# Distractor processing in low perceptual load is determined by the availability of visual short-term memory resources

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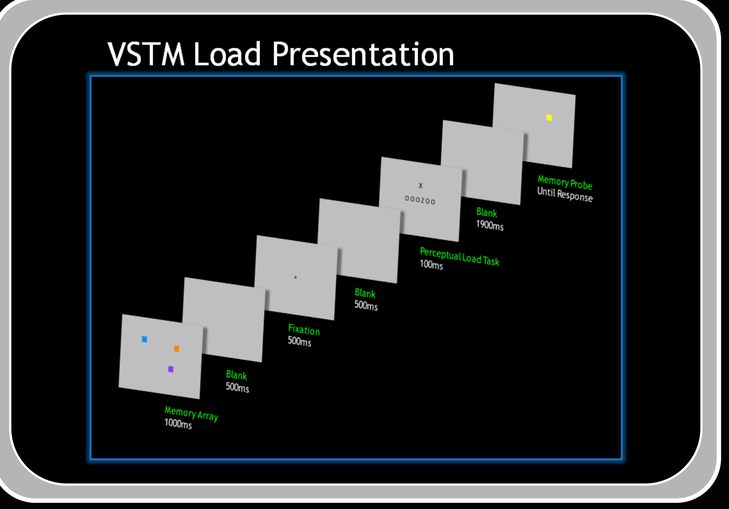
## Introduction

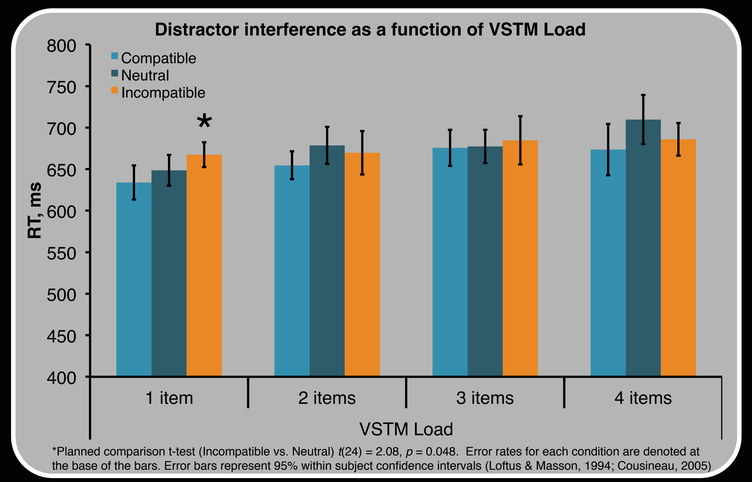
Recent additions to the early versus late attentional selection debate have led to the conceptualization of perceptual load theory which states that task-irrelevant stimuli can only be ignored when resources are sufficiently taxed to engage selective attention. However, the nature of the resources that are putatively depleted under high perceptual load is ill-defined. Because many experiments designed to examine perceptual load have employed brief exposure durations, it is tenable that visual short-term memory (VSTM) may play a role in visual selection under high perceptual load conditions. Overly-limited exposure durations would force observers to perform the task on an internal representation of the stimuli due to fleeting bottom-up support from the display. A consequence of the demand placed upon internal maintenance of task-relevant information coupled with greater entropy in high perceptual load displays may manifest itself as elevated demands on VSTM consolidation compared to the demands engendered by relatively austere low perceptual load displays. With that, we predicted that a concurrent VSTM load would reduce observers' capacity to internally represent task-relevant stimuli thereby allowing low perceptual load displays to reveal the resource limitations of high load displays. However, if VSTM taxes cognitive processes involved in distractor suppression (Lavie et al., 2004, JEP:General), then a VSTM load would increase distractor interference in low load displays.

## Methods

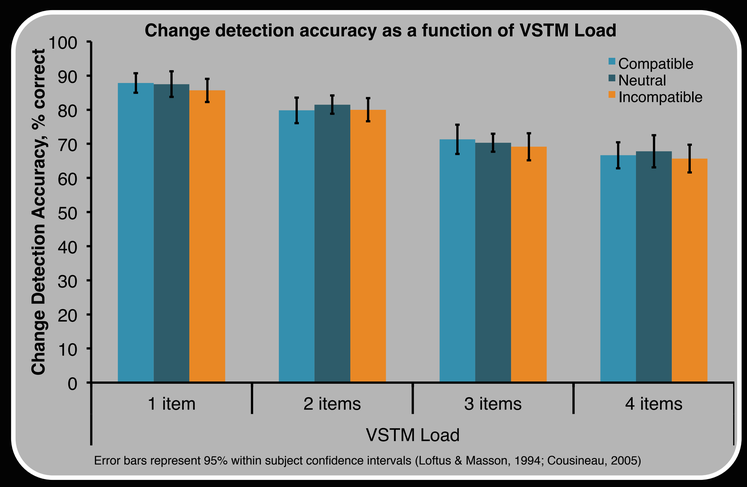



A total of 50 individuals participated in the study (25 in each experiment). In the first experiment, observers were shown 1-4 colored squares. After 2500 ms, they were shown a low perceptual load display that contained either a neutral, compatible, or incompatible distractor which was located either above or below the linear task-relevant array. 2000 ms following the perceptual load display, subjects reported whether there was a color change or not. In the second experiment, observers were naïve to the purpose of the colored squares and were instructed to passively view them ignoring them as much as possible. This was designed to control for the low-level perceptual influence that the squares could have on the perceptual load task. Observers were required to subvocalize two variable digits throughout the experiments.

## Experiment 1
### VSTM Load




*Planned comparison t-test (Incompatible vs. Neutral) $t(24) = 2.08$, $p = 0.048$. Error rates for each condition are denoted at the base of the bars. Error bars represent 95% within subject confidence intervals (Loftus & Masson, 1994; Cousineau, 2005)

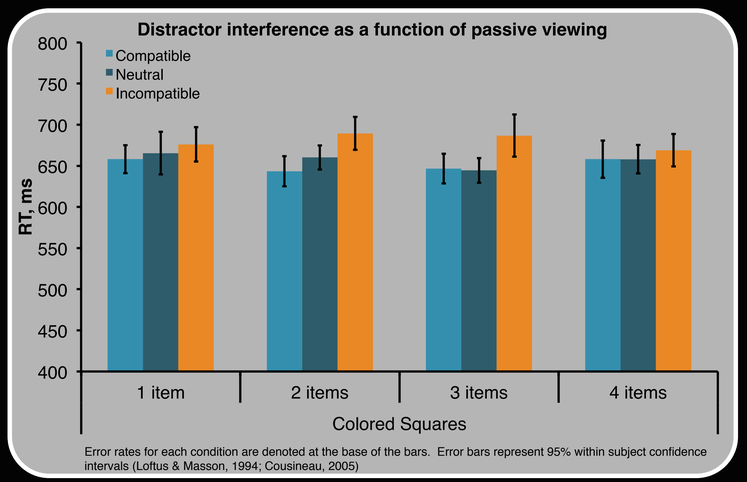



Error bars represent 95% within subject confidence intervals (Loftus & Masson, 1994; Cousineau, 2005)

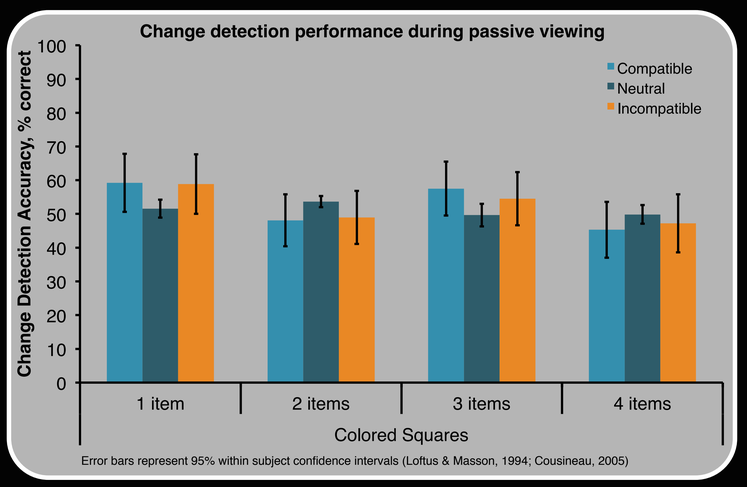
## Results & Discussion

A two condition (Incompatible and Neutral) repeated measures ANOVA revealed a significant main effect of VSTM load [$F(3,22) = 5.917$, $p = 0.004$]. Planned comparisons between incompatible and neutral conditions for each VSTM load condition revealed a significant flanker effect when there was 1 item to remember [$t(24) = 2.08$, $p = 0.048$] but not when there were 2, 3, or 4 items to remember. A two condition (Incompatible and Neutral) planned comparison between VSTM load of 1 item vs. VSTM load of 2, 3, and 4 items revealed a significant interaction of VSTM load and compatibility [$F(1,24) = 4.65$, $p = 0.041$]. We found a significant flanker effect when subjects had to store 1 item in VSTM. The effect dissipated as VSTM load grew to 2, 3, and 4 items. A second experiment ruled out low-level perceptual influences of the VSTM displays.

## Experiment 2
### Passive Viewing




Error rates for each condition are denoted at the base of the bars. Error bars represent 95% within subject confidence intervals (Loftus & Masson, 1994; Cousineau, 2005)




Error bars represent 95% within subject confidence intervals (Loftus & Masson, 1994; Cousineau, 2005)

## Results & General Discussion

A two condition (Incompatible and Neutral) repeated measures ANOVA revealed a significant main effect of Compatibility [$F(1,24) = 5.883$, $p = 0.023$]. A mixed model repeated measures ANOVA with within-subject factors of flanker compatibility and VSTM load and between-subject factors of experiment revealed a two-way interaction between VSTM and experiment [$F(3,46) = 3.30$, $p = 0.028$] and a two-way interaction between compatibility and experiment [$F(1,48) = 4.18$, $p = 0.046$]. These results reveal that a concurrent VSTM load acts to reduce available resources which would otherwise be free to process task-irrelevant stimuli in low perceptual load. We propose that the resources taxed by high 'perceptual' load are in fact mnemonic rather than perceptual in nature.