, 1994). Simple displays of low *p*-Load tax attention very little and allow attention to operate non-selectivity. In low *p*-Load displays, attentional resources are plentiful and obligatorily extend to many items, irrespective of task-relevance. However, in complex, high *p*-Load displays, the limitations of attentional resources are fully realized. These limitations engage selective processing; under high *p*-Load, attention shifts almost exclusively to task-relevant items (Lavie & Tsal, 1994, Lavie, 1995).

Despite *p*-Load theory's success in integrating various disparate results from the attention literature (Lavie, 2010), the 'resources' it invokes are nebulous. Consequently, *p*-Load theory lacks construct validity. Recent attempts to define *p*-Load have proved insightful and are gaining traction (see Roper, Cosman, & Vecera, in press; Torralbo & Beck, 2008; Scalf, Torralbo, Tapia, & Beck, 2013), but much work is still necessary to fully integrate *p*-Load theory into the cognitive literature. Now that *p*-Load has been operationally defined, due diligence may commence on a comprehensive mechanistic account.

The effects of *p*-Load have been examined under varied circumstances. Perhaps the simplest form of *p*-Load comes by way of set size manipulations (Lavie & Cox, 1997). Indeed, some contend that *p*-Load is nothing more than perceptual dilution brought about by greater set sizes (Tsal & Benoni, 2010; Wilson, Muroi, & MacLeod, 2011). Flanker effects are commonly observed under low *p*-Load, and rarely under high *p*-Load (Lavie, 1995; but see Roper, Cosman, Mordkoff, & Vecera, 2011 for instances of unselective attention under high *p*-Load). These findings indicate that attention devotes resources to process the flanker under low *p*-Load but not high *p*-Load. The reason behind this asymmetry is unclear. Several possibilities exist: resource depletion (Lavie, 1995), attentional window constriction (Handy & Mangun, 2000), feature dilution (Tsal & Benoni, 2010), and stimulus competition (Torralbo & Beck, 2008). Careful consideration of the now classic *p*-Load task hints at a possible explanatory account for attentional selectivity under a variety of *p*-Load manipulations.

The classic *p*-Load study uses a modified Eriksen flanker task (e.g., Eriksen & Eriksen, 1974) to assess the varying degrees of attentional selectivity in the face of distraction. Additionally, many *p*-Load studies employ brief displays (e.g., 100 ms, as in Lavie, 1995; Lavie & Cox, 1997; Macdonald & Lavie, 2008). When short exposure durations are used, perceptual processing is data-limited which increases the reliance on visual memory buffers to successfully complete the task (Ester & Awh, 2008). This reliance is especially relevant when the target is embedded among numerous, highly complex, and heterogeneous distractors. Thus brief displays with many stimuli of the high *p*-Load variety challenge the visual system to encode task-relevant visual information within a brief time window. Although visual information persists in iconic memory when stimuli are not backward masked (Phillips, 1974; Averbach & Coriell, 1961), the demand to encode is still great and likely insurmountable for displays sufficiently high in *p*-Load. Given that the rate of visual encoding is non-negligible, due consideration must be paid to the system’s mnemonic constraints before we can elucidate how selection unfolds in the classic *p*-Load task. Set size, as the purest form of *p*-Load, may interfere with sensory encoding just as it may interfere with memory consolidation.

Working memory (WM) and selective attention share a special relationship. In the context of the *p*-Load paradigm, concurrent WM load serves to decrease attentional selectivity. For example, task-irrelevant distractors are processed to a greater extent when observers are required to maintain the order and identity of 6 random digits (De Fockert, Rees, Frith, & Lavie, 2001). The load theory of selective attention proposes that available WM capacity is needed to precisely demarcate task-relevant stimuli from their potentially distracting milieu (Lavie, Hirst, De Fockert, & Viding, 2004). Thus *p*-Load and specific forms of mnemonic load (*m*-Load) exert opposite effects on selective attention – whereas high *p*-Load strengthens selection, high *m*-Load weakens selection allowing for greater distraction (De Fockert, 2013). However, current models of WM tend to highlight the harmony between domain-general and domain-specific components of storage and control (Baddeley, 1996).

In his model, Baddeley proposes that the central executive exerts control over modality specific slave systems (e.g., phonological loop, visuo-spatial sketchpad, etc.). The multi-component nature of WM demands the possibility that both domain-general and domain-specific *m*-Load can be imposed on the system. Accordingly, each specific form of *m*-Load may uniquely influence selective attention. Visual short-term memory (VSTM) is a distinct, domain-specific store of information (Vogel & Machizawa, 2004). Current estimates of VSTM capacity project a set-size of approximately four simple objects (Zhang & Luck, 2008). Hence, VSTM serves as a likely candidate for the maintenance of simple visual objects such as those used in the classical *p*-Load paradigm. We hypothesize that when VSTM is loaded, as opposed to WM proper, attentional selectivity will increase in the classic *p*-Load task. Consequently, a *vstm*-Load may operate on selective attention in a manner consistent with set size increments.

Recent work highlights the intimate connection between VSTM and *p*-Load. Kyllingsbæk, Sy, and Giesbrecht (2011) have built upon the Theory of Visual Attention (TVA) – originally crafted by Bundesen (1990)– to demonstrate that *p*-Load effects are best explained by appealing to a model that incorporates processing and storage capacity constraints of VSTM. Observers reported the identity of several targets in briefly presented displays while ignoring flanking letters. Target identification accuracy declined as the number of flankers increased, a result not readily predicted by load theory. Kyllingsbæk et al. (2011) argued TVA could readily explain the results – as the number of flankers increases, flankers are more likely to enter VSTM, which reduces the likelihood that a *target* will enter VSTM given the capacity-limited nature of VSTM. Further evidence that VSTM affects attentional selectivity comes from neuroimaging results demonstrating that high *vstm*-Load decreases retinotopic cortical BOLD responses to contrast (Konstantinou et al., 2012), much as *p*-Load reduces responses in visual cortex (Rees, Frith, & Lavie 1997).

Although this recent work draws parallels between *vstm*-Load and *p*-Load, there have been no direct tests of the strong view that VSTM availability directly determines the presence or absence of flanker effects in *p*-Load tasks (although see Konstantinou & Lavie, in press, for a demonstration of how *m*-Loads operate on selectivity in a general attention task). Here, we directly test the influence of a concurrent *vstm*-Load upon selective attention by having observers complete a low *p*-Load flanker task during the delay period of a change detection task that taps VSTM. If flanker interference operates irrespective of VSTM availability, then loading VSTM should have little influence on the flanker effect. We find, however, that the magnitude of the flanker effect depends upon the number of items currently stored in VSTM. The flanker effect decreases with increasing *vstm*-Load, despite the displays' low *p*-Load.

Experiment 1

Method

Observers. Twenty University of Iowa undergraduates participated in a single study session for course credit. All observers had normal or corrected-to-normal vision.

Apparatus. A Mac mini computer displayed stimuli on a 17-in. CRT monitor and recorded responses and latencies. Display resolution was 1024 x 768 pixels with 80 Hz refresh frequency. The experiment was controlled using MATLAB software with Psychophysics Toolbox Version 3 (Brainard, 1997).

Stimuli & Procedure. *Change Detection Task*. Memory items consisted of square patches subtending 1.32° x 1.32° of visual angle. These patches were randomly drawn from a pool of six colors: red (RGB values: [255 105 180]), blue [0 0 139], green [0 255 0], yellow [255 255 0], purple [128 0 1128], and orange [255 127 80]. Color duplicates never appeared in the memory display. The patches randomly appeared at one of three eccentricities measured from the center of the display (1.38°, 2.33°, and 4.65° of visual angle), along the following angles measured radially counterclockwise from horizontal (45 degrees, 135 degrees, 225 degrees, and 315 degrees). The memory set-size varied from 1 to 4 colored patches. Observers were instructed to "memorize" the color of each patch – the group of patches formed the *vstm*-Load. These stimuli were shown at the onset of every trial for 1000 ms. A blank screen then appeared for 500 ms followed by a centrally located fixation cross for 500 ms, followed by another blank screen for 500 ms, and then the *p*-Load array for 100 ms, another blank screen for 1900 ms, and finally the memory probe array until response (see Figure 1). This timing was used to prevent sensory and perceptual encoding interference with the *p*-Load task (see Joliecouer & Dell'Aqua, 1999).

Perceptual Load Task. A standard flanker response competition task was used to measure selective attention (e.g., Eriksen & Eriksen, 1974). This task resembled canonical *p*-Load tasks in two important ways: (1) there were well-defined task relevant and irrelevant areas, and (2) low *p*-Load was characterized by a single target embedded among dissimilar placeholders (Lavie et al., 2004, Lavie & Cox, 1997).[1] Targets (letters Z and X) were displayed in Helvetica font measuring1.98° tall by 1.58° wide. The target appeared in one of six locations, which were arranged horizontally[2] and centered at fixation. Targets appeared in an array of placeholders (letter O). A single flanking letter (Z, X, and P), measuring 2.85° tall by 2.24° wide, appeared randomly 5.80° visual angle, measured center-to-center, above and below the target array.

Practice Trials. Each experimental session began with separate and counterbalanced practice sessions for both tasks. Observers completed 12 *p*-Load trials and 12 change detection trials. During practice, *vstm*-Load was restricted to one

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[1] Our own work suggests that a display with these characteristics can be efficiently searched, (slope = 1 ms/item). Efficiently searched displays, in turn, are likely to produce flanker effects (incongruent – congruent) on the order of 30 ms (Roper et al., in press).

[2] We used a horizontal search array to exactly replicate the classic *p*-Load task. We have previously used both circular (Roper et al., in press) and horizontal arrays (Roper, Cosman, Mordkoff & Vecera, 2011) and obtained reliable flanker interference effects irrespective of spatial arrangement.

or two items. On half of the trials, the colors did not change. On the other half of trials, one color patch changed to a novel color in the probe display. The test item was cued with a black border. Observers responded by depressing either a left or right foot pedal. Foot pedals were used to clearly segregate the tasks' required responses. Observers were reminded to perform the "letter task" on the keyboard and the "color task" on the foot pedals.

Experimental Trials. Observers completed 288 experimental trials equally divided among the following factors: flanker type (incongruent, neutral, and congruent), target identity (Z and X), target location (one of six positions located on the horizontal), *vstm*-Load (1-4 color patches), and change detection trial type (change or no-change). Observers also performed an articulatory suppression task to prevent verbal re-coding of the colors in the VSTM task (Woodman & Luck, 2004). Before every block of 36 trials, observers were shown two random digits. Observers were instructed to repeat these digits aloud. Because some observers were tested in pairs, all observers wore sound-dampening ear protection to eliminate possible auditory distraction.

Results & Discussion

Change Detection Task. Summary data for the VSTM task appear in Table 1. Cowan's K values were computed on the following basis: K = [hit rate – false alarm rate] * VSTM array size (Cowan, 2001). Cowan's K provides an estimate of the number of items held in VSTM. We analyzed K values by carrying-out a one-way repeated-measures ANOVA with *vstm*-Load as a factor. This analysis revealed a significant effect, $F(3,17) = 194.84$, $p < 0.0005$, $\eta^2 = 0.97$. These K values were also significantly correlated with *vstm*-Load, $R^2 = 0.91$, $F(1,3) = 20.90$, $p = 0.045$, which confirms that observers actively encoded the color patches into VSTM.

Perceptual Load Task. Mean correct RTs for the *p*-Load task were computed for each observer as a function of *vstm*-Load (1-4 items) and flanker type (congruent, neutral, and incongruent). RTs outside ±2.5 standard deviations from each observer by condition mean were excluded from the analysis. This trimming excluded 5.0% of the data.

We conducted a 4 x 2 repeated measures ANOVA with *vstm*-Load and flanker type (incongruent and neutral) as independent factors.[3] We observed a significant main effect for *vstm*-Load, $F(3,17) = 6.23$, $p = 0.0050$, $\eta^2 = 0.52$, with RTs on the *p*-Load task slowing as VSTM array size increased. Most important, we found a significant interaction between *vstm*-Load and flanker type, $F(3,17) = 5.57$, $p = 0.0080$, $\eta^2 = 0.50$. Figure 2 illustrates how flanker effects decreased with *vstm*-Load increments.

We conducted planned pairwise comparisons to examine incongruent and neutral trials at each level of *vstm*-Load to assess the nature of the interaction. A significant flanker effect was observed for a one-item *vstm*-Load, $t(19) = 3.59$, $p = 0.002$. No other pairwise comparisons reached significance. Accuracy rates, listed in Table 2, generally paralleled RTs but no comparisons reached significance.

The results of Experiment 1 suggest that a concurrent *vstm*-Load greater than one-item is sufficient to abolish significant flanker congruency effects in a low *p*-Load task. These results run counter to what one would have expected with an executive *wm*-Load.

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[3] The flanker was congruent on one-third of the trials; however, we report analyses conducted solely on incongruent and neutral trials to remain consistent with the literature. Figures 2 and 3 illustrate that congruent trials deviate little from neutral trials. Indeed, statistical analyses for congruent versus neutral trials were not significant, $F(1,19) = 0.656$, $p = 0.428$, $\eta^2 = 0.033$.

Lavie and colleagues found that a concurrent verbal *m*-Load increased the likelihood of processing the flanker (Lavie et al., 2004, Lavie, 2010). We propose that concurrent *vstm*-Load consumes the resources, or alternatively, memory slots that would otherwise be available to process the stimuli in the *p*-Load display. Thus, much like strict set size (Lavie & Cox, 1997), a *vstm*-Load can set the locus of visual selection; when *vstm*-Load is great, selection occurs relatively early.

Our analyses revealed that observers actively maintained the color patches in memory; however, the influence of merely viewing the color patches themselves in the absence of a memory constraint may produce identical results. As such, it is important to rule out the possibility that the results of Experiment 1 were driven by low-level perceptual interactions as opposed to VSTM resource consumption. We designed Experiment 2 to address this possibility. Observers performed the *p*-Load task while passively viewing the color patches. If the color patches attentuate the flanker's impact on behavior by impinging on early perceptual processes rather than mnemonic resources, then we shall expect little effect of the flanker when observers passively view rather than actively maintain the patches.

Experiment 2

Method

Subjects were 20 additional University of Iowa undergraduates. The procedure was identical to Experiment 1, except that observers were kept naïve as to the purpose of the color patches and were required to press the foot pedals in order to advance to the next trial. All observers performed the articulatory suppression task described in Experiment 1 and wore ear protection throughout experimentation.

Results & Discussion

Data were aggregated identically to Experiment 1. Trimming excluded 5.4% of the data. A 4 x 2 repeated measures ANOVA revealed a main effect of congruency, $F(1,19) = 26.05$, $p < 0.0005$, $\eta^2 = 0.58$. The interaction between *vstm*-Load and congruency was not significant, $F(3, 22) = 2.16$, $p = 0.12$. Planned pairwise comparisons revealed significant flanker effects irrespective of set size, 1 item, $t(19) = 2.23$, $p = 0.038$, 2 items, $t(19) = 3.55$, $p = 0.002$, 3 items, $t(19) = 3.10$, $p = 0.006$, and 4 items, $t(19) = 2.25$, $p = 0.036$. Accuracy rates generally paralleled RTs but no comparisons reached significance (see Table 2).

Mixed Model Analysis. We examined the impact of active VSTM maintenance by comparing *p*-Load RT data from Experiment 2 to the corresponding data from Experiment 1. Statistical analyses were identical to the previously conducted 4 x 2 repeated-measures ANOVA with the addition of a between subject variable (active vs. passive *vstm*-Load). A mixed-model ANOVA revealed a significant three-way interaction, $F(3,36) = 3.61$, $p = 0.022$, $\eta^2 = 0.23$, as well as a two-way interaction between flanker congruency and viewing method, $F(1,38) = 4.88$, $p = 0.033$, $\eta^2 = 0.11$, and a two-way interaction between the number of viewed color patches and viewing method, $F(3,36) = 3.10$, $p = 0.039$, $\eta^2 = 0.21$. We also observed significant main effects of congruency, $F(1,38) = 22.06$, $p < 0.0005$, $\eta^2 = 0.37$, and the number of color patches, $F(3,36) = 3.00$, $p = 0.043$, $\eta^2 = 0.20$.

Correlation Analysis. We next examined whether *vstm*-Load could be used to predict the magnitude of the flanker effect (incongruent – neutral). We fitted these data using a logarithmic regression approach.[4] Figure 4 depicts two regressions that were separately carried-out on Experiments 1 and 2. The regression over Experiment 1 revealed a strong and significant relationship between the magnitude of the flanker effect and the number of color patches to be encoded, $R^2 = 0.96$, $F(1,3) = 53.88$, $p = 0.018$. The regression over Experiment 2 was not significant. An F-test revealed that the strength of the relationship in Experiment 1 was significantly stronger than the strength of the relationship in Experiment 2, $F(3,36) = 8.46$, $p = 0.044$.

The results of Experiment 2 confirm that passively viewing the color patches is not sufficient to abolish the flanker effect under low *p*-Load. Our regression analyses reveal that without an active *vstm*-Load, the number of color patches does not significantly predict the magnitude of the flanker effect; however, when VSTM is loaded, then the number of to-be-remember color patches significantly predicts the magnitude of the flanker effect.

General Discussion

We have demonstrated that gradual increases in VSTM demand accompany gradual declines in the flanker interference effects under low *p*-Load. We propose that the processing demand brought about by concurrently performing the change detection task interferes with the visual system's ability to quickly encode *p*-Load stimuli when they are briefly presented. These results suggest that briefly presented stimuli impose a heavy reliance upon scarce VSTM resources to encode or otherwise endogenously represent those stimuli before downstream processing – such as response selection – occurs. A

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[4] We have previously argued that the use of a logarithmic regression is appropriate because as processing resources are continuously depleted the likelihood that the flanker effect is observed approaches zero rather than the less likely alternative that resource depletion produces inverse flanker interference effects (Roper et al., in press). For consistency, we have fitted the current data set using a logarithmic approach.

natural extension from this work yields the hypothesis that if exposure duration is increased, then the burden to encode task-relevant stimuli into VSTM should decrease. Such a result would serve to decrease attentional selectivity. Indeed, work from our lab indicates this to be the case (Roper, Cosman, Mordkoff, & Vecera, 2011). We extended the exposure duration of task-relevant stimuli in a high *p*-Load task and found attention to be quite unselective – we observed significant flanker effects despite high *p*-Load. Thus the relationship between VSTM and selective attention is clear – when VSTM resources are ample, attention is mandatorily unselective, and when VSTM resources are scarce and sufficiently taxed, attention operates selectively. We conclude that because entry into VSTM is a resource-limited process (Vogel, Woodman, & Luck, 2001), it is likely that the restrictions induced by the change detection task diminish the system's ability to process the task-irrelevant flanker, thereby attenuating the flanker's impact upon behavior. We should add that our view is agnostic of the ongoing debate between characterizations of VSTM as involving fixed 'slots' or flexible, continuous resources (Zhang & Luck, 2008); however, our view is inconsistent with a pure amodal model of WM store as the constraining factor on selective attention. Rather, our view appeals to modality-specific WM systems (Fougnie & Marois, 2011) where a concurrent *vstm*-Load interferes with the visual system's ability to identify task-irrelevant stimuli – stimuli that are otherwise obligatorily processed under single-task conditions.

We observed heightened attentional selectivity under *vstm*-Load. This result directly contrasts with the diminished selectivity brought about by a domain-general *wm*-Load (De Fockert et al., 2001). We reason that, because VSTM is domain-specific, *vstm*-Load consumes low-level visual resources that would otherwise come to represent task-irrelevant stimuli. Indeed, our findings conform to a recent study by Konstantinou and Lavie (in press). They measured contrast sensitivity under three forms of load – *p*-Load, *wm*-Load, and *vstm*-Load. Their results clearly demonstrate the dissociable roles that *vstm*-Load and *wm*-Load exert on contrast sensitivity. In accordance with our proposed *m*-Load account, Konstantinou and Lavie found that *vstm*-Load and *p*-Load serve to increase attentional selectivity while *wm*-Load decreases selectivity.

Although we have established that *vstm*-Load strengthens selective attention, it is unclear where along the stream of processing the flanker's representation is disrupted. At least three alternatives remain viable. Loading VSTM may induce flanker blindness by interfering with the initial perception of the flanker, it may prevent the flanker's consolidation into a more robust form of storage, or it may simply dilute the flanker's representation in VSTM itself. Future work is necessary to disambiguate these competing alternatives.

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Figure Captions

Figure 1.*Trial Schematic*. Each trial began with the presentation of 1-4 color patches followed shortly by a letter array that constituted the perceptual load task. A subsequent memory probe concluded the trial. Color patches were present in Experiments 1 and 2, but observers were instructed to “memorize” the patches in Experiment 1 and to ignore the patches in Experiment 2. Stimuli are not drawn to scale.

Figure 2. *Mean correct RT on the perceptual load task as a function of VSTM load*. Error bars represent standard error of the mean.

Figure 3. *Mean correct RT on the perceptual load task as a function of the number of passively viewed color patches*. Error bars represent standard error of the mean.

Figure 4. *Regression plot*. Trend lines represent the best logarithmic fit of each data set. Each data point reflects the experiment-wide average for the designated condition. R^2 values are reported for each experiment; additional statistics can be found in the text (see Results section of EXP 2).

Figure 1

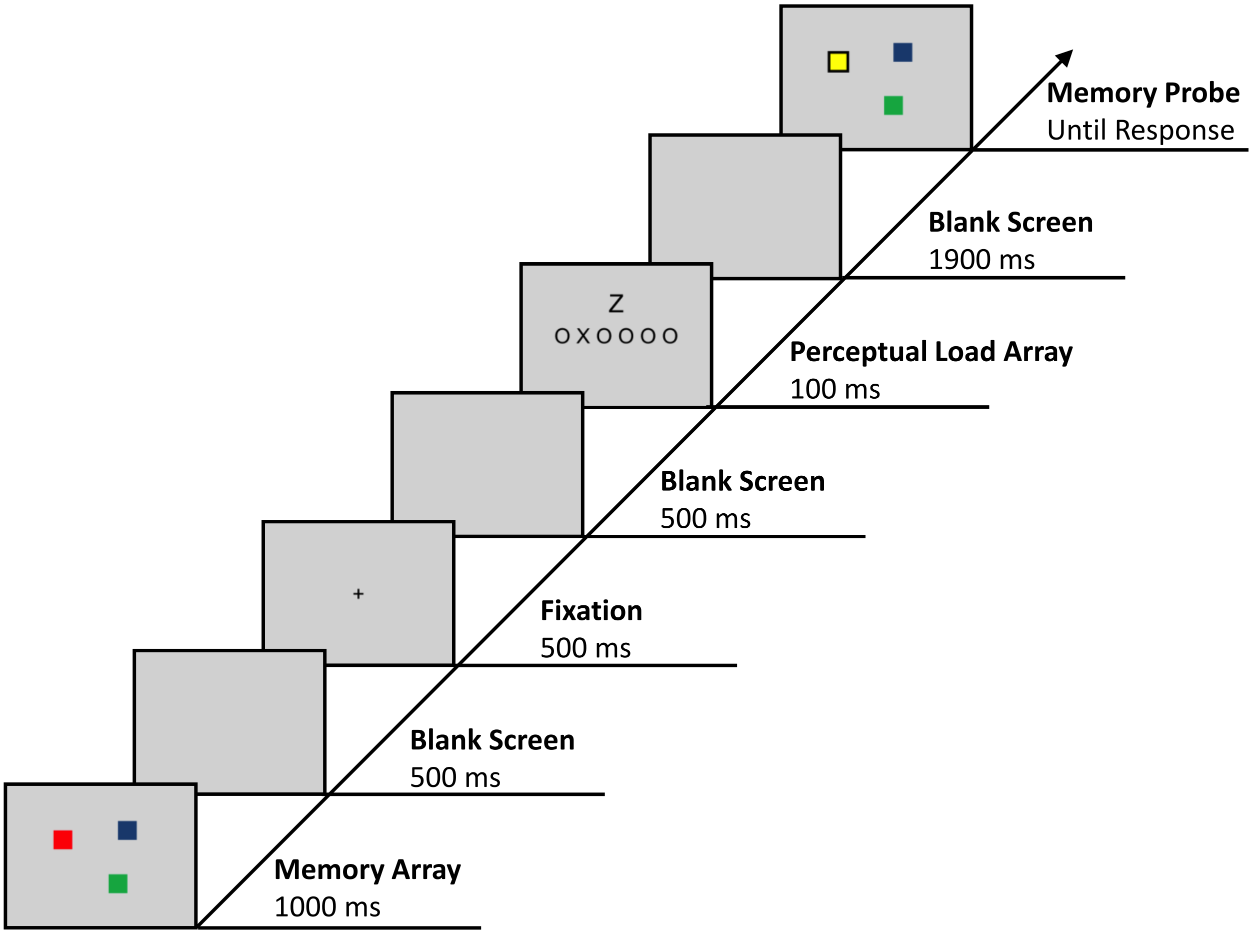
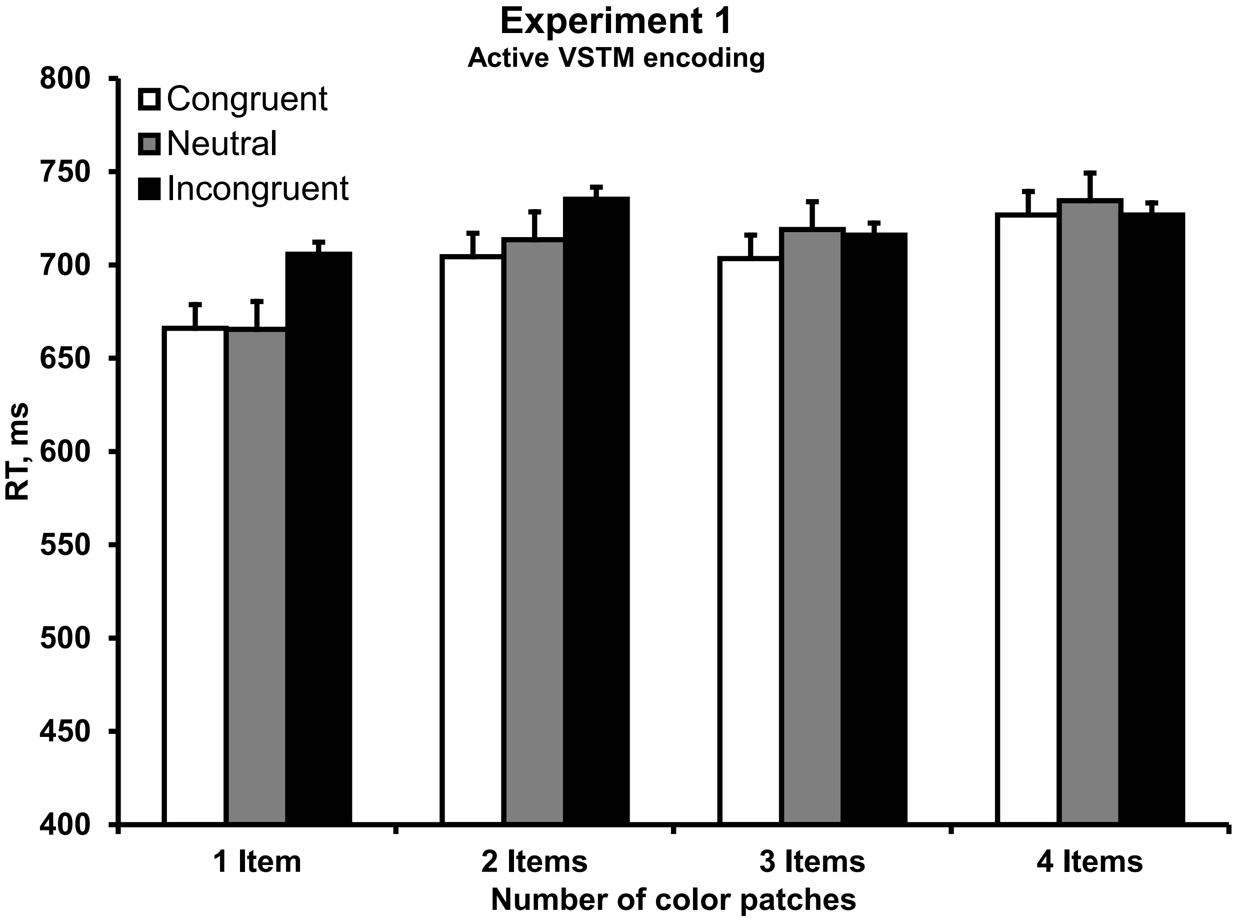

Memory Probe
Until Response
Blank Screen
1900 ms
Z
OXOOOO
Perceptual Load Array
100 ms
Blank Screen
500 ms
+
Fixation
500 ms
Blank Screen
500 ms
Memory Array
1000 ms

Figure 2



Experiment 1

Active VSTM encoding

Figure 3

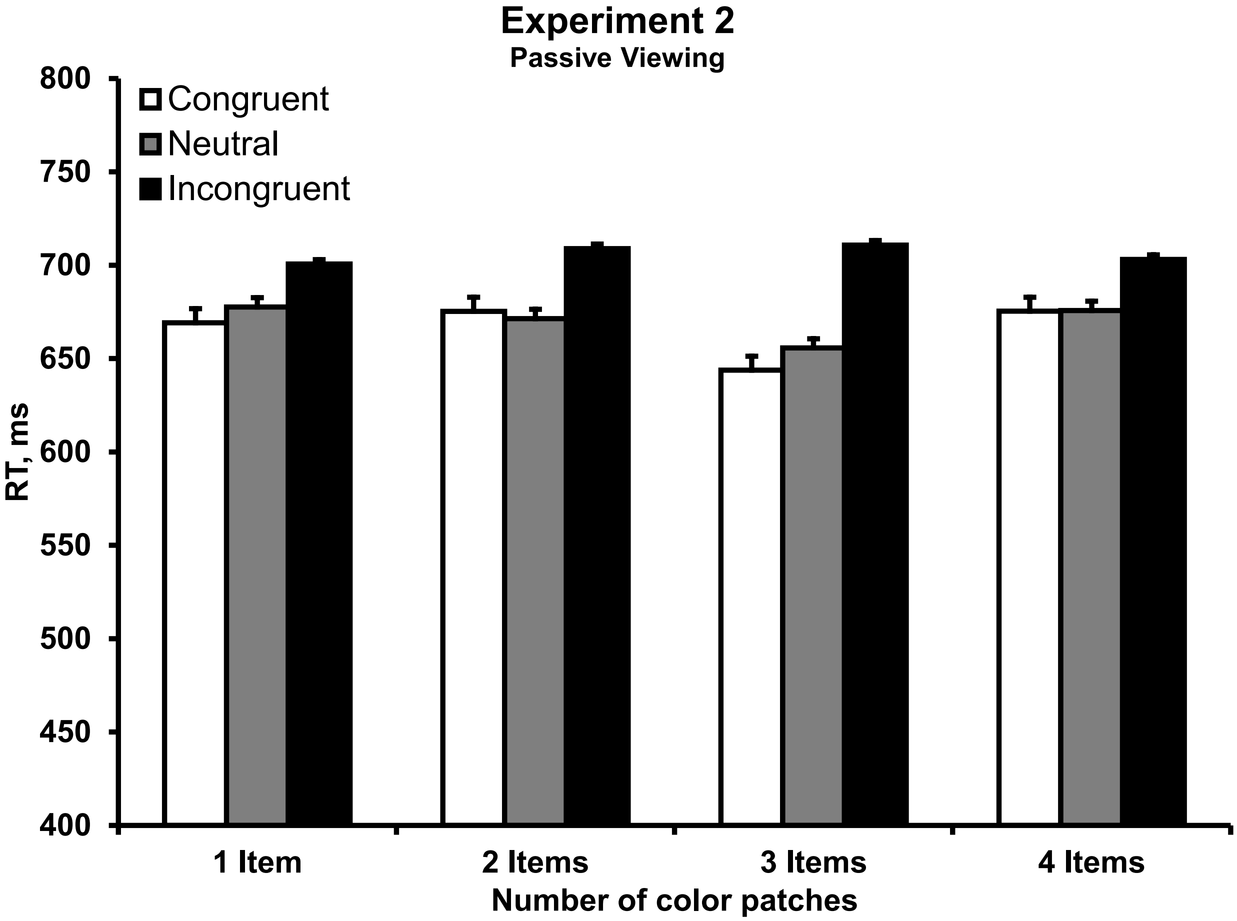

Experiment 2
Passive Viewing
Congruent
Neutral
Incongruent
RT, ms
800
750
700
650
600
550
500
450
400
1 Item
2 Items
3 Items
4 Items
Number of color patches

Figure 4

VSTM load abolishes distractor processing

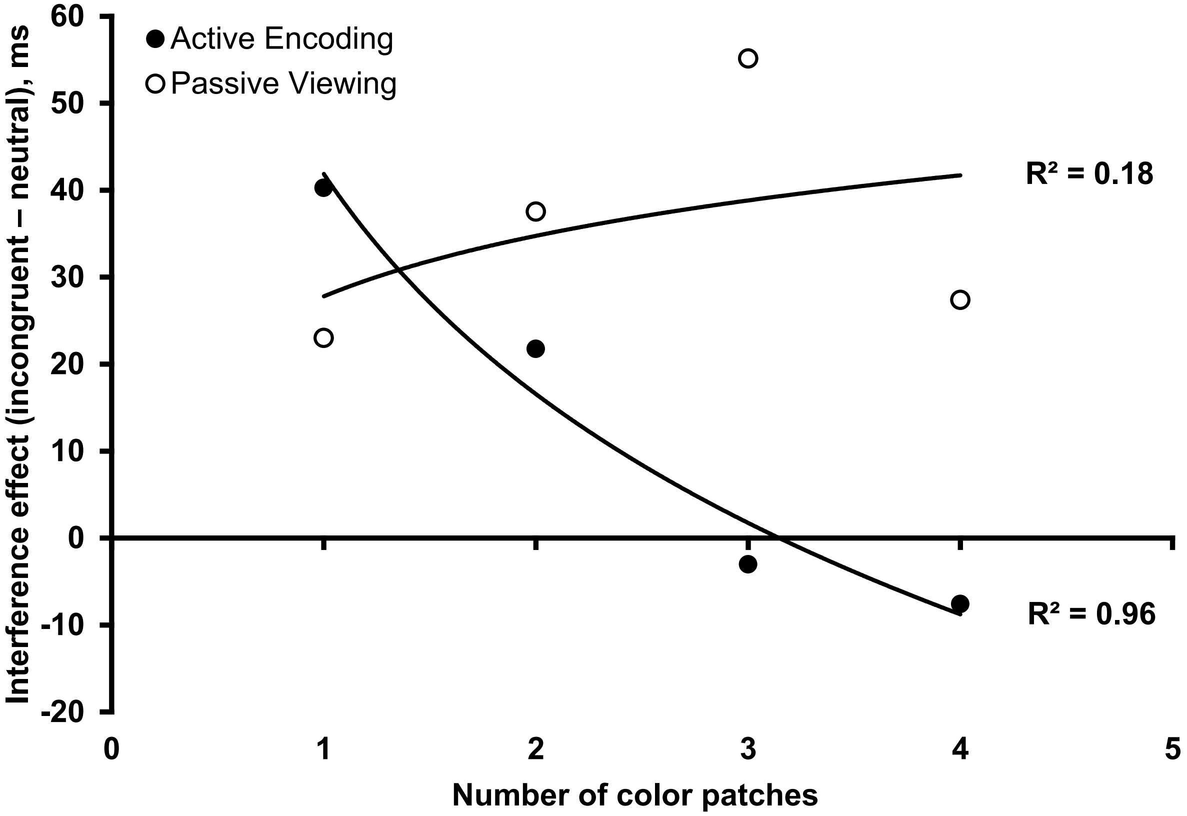


Table 1

Experiment 1: Change detection accuracy proportions and Cowan's K values as a function of VSTM load

	Flanker Type							
	Incongruent		Neutral		Congruent		Cowan's K	
VSTM load	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
One item	0.90	0.08	0.88	0.10	0.87	0.11	0.72	0.21
Two items	0.82	0.11	0.85	0.10	0.82	0.10	1.52	0.25
Three items	0.72	0.13	0.72	0.11	0.71	0.12	1.61	0.74
Four items	0.69	0.11	0.71	0.11	0.69	0.12	2.10	1.08

Note. Accuracy values represent the proportion of correct trials on the change detection task. Cowan's K was computed using the formula: K = (hit rate - false alarm rate) x VSTM array size.

Table 2

Perceptual load task accuracy proportions as a function of flanker type, number of color patches, and viewing method

		Flanker Type					
		Incongruent		Neutral		Congruent	
Viewing Method	# of Color Patches	*M*	*SD*	*M*	*SD*	*M*	*SD*
Active Encoding (Experiment 1)	One item	0.92	0.07	0.91	0.09	0.91	0.08
	Two items	0.92	0.10	0.93	0.06	0.92	0.06
	Three items	0.91	0.10	0.94	0.09	0.89	0.11
	Four items	0.88	0.13	0.91	0.08	0.91	0.09
Passive Viewing (Experiment 2)	One item	0.96	0.06	0.94	0.08	0.91	0.07
	Two items	0.94	0.06	0.94	0.06	0.93	0.09
	Three items	0.96	0.05	0.96	0.04	0.91	0.09
	Four items	0.93	0.10	0.95	0.06	0.93	0.13