Searching for two things at once: Multiple attentional control settings independent of space

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Introduction

Many recent studies have asked about the number of task sets, or attentional control settings, observers can hold. In short, can the attentional system be configured to search for more than one possible target at once? Observers can rapidly switch from one attentional control setting to another (Lien, Ruthruff, & Johnston, 2010), but the evidence for the simultaneous maintenance of multiple control settings is mixed. For example, results from Adamo et al. (2008) suggested that observers could hold different attentional control settings for different spatial locations. In contrast, Folk and colleagues (Folk & Anderson, 2010; Folk & Remington, 2008) have suggested that when searching for multiple targets, observers adopt a more general attentional control setting for unique singletons.

In the current experiments, we provide a strong test of multiple control settings by (1) presenting potential distractors and targets in the same or different colors, allowing us to directly measure any possible perceptual priming and (2) presenting colored targets among heterogeneously colored distractors, forcing observers to attend to specific colors, not to unique color singletons.

Methods

Stimuli

Target Colors

RED GREEN

Target Letters

A B C D E F G H
J K L M N P R

Spatial Distractor Colors

RED GREEN
BLUE GRAY

Distractor Symbol

#

Experiment 1

Filler Letter Color

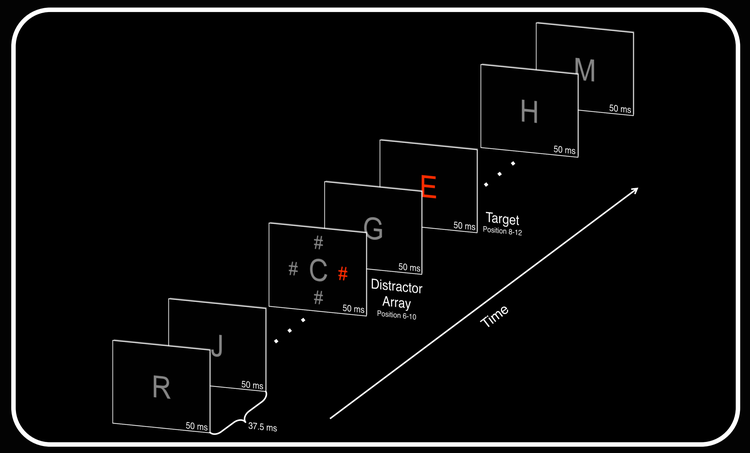
GRAY

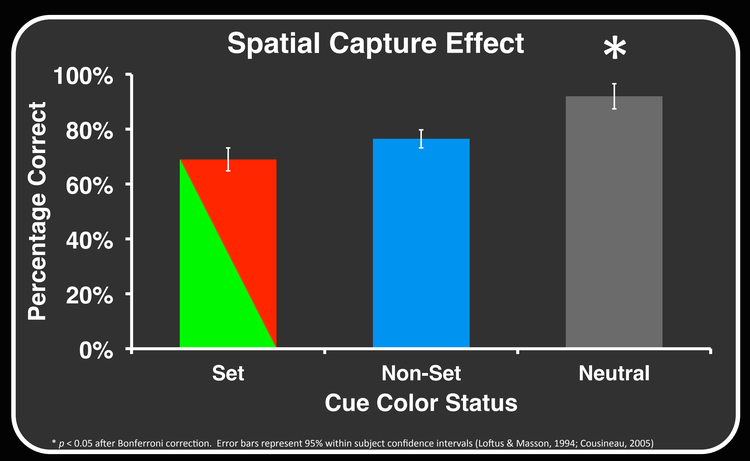
Experiment 2

Filler Letter Colors

DEEP-PINK YELLOW
ORANGE ROYAL-BLUE
MAGENTA HOT-PINK
MEDIUM-PURPLE CYAN
GOLD BLUE-VIOLET
DODGER-BLUE KHAKI
GOLDENROD PURPLE

Experiment 1 – Singleton Search





* $p < 0.05$ after Bonferroni correction. Error bars represent 95% within subject confidence intervals (Loftus & Masson, 1994; Cousineau, 2005)

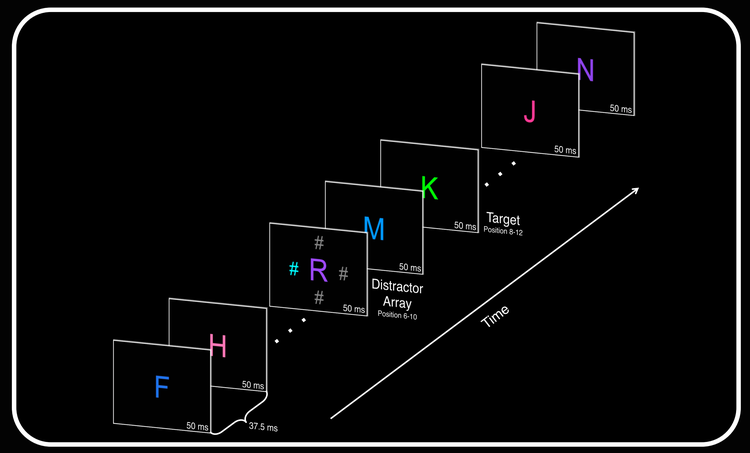
Results & Discussion

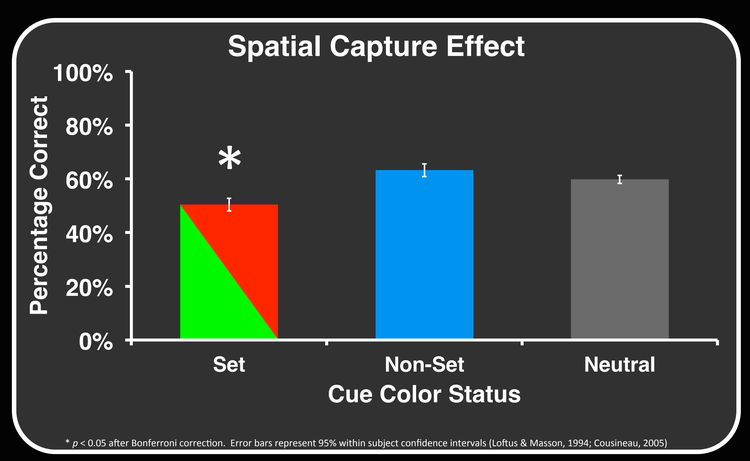
As is evident in the graph, observers were distracted little by neutral, homogenous gray distractors and were accurate in reporting the target's identity. However, observers were distracted by all singleton distractors, both those that matched the target colors (red and green) and those that did not match the target colors (blue).

A one-way repeated measures ANOVA revealed significance, $F(2, 8) = 18.68$, $p < .01$; follow-up comparisons revealed significant differences between Neutral and Set ($t_{Bonferroni}(9) = -5.49$, $p < .001$) as well as Neutral and Non-Set ($t_{Bonferroni}(9) = 4.41$, $p < .01$), but not between Set and Non-Set ($t_{Bonferroni}(9) = -2.16$, $p > .05$).

These findings generally replicate those reported by Folk and Anderson (2010) and suggest that observers were in singleton search mode. Any salient, unique distractor captured attention and produced a spatial blink, which reduced target identification. Task relevance did not influence attentional capture.

Experiment 2 – Feature Search





* $p < 0.05$ after Bonferroni correction. Error bars represent 95% within subject confidence intervals (Loftus & Masson, 1994; Cousineau, 2005)

Results & General Discussion

This graph depicts a pattern different from that in Experiment 1; although observers were again minimally distracted by neutral, homogenous gray distractors, a salient (blue) singleton that did not match the task-relevant colors now failed to capture attention. Only task-relevant target colors (red and green) produced a large spatial blink, evidenced by impaired target identification.

A one-way repeated measures ANOVA revealed significance, $F(2, 8) = 21.61$, $p < .01$; follow-up comparisons revealed significant differences between Neutral and Set ($t_{Bonferroni}(9) = -5.67$, $p < .001$) as well as Set and Non-Set ($t_{Bonferroni}(9) = -5.43$, $p < .001$), but not between Neutral and Non-Set ($t_{Bonferroni}(9) = -1.73$, $p > .05$).

The current results add to the range of attentional control settings that observers may adopt. Not only can we readily configure attention toward singletons and specific features, but also we appear able to configure attention toward at least two specific features (provided the right environment). This range of control settings points to the flexibility of the attentional system and the behavior produced by that system.