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BRIEF REPORT

Searching for two things at once: Establishment of multiple attentional control settings on a trial-by-trial basis

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Abstract Recent work has demonstrated that attention can be configured to multiple potential targets in spatial search. However, this previous work relied on a fixed set of targets across multiple trials, allowing observers to offload attentional control settings to longer-term representations. In the present experiments, we demonstrate multiple attentional control settings that operate independently of space (Experiments 1 and 2). More important, we show that observers can be cued to different control settings on a trial-by-trial basis (Experiment 3). The latter result suggests that observers were capable of maintaining multiple control settings when the demands of the task required an attentional search for specific feature values. Attention can be configured to extract multiple feature values in a goal-directed manner, and this configuration can be can be dynamically engaged on a trial-by-trial basis. These results support recent findings that reveal the high precision, complexity, and flexibility of attentional control settings.

Keywords Attention · Cognitive and attentional control · Attentional capture · Attentional blink

Attention can be controlled—or guided—by both stimulus-based and goal-based information. For example, a salient visual feature, such as a uniquely colored object or an abruptly appearing object, will capture attention irrespective of an observer's goals (see Theeuwes, 1992, 2010), producing *stimulus-driven attentional capture*. In contrast, attention is guided to less salient objects on the basis of the extent to which an object matches an observer's goals or task set, producing *contingent attentional capture* (e.g., Folk, Remington, & Johnston, 1992). In contingent capture, a red item, but not a green item, will capture attention when an observer is searching for a red target, given the right stimulus environment (Folk, Leber, & Egeth, 2002).

A long-standing debate on attentional control has centered on whether stimulus-driven capture or contingent capture provides a default attentional control mode (e.g., Kawahara, 2010). Contingent capture theory explains the extant literature by proposing different control settings to explain the various types of attentional capture (e.g., Bacon & Egeth, 1994; Folk et al., 2002; Leber & Egeth, 2006). Observers rely on singleton search mode to find any unique singleton target, but this mode allows irrelevant singletons to capture attention and produce stimulus-driven capture. When a target is not unique, observers must rely on feature search mode to find a target defined by a specific feature, such as *red* or *diamond*. In feature search mode, only features that match properties of the target capture attention. Salient distractors that do not match target properties no longer capture attention (e.g., Bacon & Egeth, 1994; Leber & Egeth, 2006).

Against this backdrop of attentional control, 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? Several recent studies have presented evidence for multiple control settings. For example, the results from Adamo, Pun, Pratt, and Ferber (2008) suggested that observers could hold different attentional control settings for different spatial locations. Observers detected blue targets at location one (e.g., left of fixation) and green targets at location two (e.g., right of fixation); blue distractors that appeared at the left location produced

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faster responses to blue targets than when the same distractor appeared at the right location and preceded a green target, suggesting that the attentional set for target color was tied to a specific location and influenced attentional capture (see also Adamo, Wozny, Pratt, & Ferber, 2010; Parrott, Levinthal, & Franconeri, 2010). Moore and Weissman (2010, 2011) reported relevant results from a rapid serial visual presentation (RSVP) task, although this work investigated the effects of distractors, not the number of control settings that could be maintained. Observers reported the identity of targets that could be one of two colors; distractors that matched target colors produced a larger attentional blink than did distractors in nontarget colors, suggesting that observers maintained multiple attentional sets for color. Most recently, Folk and colleagues (Folk & Anderson, 2010; Irons, Folk, & Remington, 2012) demonstrated that when searching for multiple targets, observers adopt a more general attentional control setting for unique singletons (Folk & Anderson, 2010), but only when the potential targets are unique singletons. When observers perform a more demanding feature search for two specific colors among heterogeneously colored nontargets, attention is captured only by distractors that match potential target colors (Irons et al., 2012).

Although there is solid evidence for multiple attentional control settings, at least some of the previous results could be explained by perceptual priming, not control settings per se. For example, in tying control settings to spatial locations, Adamo et al.'s (2008) procedure might have allowed perceptual priming to affect reaction times (RTs). When a blue target appeared in the left location and was preceded by a blue distractor, RTs could have been shorter because of location-based color priming; this priming would be weakened if color and location mismatched. Moore and Weissman (2010) reported findings consistent with priming: Observers were more accurate at identifying a colored target that was preceded by a distractor of the same color than at identifying one that was preceded by a different color. Despite these concerns, Irons et al. (2012) nicely demonstrated that there was no evidence for priming when two control settings were maintained; when searching for red or green targets, observers were captured as much by a distractor that matched the target color (e.g., green distractor/green target) as by a distractor that mismatched the target color (e.g., red distractor/green target).

In the present experiments, we asked two important questions regarding multiple attentional control settings. First, are these settings nonspatial, allowing them to operate across the entire visual field? Second, how are multiple control settings maintained? Recent work has demonstrated that observers can rapidly switch from one attentional control setting to another (Lien, Ruthruff, & Johnston, 2010), and it is tempting to speculate that multiple attentional control settings are stored and maintained in working memory as a *target template* that guides attention, as in biased competition accounts of attention (Desimone & Duncan, 1995; see also Bundesen, 1990). The previous work on multiple attentional control settings has used fixed target colors, however, which allows observers to offload control settings to a longer-term memory system. Current estimates based on the contralateral-delay activity (CDA) event-related potential (ERP) suggest that a target template can be transferred from visual working memory to a more robust longer-term storage in fewer than ten trials (Carlisle, Arita, Pardo, & Woodman, 2011; Woodman, Luck, & Schall, 2007; see Vogel & Machizawa, 2004, for an index of the CDA ERP component). To date, studies investigating the maintenance of multiple attentional control settings have employed consistent, predictable targets that can be readily offloaded into long-term memory (Adamo et al., 2008; Adamo et al., 2010; Folk & Anderson, 2010; Irons et al., 2012; Moore & Weissman, 2010, 2011). Can multiple control settings be established and maintained on a trial-by-trial basis?

As is shown in Fig. 1, observers in our experiments searched for either a red or a green letter in a centrally presented RSVP stream and reported the identity of this target (Folk et al., 2002). Spatial distractors appeared two frames before the target. When these distractors capture attention, a spatial attentional blink results: Attention is

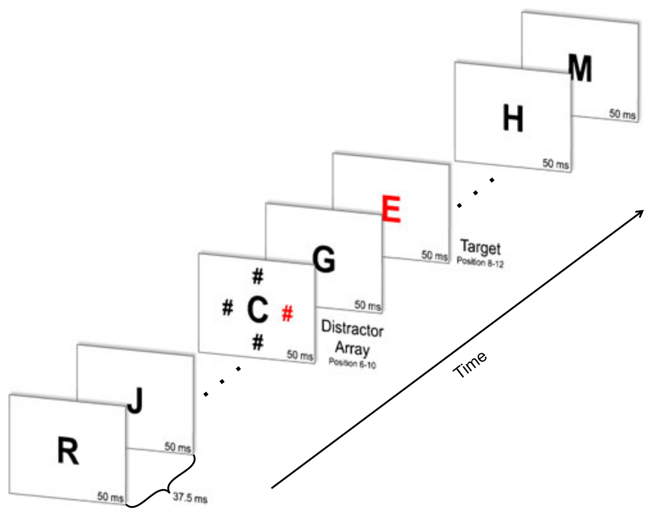

Fig. 1 Schematic depicting the sequence of events for a set (Distractor-target match) trial events. Target letters were defined by a specific color (red or green), exactly one of which was present on each trial. Participants reported the identity of the letter at the conclusion of the RSVP stream. Target arrays appeared 175 ms after the onset of the colored distractor array. One of the four distractors (# symbol) appeared in color on three quarters of the trials and was equiprobably blue, red, or green. All nontarget letters were presented in gray color in Experiment 1 and were heterogeneously colored (never red or green) in Experiment 2. The presentation sequence for Experiment 3 was identical to that in Experiments 1 and 2; however, the color of the target and distractors was different (see the Method sections for details)

directed away from the main RSVP stream, and the target is missed, reducing target identification accuracy. In Experiment 1, observers searched for a red or a green target among gray nontargets; we found that observers relied on singleton search mode and were captured by any salient peripheral distractor. In Experiment 2, observers searched for red and green targets that appeared among heterogeneously colored nontarget letters. In this case, only red and green peripheral distractors produced a spatial blink, suggesting that observers maintained multiple attentional control settings for these specific task-relevant features. Finally, in Experiment 3, observers searched for two possible target colors, and the colors varied on each trial. Despite being unable to use a longer-term representation of the target colors, as in Experiment 2, observers in Experiment 3 continued to be captured only by distractors in the cued set. Not only can attention be configured to multiple potential targets, but also multiple control settings are flexible and can be maintained in shorter-term representations.

Experiments 1 and 2

Method

Participants

Forty University of Iowa undergraduates (20 per experiment) participated in a single study session for course credit. All had normal or corrected-to-normal vision.

Stimuli and procedure

A Mac mini computer displayed stimuli on a 17-in. CRT monitor and recorded responses made via a keyboard buttonpress. The monitor resolution was 1,024 × 768 pixels, with an 80-Hz refresh rate. The experiment was controlled using MATLAB software with Psychophysics Toolbox Version 3 (Brainard, 1997).

Observers viewed stimuli from 55 cm in a dimly lit room. A white fixation circle measuring 0.26° of visual angle in diameter appeared at the center of a black screen for 1,000 ms, followed by a 150-ms blank black screen. Stimuli appeared in 20-point uppercase Helvetica font. Target and nontarget letters were presented at the center of a black screen; the letters were 1.32° wide × 1.85° tall. Each target was chosen equiprobably from the following set of 15 letters: A, B, C, D, E, F, G, H, J, K, L, M, N, P, and R. The remaining 14 letters served as nontarget fillers and were presented with the target in the RSVP stream. The target was located equiprobably in position 8, 9, 10, 11, or 12 of the 15-position RSVP stream. Each item was displayed for 50 ms, followed by a 37.5-ms (three screen refreshes) blank display. On every trial, four distractor pound (#) symbols were presented. The distractor arrays were simultaneously presented with a filler letter and always occurred exactly two positions (180 ms) before the target. The distractors were the same size as the target and fillers but were displayed 3.80° (center to center) above, below, to the right, and to the left of the RSVP stream. Trials were initiated via keypress response to the preceding trial.

For Experiments 1 and 2, target letters were either red or green (RGB values [255 0 0] and [0 255 0], respectively). On 75 % of the trials, a single random distractor was equiprobably red, green, or cyan (RGB value [0 255 255]). At all other times, distractors were gray (RGB value [150 150 150]). For Experiment 1, nontarget letters in the RSVP stream were gray. For Experiment 2, nontarget letters in the stream were heterogeneously colored. Each of the following 14 colors was used on every trial: cyan, purple (RGB value [155 48 255]), yellow [255 255 0], orange [255 128 0], magenta [255 0 255], medium purple [147 112 219], royal blue [65 105 225], dodger blue [30 144 255], deep pink [255 20 147], khaki [240 230 140], gold [255 215 0], goldenrod [218 165 32], blue violet [138 43 226], and hot pink [255 105 180].

Observers were instructed to maintain fixation at the center of the screen and monitor the stream of letters for the red or green target. Observers were told that there would always be either a red or a green letter, and they were instructed to report the identity of the red or green letter via keyboard press at the conclusion of the RSVP stream. Observers had unlimited time to produce their response. Observers were also informed that there would be distracting stimuli that needed to be ignored in order to properly complete the task.

Both experiments included four conditions based on the relationship between the distractor type and the target color: (1) *neutral* condition (four gray pound symbols appeared with no color singleton; neutral distractors appeared on 25 % of the trials), (2 and 3) *set* condition (a red or green singleton appeared in the distractor display; these distractors were further divided on the basis of whether they matched the target color on the trial [e.g., red singleton distractor followed by a red target] or mismatched the target color on the trial [e.g., red singleton distractor followed by a green target]; matching and mismatching set color distractors each appeared on 25 % of trials), and (4) *nonset* condition (a blue singleton appeared in the distractor display; these distractors appeared on 25 % of the trials).

Observers first completed a practice block of 20 trials. For all experiments, practice trials were identical to their respective experimental trials, with the exception that practice trials included only gray distractors. Experiments 1 and 2 consisted of 600 trials, with breaks every 50 trials. The entire session lasted approximately 30 min.

Results and discussion

Experiment 1: singleton search mode

Target identification accuracy for each of the four distractor types appears in Fig. 2. Set colored distractors have been split between match trials (distractor color and the target color were identical) and mismatch trials (distractor color and the target color were different). These conditions were analyzed separately for all experiments. As is evident in the graph, observers were distracted little by neutral, homogeneous gray distractors and were accurate in reporting the target's identity; however, observers were distracted by all singleton distractors, both those that were drawn from the target color pair (red and green) and those that were not drawn from the target color pair (blue).

These observations were supported by a one-factor repeated measures ANOVA, which found significant differences among the four conditions, $F(3, 17) = 17.57$, $p < .0005$. Bonferroni-corrected pairwise comparisons revealed a significant difference between distractors that were identical to the target color (set match condition; 71 % correct) and neutral gray distractors (91 % correct), $t(19) = -7.81$, $p < .0005$, and between distractors that did not match the target colors but were nevertheless set colors (set mismatch condition; 72 % correct) and neutral gray distractors, $t(19) = -7.22$, $p < .0005$. Additionally, there was a significant difference for target identification accuracy between distractors that were not part of the set colors (nonset condition; 77 % correct) and neutral gray distractors, $t(19) = -6.13$, $p < .0005$. There was also a significant difference between set match and nonset distractor colors, $t(19) = 3.73$, $p = .009$, and a marginal difference between set mismatch and nonset distractors, $t(19) = -3.00$, $p = .054$. There was no difference between set match and mismatch distractors, $t(19) = -0.89$, $p > .99$, replicating previous results (e.g., Irons et al., 2012).

Experiment 1 generally replicated the findings reported by Folk and Anderson (2010) and suggests that observers were in singleton search mode. Any salient, unique distractor captured attention and produced a spatial blink, which reduced target identification.

Experiment 2: feature search mode

Target identification accuracy for each of the four distractor types appears in Fig. 3. This graph depicts a pattern different from that in Experiment 1: Although observers were again distracted little by neutral, homogeneous 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.

These conclusions were supported by a one-factor repeated measures ANOVA, which found significant differences among the four conditions, $F(3, 17) = 19.68$, $p < .0005$. Bonferroni-corrected pairwise comparisons revealed a significant difference between distractors identically matching the target colors (set match condition; 49 % correct) and neutral gray distractors (neutral condition; 55 % correct), $t(19) = -4.62$, $p = .001$, and nonset distractors (nonset condition; 58 % correct), $t(19) = -5.44$, $p < .0005$. Identification accuracy also differed between set colored distractors that did not match the target (set mismatch condition; 45 % correct) and neutral gray distractors, $t(19) = -5.94$, $p < .0005$, and nonset distractors, $t(19) = -7.53$, $p < .0005$. There

Fig. 2 Mean percent accuracy as a function of distractor color condition in Experiment 1. Asterisks denote significance from the neutral condition at the $p < .0005$ level via Bonferroni-corrected *t*-tests. Error bars represent 95 % within-subjects confidence intervals (Cousineau, 2005; Loftus & Masson, 1994)

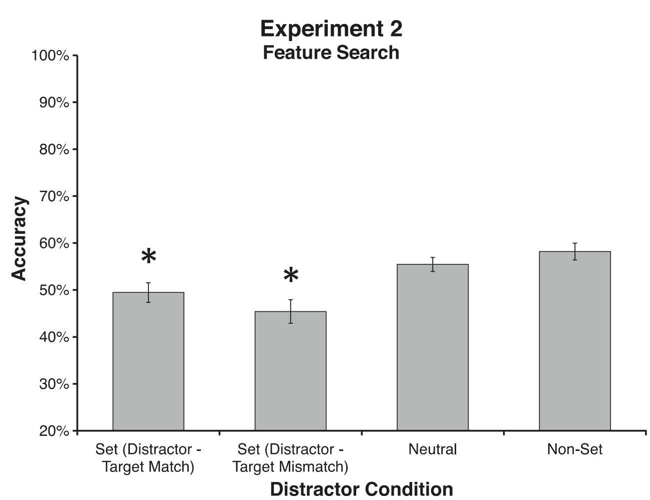

Fig. 3 Mean percent accuracy as a function of distractor color condition in Experiment 2. Asterisks denote significance from the neutral condition at the $p < .001$ level via Bonferroni-corrected *t*-tests. Error bars represent 95 % within-subjects confidence intervals (Cousineau, 2005; Loftus & Masson, 1994)

was no difference between set match and mismatch distractors $t(19) = 2.28$, $p = .24$, replicating previous results (e.g., Irons et al., 2012). No other pairwise comparisons were significant.

For further support of multiple control settings in feature search mode, we compared the amount of capture produced by a task-irrelevant (blue) singleton and neutral distractors across Experiments 1 and 2. In Experiment 1, nonset singletons reduced target identification accuracy by 15 percentage points, as compared with neutral distractors. In contrast, in Experiment 2, task-irrelevant singletons did not reduce target identification accuracy, as compared with neutral distractors. The decrement in target identification was significantly larger in Experiment 1 than in Experiment 2, indicated by a significant two-way interaction between experiment and distractor condition (nonset distractor vs. neutral distractor), $F(1, 38) = 21.43$, $p < .0005$.

The present findings replicate those in previous studies of multiple control settings under singleton search (Folk & Anderson, 2010) and feature search (Irons et al., 2012). Furthermore, we do not find evidence for any priming across distractor and target colors (see also Irons et al., 2012). Importantly, due to the nature of the RSVP task, our results demonstrate that multiple attentional control settings operate independently of spatial location. This supports the finding of Irons et al. suggesting that multiple attentional control settings operate across an entire visual scene.

As was discussed above, in Experiment 3 we asked whether multiple attentional control settings can be established and maintained on a trial-by-trial basis, presumably mediated by working memory. Observers performed the feature search task used in Experiment 2, but there were three potential target colors (red, green, and blue), and two of these three colors were cued on each trial. To determine whether control settings can be unique for an individual trial, peripheral distractors could be (1) one of the possible target colors (*set* colors) that was cued on the current trial (*cued set* condition), (2) a set color, but one that was not cued on the current trial (*uncued set* condition), or (3) a color that was never a target (*nonset* condition). These distractors were contrasted with neutral distractors as in the previous experiments.

If multiple attentional control settings can be established on a trial-by-trial basis, observers would show poorer accuracy for cued set distractors, but not for uncued set distractors. In contrast, if observers configure attention to all possible target colors, accuracy would be low for all possible set colors, irrespective of which colors were cued on the current trial, but nonset peripheral distractors would not capture attention.

Experiment 3

Method

Participants

Twenty University of Iowa undergraduates participated for course credit. All participants had normal or corrected-to-normal vision.

Stimuli and procedure

Experiment 3 differed from the first two experiments in several important ways. First, target colors throughout the entire experiment were equiprobably red, green, and blue (blue RGB value [30 144 255]). Before every trial, two of these three colors were cued by displaying the name of the colors in white text for a duration of 1,000 ms; one cue word appeared above fixation, and the other below fixation. These cues indicated the color of the upcoming target with 100 % certainty; one of the two cued colors would always be the target, and each cued color was equally likely to be the target. Second, new distractor colors were introduced to replace filler colors that could potentially be confused with the blue target color. These new distractor colors included yellow (RGB value [255 255 0]), plum [221 160 221], and brown [139 69 19]. On 25 % of the trials, a neutral distractor appeared; as in Experiments 1 and 2, this distractor did not contain a singleton (as in Experiments 1 and 2). On 75 % of the trials, a colored distractor appeared and was equiprobably a cued set color, an uncued set color, or a nonset color (equiprobably yellow, saddle brown, or plum). For example, if *red* and *green* were the targets on a particular trial, red and green distractors would be cued set distractors, a blue distractor would be an uncued set distractor, and a sienna distractor would be a nonset color distractor. The latter type of singleton distractor allowed us to determine whether observers maintained an attentional set for all three possible target colors or whether they selectively configured attention to the two cued target colors on an individual trial. Experiment 3 consisted of 480 trials, with breaks every 40 trials, and lasted approximately 30 min.

Results and discussion

Target identification accuracy for each of the five distractor types appears in Fig. 4. To reduce any putative intertrial effects, uncued set trials where the distractor color matched the target color of the previous trial were eliminated. This resulted in a reduction of one third of the trials in the uncued set condition (8.33 % overall). No trends were affected by the elimination of these data. As is illustrated in the graph, observers were distracted less by gray distractors, salient

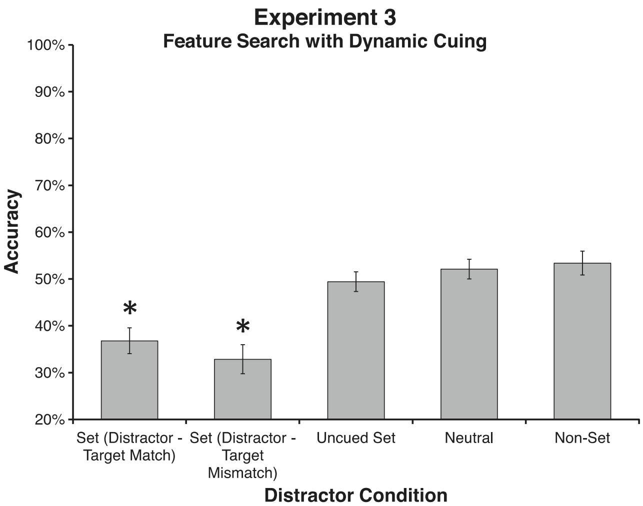

Fig. 4 Mean percent accuracy as a function of distractor color condition in Experiment 3. Asterisks denote significance from the neutral condition at the $p < .0005$ level via Bonferroni-corrected t-tests. Error bars represent 95 % within-subjects confidence intervals (Cousineau, 2005; Loftus & Masson, 1994)

colored nonset distractors, and uncued yet, nonetheless, set colored distractors, as compared with cued set colored distractors. An additional finding, which is consistent with Experiments 1 and 2 and replicates Irons et al. (2012), is that we found no difference between set colored distractors that matched versus mismatched the color of the target.

These conclusions were supported by a one-factor repeated measures ANOVA, which found significant differences between the five conditions $F(4, 16) = 41.86$, $p < .0005$. Bonferroni-corrected pairwise comparisons revealed significant differences between cued set match (37 % correct) and uncued set (49 % correct), $t(19) = -7.88$, $p < .0005$, neutral (52 % correct), $t(19) = -9.00$, $p < .0005$, and nonset colored (53 % correct), $t(19) = -7.90$, $p < .0005$, distractors, as well as significant differences between cued set mismatch (33 % correct) and uncued set, $t(19) = -9.22$, $p < .0005$, neutral, $t(19) = -8.77$, $p < .0005$, and nonset colored, $t(19) = -8.91$, $p < .0005$, distractors. There was no difference between cued set match and mismatch distractors, $t(19) = 1.70$, $p > .99$, replicating previous results (e.g., Irons et al., 2012). No other pairwise comparisons were significant.

D'Zmura (1991) and Bauer, Jolicoeur, and Cowan (1996a, 1996b) have proposed that visual search performance is modulated by whether the target color can be linearly separated from the distractor colors in CIE(x,y) color space. They found that visual search is easiest when a straight line can be drawn in color space that completely segregates the target color from the distractor colors; search becomes increasingly more difficult as the degree of separation is decremented. One possible account of our results is that the linear separability of targets and distractors affected capture, not the maintenance of multiple control settings. Specifically, observers could rely on a separation in color space, not multiple control settings, to control attention.

To address this linear separability alternative, we addressed the extent to which potential target colors were or were not linearly separable from potential distractors. Using standard luminance values, all colors from Experiment 3 were transformed from RGB to CIE (u',v') and plotted on a CIE uniform chromaticity scale chart (see Fig. 5). This linear separability account would amount to increased accuracy when the cued target colors were linearly separable, as compared with when they were not. Consequently, we would expect greatest accuracy when the cued target colors are green and blue, because those two colors are mutually separable from the other colors. The cued target colors red and blue can be linearly separated from other potential distractor colors (green, yellow, brown, plum, and gray), but not from all colors. The third cued target color pair, red and green, cannot be linearly separated from potential distractor colors or nontarget filler colors and, therefore, would be expected to produce the least accurate responses.

Planned comparison t-tests revealed differences depending upon which target colors were cued, but these differences did not accord with the linear separability hypothesis. Accuracy when red and green were potential targets was not significantly different from that when green and blue were potential targets (50 % correct vs. 49 % correct), $t(19) = 0.69$, $p = .50$; however, performance when cued target colors were blue and red (45 % correct) was significantly worse than when cued target colors were red and green, $t(19) = 3.13$, $p = .0056$, and when they were green and blue, $t(19) = 2.89$, $p = .0094$. Thus, although observers had an

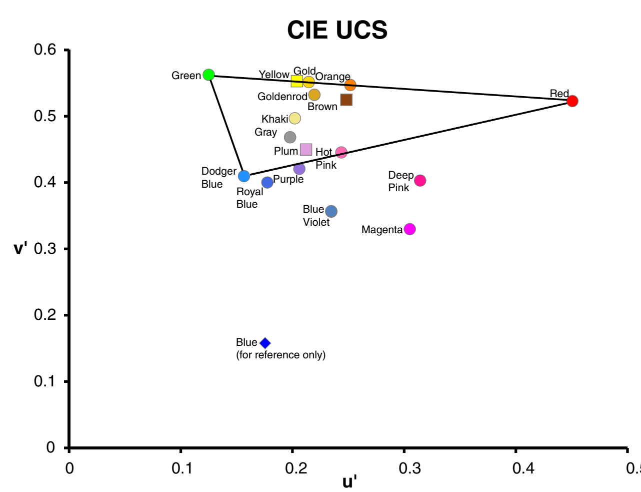

Fig. 5 Color space plot depicting all colors used in Experiment 3. Potential target colors (red, green, and dodger blue) are connected with lines, and nonset colors are denoted by squares. The blue color (RGB value [0 0 255]), denoted by the diamond, is included for reference only. Color values are represented using the CIELUV metric

opportunity to use a linear separability strategy, it appears that they did not use this strategy.

General discussion

These experiments demonstrate that human observers are extraordinarily flexible in establishing and employing attentional control settings. When a task environment allows a target to be discriminated from distractors on the basis of a single color feature, observers implement a *singleton* control setting and search for any inhomogeneity in the display (Experiment 1). Consequently, any uniquely colored distractor captures attention, irrespective of whether it matches or mismatches the target set. When a task environment requires more precise attentional control, as when a red or green target is searched for among colored distractors, observers implement a *feature search* control setting (Experiment 2). In this case, observers appear able to implement multiple control settings and search for a target that is either red or green. Finally, and most important, observers can configure attention uniquely on each trial, searching only for two cued colors (Experiment 3). These cued colors capture attention, but an uncued color distractor does not, even though this color is a potential task-relevant color on other trials.

An important question for discussion concerns how observers maintained two control settings for potential target colors. Previous research, and Experiments 1 and 2, make it difficult to distinguish between two possibilities: (1) observers maintaining separate settings for ‘red’ and ‘green’ simultaneously or (2) observers choosing a single color as their setting across the entire experiment or on a trial-by-trial basis. However, our third experiment indicates that observers can dynamically use multiple control settings on a trial-by-trial basis. One possibility, however, is whether observers hold control settings for both of the cued colors in working memory or whether they randomly choose one cued color. Such a possibility would be difficult to test, but converging evidence could be obtained from a concurrent working memory task or from an indirect measure of the contents of working memory; for example, the CDA ERP component (Vogel & Machizawa, 2004) could be used to examine whether the maintenance of multiple control settings is reliant upon the availability of working memory resources. In Experiment 3, we made the assumption that observers discretely maintained the two cued colors. Because two of three potential colors were cued on each trial, it is possible that observers could have, instead, adopted an inhibitory template for the uncued color. This alternative appears highly unlikely, since the data show no evidence of capture for the nonset colors.

Our findings speak to an emerging literature on multiple control settings. They also appear to address recent claims regarding the *attentional template* used to guide attention in visual search. A literature review by Olivers, Peters, Houtkamp, and Roelfsema (2011) suggested that the current evidence favors only a single attentional template within visual working memory. Our results indicate that observers can maintain two target templates. Of course, there are differences between capture tasks and typical visual search tasks used to assess target templates. Also, there is some evidence that the control settings for feature and singleton search modes may not rely on visual working memory: Wang and Most (2008) asked observers to maintain items in visual working memory while performing a contingent attentional capture task; observers maintained attentional control settings in the face of a high visual working memory load, suggesting that visual working memory was not necessary for maintaining control settings. However, targets were constant across the Wang and Most experiments, allowing the possibility that longer-term memory, not working memory, was used to maintain the control settings.

The present 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 task environment). This range of control settings points to the flexibility of the attentional system and the behavior produced by that system.

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