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Emotional Devaluation of Distracting Patterns and Faces: A Consequence of Attentional Inhibition During Visual Search?

Jane E. Raymond
University of Wales, Bangor

Mark J. Fenske
Harvard Medical School

Nikki Westoby
University of Wales, Bangor

Visual search has been studied extensively, yet little is known about how its constituent processes affect subsequent emotional evaluation of searched-for and searched-through items. In 3 experiments, the authors asked observers to locate a colored pattern or tinted face in an array of other patterns or faces. Shortly thereafter, either the target or a distractor was rated on an emotional scale (patterns, cheerfulness; faces, trustworthiness). In general, distractors were rated more negatively than targets. Moreover, distractors presented near the target during search were rated significantly more negatively than those presented far from the target. Target–distractor proximity affected distractor ratings following both simple-feature and difficult-conjunction search, even when items appeared at different locations during evaluation than during search and when faces previously tinted during search were presented in grayscale at evaluation. An attentional inhibition account is offered to explain these effects of attention on emotional evaluation.

Keywords: visual search, attention, evaluation, faces, inhibition

The ability to rapidly and efficiently locate a specific object of interest in a crowded visual array is a fundamental function of the human visual system. Indeed, over the past 40 years or so, the visual and attentional mechanisms that determine visual search efficiency have been studied extensively, and several accounts have been posited (e.g., Duncan & Humphreys, 1989; Julesz, 1984; Neisser, 1967; Treisman, 1999; Treisman & Gelade, 1980; Treisman & Sato, 1990; Wolfe, 1994; Wolfe, Cave, & Franzel, 1989). Searching for and locating an object is, however, just the first step in the visual control over action. Once an object is located, it must be evaluated emotionally in light of immediate and long-term goals to determine whether approach versus avoidance behaviors should be engaged. Therefore, if vision is to control and direct action appropriately (e.g., reaching for a ripe red apple, avoiding a bruised one), coordinated activity of both visual search and visual evaluative mechanisms is necessary.

The need for coordinated activity suggests that the brain systems mediating visual search and affective evaluation should interact. Indeed, recent human neuroimaging studies have shown that some brain structures, such as the anterior cingulate and orbitofrontal cortices, are important for both attentional control and emotional evaluation and are involved during emotionally mediated attentional responses (Armony & Dolan, 2002; Bush, Luu, & Posner, 2000; Vuilleumier, Armony, Driver, & Dolan, 2001). Given the role of emotion in setting behavioral agendas, it is not surprising that emotional states have been found repeatedly to influence selective attention processes. Numerous behavioral, electrophysiological, and neuropsychological studies have shown that emotional stimuli (e.g., angry faces) attract (Eastwood, Smilek, & Merikle, 2001; Pourtois, Grandjean, Sander, & Vuilleumier, 2004; Vuilleumier & Schwartz, 2001) and hold (Fenske & Eastwood, 2003; Fox, Russo, Bowles, & Dutton, 2001) attention more than neutral or novel stimuli and that subjective mood states (Sedikides, 1992) and emotional disorders (MacLeod, Mathews, & Tata, 1986; McCabe & Gotlib, 1995) alter selective attention. Moreover, recent pharmacological neuroimaging data obtained after administration of the acetylcholinesterase inhibitor physostigmine (Bentley, Vuilleumier, Thiel, Driver, & Dolan, 2003) suggest that the modulatory effects of emotion on attention may be mediated through cholinergic projections to the parietal (Holland & Gallagher, 1999) and orbitofrontal (Aou, Oomura, & Nishino, 1983; Cavada, Company, Tejedor, Cruz-Rizzolo, & Reinoso-Suarez, 2000) cortices. Taken together, these studies provide substantial evidence that emotion can influence attention. However, what about the reciprocal effect? Do the attentional processes operating during visual search exert an influence over the emotional response to the searched-for and searched-through items?

Only a handful of studies speak to this issue. Raymond, Fenske, and Tavassoli (2003) presented two different colorful, abstract patterns (*Mondrians*) and asked observers to locate one and ignore the other. After this simple visual localization task, which served

Jane E. Raymond and Nikki Westoby, School of Psychology, University of Wales, Bangor, Gwynedd, Wales; Mark J. Fenske, MGH Martinos Center for Biomedical Imaging, Harvard Medical School.

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Correspondence concerning this article should be addressed to Jane E. Raymond, School of Psychology, Brigantia Building, University of Wales, Bangor, Gwynedd LL57 2AS, Wales. E-mail: j.raymond@bangor.ac.uk

to focus attention on one of two items, observers rated previously attended, previously ignored, or novel patterns on a positive (i.e., how cheerful?) or negative (i.e., how dreary?) emotional dimension. By using both positively and negatively valenced response scales, the authors were able to assess emotional tone rather than a simple response bias toward whatever was being held in mind. Their main finding was that previously ignored stimuli, compared with previously attended or novel stimuli, were subsequently emotionally devalued (i.e., liked less). This was the first demonstration that attention can indeed influence emotional evaluation, and it provides the basic rationale for exploring the possibility that visual search of complex arrays may have emotional consequences.

The devaluation of prior distractors (compared with prior targets), referred to here as the *distractor devaluation effect*, cannot be explained by existing theories regarding preexposure effects on affective responses to stimuli, such as the mere exposure effect. The mere exposure effect refers to enhanced emotional evaluation of stimuli produced through repeated exposure (Bornstein, 1989; Zajonc, 1968, 2001). One widely accepted explanation for this phenomenon postulates that prior experience eases subsequent perceptual processing. The resulting *perceptual fluency* that is experienced in subsequent encounters is interpreted as positive affect (Bornstein & D'Agostino, 1994; Seamon, Brody, & Kauf, 1983). However, the affective correlates of fluency are thought to be distinctively positive (e.g., Reber, Winkielman, & Schwarz, 1998; Winkielman & Cacioppo, 2001), which contrasts with Raymond et al.'s (2003) finding that evaluations of previously ignored items were more negative than evaluations of novel (and therefore nonfluent) items.

To explain the distractor evaluation effect, Raymond et al. (2003) suggested an inhibition-based account of the influence of attention on emotion. They proposed that when an inappropriate stimulus (distractor) competes for control over responses, attentional inhibition is applied and stored with its representation (Kessler & Tipper, 2004; Tipper, Grison, & Kessler, 2003). When the previously ignored stimulus is then encountered again, this inhibition is reinstantiated and, when applied to the current evaluative task, leads to emotional devaluation.

According to this view, attention should influence emotional evaluation whenever inhibition has been applied. However, many traditional views of the attentional processes underlying visual search do not explicitly posit distractor inhibition and, therefore, do not predict distractor devaluation effects to result from search. These models emphasize excitatory mechanisms that capitalize on the results of a parallel, preattentive stage that establishes basic features (e.g., Treisman & Gelade, 1980; Wolfe, 1994; Wolfe et al., 1989), stimulus saliency (e.g., Cave & Wolfe, 1990), or similarity among stimuli (e.g., Duncan & Humphreys, 1989) in a bottom-up fashion. This is then matched with top-down strategic influences to ensure that targets receive the priority processing needed for successful recognition and appropriate response. Despite these prevailing views, some accounts of behavioral performance in search tasks explicitly posit that interference from distractors is reduced by the application of inhibition to locations containing stimuli with task-irrelevant features (Treisman, 1993; Treisman & Sato, 1990). A number of computational models of search also implement distractor inhibition (e.g., Cave, 1999; Deco & Zihl, 2001; Heinke & Humphreys, 2003; Humphreys & Müller, 1993; Mozer & Sitton, 1998; Tsotsos et al., 1995), and several behavioral reaction time (RT) studies of distractor interference have posited inhibition to account for their results (e.g., Caputo & Guerra, 1998; Cave & Zimmerman, 1997; Cepeda, Cave, Bichot, & Kim, 1998; Cutzu & Tsotsos, 2003; Mounts, 2000). It is critical to note that single-unit recordings from the monkey inferior-temporal cortex during visual search tasks have shown that cells sensitive to distractors showed discharge inhibition about 200 ms after search displays were presented (Chelazzi, Miller, Duncan, & Desimone, 1993). Similarly, single-unit recordings from monkey frontal eye field cells showed that target selection during a typically highly efficient pop-out search task also used distractor suppression (Bichot & Schall, 2002). Together, these studies suggest that distractor inhibition may operate during visual search, and if Raymond et al.'s (2003) devaluation-by-inhibition hypothesis is correct, then there may indeed be affective consequences for stimuli presented while one is performing a simple visual search task.

It is now well established that attentional inhibition can be specifically associated with object representations (e.g., Abrams & Dobkin, 1994; Gibson & Egeth, 1994; Jordan & Tipper, 1999; Kessler & Tipper, 2004; Reppa & Leek, 2003; Tipper, 1985; Tipper & Cranston, 1985; Tipper, Driver, & Weaver, 1991). Location-based inhibitory processes also play a crucial role in selection. This point is made clear by the results of studies showing that the amount of distractor interference in visual search was determined by target–distractor proximity, presumably because of greater distractor inhibition at locations near the target than those farther away. Mounts (2000), for example, reported that performance in a form discrimination task was impaired by the presentation of a salient color singleton meant to capture attention away from the target. However, the magnitude of this distraction effect was significantly less when the distracting singleton was presented closer to the target than when it appeared farther away. Because distractors close to targets may otherwise interfere more than distractors far from targets, the results of this study suggest that the visual system may adaptively engage a ring of attentional inhibition that surrounds an attended item. There is additional support for this proposal from a number of behavioral, electrophysiological, and neuroimaging studies showing similar distance-mediated inhibition effects on behavioral RTs and on cortical response in striate and extrastriate regions (e.g., Bahcall & Kowler, 1999; Caputo & Guerra, 1998; Cave & Zimmerman, 1997; Cepeda et al., 1998; Cutzu & Tsotsos, 2003; Slotnick, Hopfinger, Klein, & Sutter, 2002; Slotnick, Schwarzbach, & Yantis, 2003). Thus, the devaluation-by-inhibition hypothesis predicts that both object-based and location-based inhibitory attentional effects should contribute to search-related effects on evaluative responding. Moreover, the *center-surround* view of attentional inhibition allows the further prediction that distractors in a search array should be evaluated more negatively when they are near the target than when they are far from it.

Perceptual fluency theories of evaluation make quite different predictions regarding the affective consequence of visual search. A straightforward interpretation of the perceptual fluency notion predicts that targets and distractors should be evaluated equally because each is exposed for the same amount of time. Another possible prediction arising out of perceptual fluency theory is that, if one assumes a briefly presented array, items presented near the initial fixation point might receive more or higher quality perceptual processing than items presented at more eccentric locations because of cortical magnification of the central retina (De Valois & De Valois, 1988). If this were the case, centrally presented (high-fidelity) items should receive higher evaluations than more eccentrically presented (low-fidelity) ones.

However, data arguing against a role for perceptual fluency in visual search tasks were reported in a recent study by Fenske, Raymond, and Kunar (2004). They measured emotional evaluation of Mondrian stimuli that had been just previously presented in a temporally segmented visual search paradigm involving a preview of a subset of distractors (Watson & Humphreys, 1997). On some trials, half of the distractors were presented for one full second (preview) prior to the onset of a search array containing another set of distractors and a target, which thus provided an opportunity for significant fluency for the previewed items to develop. The first set of distractors shared one feature (texture) with the target, and the second set of distractors shared a different feature (color) with the target. On other, no-preview trials, both sets of distractors and the target were presented simultaneously. After each search trial, observers rated a distractor Mondrian using a *cheery or dreary* scale. As expected, the majority of participants showed more efficient search with a lengthy preview of the first set of distractors. Watson and Humphreys (1997) proposed that the beneficial effect of the preview occurs because the locations of the previewed distractors are subjected to attentional inhibition, which leaves the target to compete with a smaller, featurally distinct set of distractors. Consistent with the devaluation-by-inhibition hypothesis, Fenske et al. found that the benefit in search times was accompanied by devaluation of the first set of distractors when they were presented in preview compared with when they were presented simultaneously with the target and other set of distractors. This result is impressive because the attentional effects clearly overwhelmed any effect of perceptual fluency associated with previewed distractors having longer exposure duration and being associated with an easier task (i.e., the more efficient search condition). However, although this study provides evidence that presumed inhibitory processes in search can influence later evaluative responses, it does not provide any direct clues as to the presence of a distractor devaluation effect in simple search tasks, because participants searched for a conjunction of features and because the targets were not evaluated per se.

In the first two experiments of the current study, we presented participants with arrays of 4, 8, or 16 unique Mondrian patterns and asked them to locate a target as quickly as possible. The target was always defined by color alone, and distractors always shared the same color (different from the target), which enabled highly efficient responding independent of set size. A few seconds later, participants evaluated the just-seen target or one of the distractors. In the first experiment, these to-be-rated stimuli were presented at the same location they had just previously occupied in the search task. Half the participants rated the stimuli for cheerfulness, and half rated them for dreariness. In the second experiment, we presented each to-be-rated pattern centrally so that we could separate the contribution of location-based and object-based inhibition. In the third experiment, we replaced the Mondrian stimuli with grayscale faces that had been transparently tinted yellow or blue. The set sizes presented were reduced to 3, 5, or 7, and the task was altered to become a slow, effortful search for a conjunction of gender and tint. After each search trial, a single grayscale face (either the prior target or a prior distractor) without a tint was presented at the center of the screen. Participants rated it for trustworthiness or untrustworthiness. In all three experiments, we found that prior attention could modulate emotional evaluation of stimuli and that the magnitude of this effect increased with target–distractor proximity.

Experiment 1

There are four main questions addressed by Experiment 1: (a) Would the distractor devaluation effect found previously (Raymond et al., 2003) with a simple, two-item visual search task be evident with search arrays containing multiple distractors? (b) Would these effects vary with set size? (c) Would the relative proximity of items to central fixation affect their subsequent evaluation? (d) Would the proximity of targets to distractors have an effect on their subsequent rating? The devaluation-by-inhibition hypothesis predicts that distractors should be devalued in multiple-item visual search, regardless of the number of distractors, and that target–distractor proximity should modulate the amount of distractor devaluation. Perceptual fluency predicts no devaluation of distractor relative to targets and possibly elevated ratings for centrally presented items.

Method

Participants. Forty experimentally naive adults (mean age 22.5 years; 22 women, 18 men) were recruited from the student and community participant panels of the University of Wales, Bangor, and participated in Experiment 1 in exchange for course credit or money. All reported normal or corrected-to-normal visual acuity, and each gave informed consent prior to participation.

Apparatus and stimuli. The experiment was conducted with a Pentium-IV computer controlling a 33-cm color monitor (100-Hz; 1,024 × 768 resolution) running E-Prime 1.1 software (Schneider, Eschman, & Zuccolotto, 2002). Displays were viewed at an average distance of 70 cm in a small, quiet room, without other people present and with low ambient illumination.

All stimuli appeared on a uniform white field. Alphanumeric stimuli (i.e., + and ?) appeared in black 18-point Courier-New font. Mondrians were 3.5-cm (approximately 2.9°) square patterns, each composed of 32 overlapping square elements, with each element colored (eight-bit palette) a randomly selected shade of red (red/green/blue [RGB] range: 119/0/0 to 238/0/0) or each colored a random shade of green (RGB range: 0/119/0 to 0/238/0). An example is shown in Figure 1 (panel A). The size of each square was also selected randomly (range: 3.5 mm–13.5 mm), as was the extent to which it overlapped or was overlapped by other elements. For added distinctiveness, the foreground (red or green) elements of each pattern appeared on a background of 9 larger (11.7 mm) square elements, each colored a randomly selected shade of gray (RGB range: 34/34/34 to 238/238/238). Thus, it appeared as though the gaps between red or green elements were filled by different shades of gray.

Each Mondrian was presented only once in a single visual search display, and a subset was seen a second time during the succeeding evaluation task. The Mondrians used in each trial for each participant were randomly selected from a pool of 944 exemplars. In this way, every target and distractor in every search trial was a novel, unique exemplar. Using this random selection technique also served to minimize any systematic item effects on ratings scores.

Experimental design. There were two possible targets, defined simply by color (red or green). Half of the participants searched for red targets in arrays of green distractors, and the remaining participants searched for

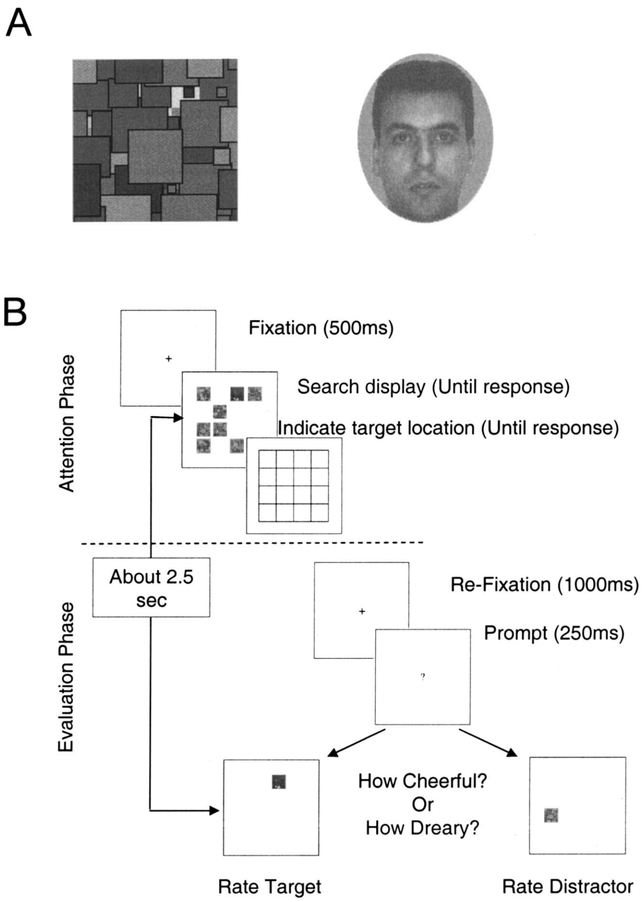

Figure 1. Panel A: An example of the stimuli used. Panel B: An example of a trial from Experiment 1.

green targets in arrays of red distractors. For the rating task, half of each group rated stimuli (using a 5-point scale) on a positively worded scale regarding the cheerfulness of each Mondrian (1 = *not at all cheerful* to 5 = *very cheerful*). The remaining participants rated how dreary each stimulus appeared (also using a 5-point scale; 1 = *not at all dreary* to 5 = *very dreary*).

Every participant in each group completed 96 experimental trials. Each trial consisted of a visual search task followed by a rating task. There were 32 trials for each of three different set sizes (4, 8, and 16). The target and distractors always appeared in randomly determined locations, with the sole constraint that on half of the trials the target appeared to the right of the fixation and on the remaining trials it appeared to the left of the fixation. For half of the trials, the target in that trial's search task was evaluated in the rating task. On the remaining trials, a randomly selected distractor from that trial's search task was evaluated. The order of trial types was randomized separately for each participant.

Procedure. An illustration of the trial sequence used in Experiment 1 is provided in Figure 1B. A trial began with a 500-ms presentation of a fixation cross, immediately followed by the presentation of the search array. Participants were instructed to left click the mouse as soon as they detected the target. With this response, the display was removed and replaced with a grid demarcating all possible target locations. Participants moved the cursor (using the mouse) to the target's grid position and again left clicked the mouse. After this response, another fixation cross was presented for 1,000 ms, followed by a "?" prompt for another 250 ms. A Mondrian from the previous array was then presented for 500 ms in its original location. The screen then went blank, and participants entered a rating value (1 to 5) using the number keys of the computer keyboard. They were told to base their evaluation of the Mondrian on an initial gut reaction to the stimulus.

Each experimental session was preceded by 12 practice trials. Experimental trials were then conducted in three separate blocks of 24 trials, with a brief rest period between blocks. The experimental session lasted no longer than 15 min.

Data analysis. Data were analyzed only from trials in which the target localization task was correctly performed. Error rates were low (7%) and did not vary systematically with set size or rating scale (as tested via mixed-design repeated measures analysis of variance [ANOVA]; both Fs < 1). We then subjected target RT data to the recursive procedure described by Van Selst and Jolicoeur (1994) to identify and eliminate trials with outliers (i.e., those with unusually long or short search task RTs). This procedure excluded fewer than 4% of remaining trials from further analysis. Finally, we calculated the mean RT to make rating judgments for each participant and eliminated those trials for which the rating judgment was made in less than 200 ms (anticipation errors) or was longer than 4 s. This procedure preempted 4% of remaining trials from further analysis. From the remaining data, we calculated mean search RTs from trials at each set size for each participant.

Data from the rating scales were converted to reflect emotional tone: Cheeriness ratings remained the same, but dreariness ratings were reversed (e.g., a score of 5 was converted to a score of 1). Thus, a high score on the converted data reflects a positive evaluation, and a low score reflects a negative evaluation. Mean ratings were calculated for each participant from these converted data for prior targets and distractors from trials at each set size. Where applicable, either mixed-model or repeated-measures ANOVAs and paired-sample t tests were used to assess statistical significance. A criterion alpha value of .05 was used throughout.

Results and Discussion

Visual search performance. Search RTs were highly similar across set size, with group means of 538 ms, 543 ms, and 547 ms for 4, 8, and 16 items, respectively. When plotted as a function of set size, these data produced a mean search slope of 0.76 ms/item (SE = 0.86 ms/item). This shallow slope, combined with the finding that there was no systematic effect of set size, $F(2, 39) < 1.0$, indicates that visual search was highly efficient, as expected. An ANOVA on the RT data showed a marginally significant effect of rating scale, $F(1, 38) = 3.37$, $p = .06$. Search times were, on average, 113 ms slower for the dreary-scale users. However, these users' slopes were nonsignificantly different from the slopes of those using the cheery scale.

Although we were not specifically concerned with the RT to indicate grid location, a response that was made after signifying that the target had been detected, this value determines the length of the interval between the onset of the search array and the representation of the to-be-rated Mondrian. Participants took, on average, 717 ms (SD = 244) to locate the target's position. (There was no difference in this value for participants using the different rating scales.) The average interval between the first and second exposure to a Mondrian was therefore 2.51 s (i.e., the sum of the average detection and localization RTs plus the duration of the refixation cross and prompt signal).

Cheery versus dreary ratings. There were no statistically significant differences in the converted rating data of participants using the two different rating scales (cheery, dreary), and a mixed-factors ANOVA with rating scale as a between-subjects factor and attention status (target, distractor) and set size (4, 8, 16) as within-subject factors showed that the main effect of rating scale and its interaction with attention were nonsignificant, both $Fs(1, 38) < 1$. This means that any effect of attention on ratings reflects effects of emotional tone rather than simple response biases. This result is consistent with our previous experience using these response scales (Fenske et al., 2004; Raymond et al., 2003) and tells us that the marginally significant differences in search RTs between these two groups had no apparent impact on the response of interest here (i.e., ratings). Data were therefore averaged across the different rating-scale groups for subsequent analyses.

Combined rating data. Figure 2 shows the mean ratings (averaged across groups) for targets and distractors as a function of set size. Distractors were rated significantly more negatively than targets, $F(1, 38) = 6.63$, $p < .05$. This difference (about 0.38 points on the 5-point scale used here) did not vary significantly with set size, $F(2, 78) < 1$. These results support the supposition that attention during a prior task has a systematic influence on subsequent affective evaluation (Fenske et al., 2004; Raymond et al., 2003). Note that overall ratings were affected by set size, $F(2, 78) = 4.99$, $p < .05$; ratings for all items seen in arrays of 16 were 0.11 points lower than ratings for items seen in smaller arrays. This attention-independent effect may reflect an overall negative emotional response associated with the perception that the task was more difficult with the largest set size (even though performance was not affected).

Although perceptual fluency theories of affective appraisal predict no difference in evaluation of targets and distractors, because each type of item is exposed for the same amount of time, this theory might predict that items seen near the central fixation will be evaluated more positively than those presented more eccentrically. This might occur because central, as opposed to peripheral, stimuli (both targets and distractors) might receive more perceptual processing. To assess this possibility, we analyzed separately the evaluations given to items presented in the central 4 locations and those presented in the eccentric 12 locations. An ANOVA using location (central, eccentric) and attention (target, distractor) as within-subject factors revealed a nonsignificant effect of location, $F(1, 39) = 1.97$, $p > .10$, and a nonsignificant interaction with attention, $F(1, 39) < 1$. The main effect of attention was significant, $F(1, 39) = 6.93$, $p \leq .05$. This result, then, provides no support for perceptual fluency accounts.

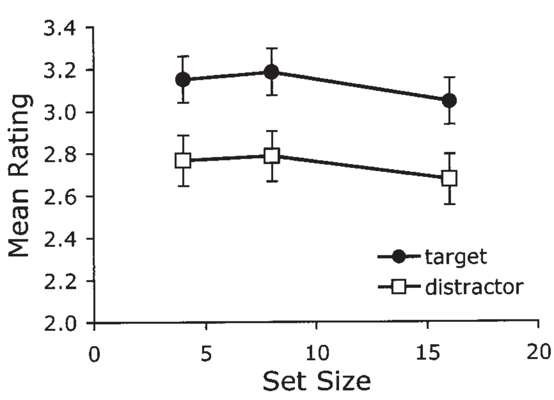

Figure 2. Group mean ratings of targets and distractors just previously viewed in a simple visual search task. Vertical lines indicate plus or minus one standard error of the mean.

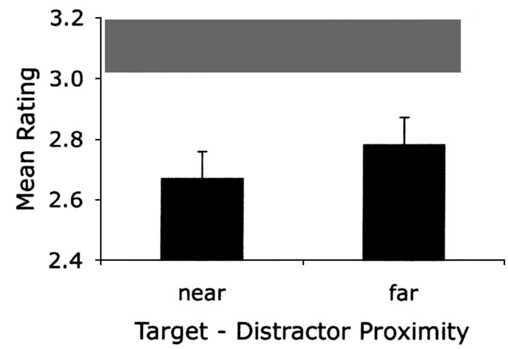

Figure 3. Group mean ratings for distractor stimuli just previously seen near to or far from the target. Vertical bars indicate plus or minus one standard error of the mean. The hatched area represents plus or minus one standard error of the mean target rating.

We next examined the effects of target–distractor proximity in the search array. If emotional devaluation of distractors is produced as a result of attentional inhibition, then this inhibition might be expected to be greatest when distractors are most proximal to targets and to wane as proximity decreases (Bahcall & Kowler, 1999; Caputo & Guerra, 1998; Cave & Zimmerman, 1997; Cepeda et al., 1998; Cutzu & Tsotsos, 2003; Mounts, 2000; Slotnick et al., 2002, 2003). The additional advantage of analyzing proximity effects on distractor ratings is that it allows us to make comparisons between ratings for the same type of stimuli (comparing apples with apples) made by the same participants rather than making target–distractor comparisons (comparing apples with oranges) and relying on between-groups comparisons, with their attendant problems.

We divided distractors into near (one grid location away in any direction from the target) and far (two or more grid locations away from the target) conditions and then calculated mean ratings for each. As shown in Figure 3, near distractors were rated significantly more negatively than far distractors (a difference of 0.10), $t(39) = 2.02$, $p < .05$. This effect might suggest that distractors are not subjected to a single, uniform emotional response but rather are individuated by their location in the search task. Whereas Raymond et al. (2003) showed that devaluation of distractors can generalize to a novel item that is similar to a previously ignored item, the current data suggest that there is also a stimulus-specific devaluation that is modulated by target proximity. Alternatively, locations that are near targets could be subject to inhibition, which leads to the subsequent devaluation of any items presented at the location. In either view, our finding that near distractors were devalued relative to far distractors fits neatly with the idea that attentional inhibition modulates affective responses. As discussed previously, visual search data suggest that near distractors may be inhibited more than far distractors. Our subtle but significant effect of target–distractor proximity on ratings is consistent with the idea that this inhibition can be maintained after stimuli are no longer visible and can be reinstated later during the evaluation task.

However, the target proximity effect could have resulted because participants saccaded to the target before responding. This eye movement would have placed the image of near distractors at retinal locations more central than those for far distractors, giving near items the benefit of better spatial resolution and thus individuation. Because eye movements were not measured in this experiment, we can only indirectly assess this possibility by revisiting the analysis of distractors presented near to versus far from fixation in the search array. Prior to any eye movements, near-fixation items would have received higher resolution processing than far-from-fixation items. We found that the mean rating given to distractors presented in the central four locations ($M = 2.80$, $SE = 0.12$) was not significantly different, $t(39) = 0.91$, from that given to distractors presented at peripheral locations ($M = 2.73$, $SE = .10$) and did not interact with the effect of attention. This suggests that visual resolution cannot account for the target–distractor proximity effect.

In Experiment 1, stimuli were rated at the same location in which they were initially presented in the visual search task, which thus confounds distractor identity and location. Because we cannot disentangle these two factors, it is impossible to know whether attentional inhibition has both a location-based and an object-based effect on affective ratings. Accordingly, in Experiment 2 we deconfound search item identity from location by presenting each to-be-rated stimulus at fixation rather than at its original location.

Experiment 2

The main difference between this and Experiment 1 is that the to-be-rated item was presented centrally at the fixation location. If the distractor devaluation effect seen in Experiment 1 were due solely to location-based inhibition, then we would not expect a distractor devaluation effect in Experiment 2. However, if some degree of object-based inhibition contributed to the distractor devaluation effect in Experiment 1, then some modulation of distractor ratings might be evident in Experiment 2, despite the changed location of to-be-rated items. An affective finding reflecting object-based inhibition during efficient search would be highly significant theoretically because it requires that the identity of distractors be encoded. If simple feature search (e.g., a red item among green items) is preattentive, then such individuated encoding seems unlikely in view of well-established models of visual search (e.g., Treisman, 1999; Treisman & Gelade, 1980; Wolfe, 1994). However, Starreveld, Theeuwes, and Mortier (2004) recently demonstrated that the identities of distractor stimuli can be encoded even during highly efficient visual search. They combined an Eriksen flanker task (Eriksen & Eriksen, 1974) with a visual search task requiring the discrimination of a red target letter (*A* or *R*) in an array of green letters. When distractors were the same letter as the target, RTs were faster than when distractors were incompatible (the other letter). A flat function relating RTs and set size showed that the search in this task was indeed highly efficient. Thus, Starreveld et al.'s study provides important evidence that even when distractors are preattentively searched, their identity can be encoded. This interesting finding has implications for our Experiment 2 because it suggests that object-based inhibition might be present in our search task and might therefore contribute to a distractor devaluation effect.

Experiment 2 was identical to Experiment 1 with the following two exceptions. First, the to-be-rated stimulus was always presented at the center of the screen instead of at its original location in the search array, which thus deconfounded object identity and location. Second, all participants made ratings using only the cheery scale, because we have established in Experiment 1 and in three other experiments (Fenske et al., 2004; Raymond et al., 2003) that responses on this scale reflect perceived emotional tone rather than the effects of a response bias.

Method

Participants. Twenty-two adults (mean age 19.1 years; 18 women, 4 men) were recruited from the student and community participant panels of the University of Wales, Bangor, and participated in Experiment 2 in exchange for course credit or money. All reported normal or corrected-to-normal visual acuity, and each gave informed consent prior to participation. Half searched for red targets and half for green targets.

Apparatus and stimuli. The apparatus, stimuli, and viewing conditions in Experiment 2 were the same as those used in Experiment 1.

Experimental design and procedure. The experimental design and procedure were exactly the same in Experiment 2 as those used in Experiment 1, with two exceptions: First, each to-be-rated item was presented at the center of the display during evaluation; second, only the cheery scale was used.

Data analysis. Data analysis and the criteria for data inclusion in subsequent analyses were the same in Experiment 2 as those used in Experiment 1. Error rates were low (7%) and did not vary systematically with set size ($F < 1$). Fewer than 8% of the remaining trials were identified and excluded as target RT or rating RT outliers.

Results and Discussion

Visual search performance. As in Experiment 1, mean RTs plotted as a function of set size produced shallow search slopes ($M = 0.50$ ms/item, $SE = 0.75$). It is not surprising that the main effect of set size on RT was nonsignificant ($F < 1$).

Rating data. Mean ratings for targets and distractors from each set size condition are plotted in Figure 4. In contrast to the findings of Experiment 1, targets and distractors were not rated differently, $F(1, 18) < 1$. Set size had no effect, $F(2, 42) = 2.45$, $p > .10$, and the interaction of set size and attention was nonsignificant, $F(2, 42) = 1.43$, $p > .10$. This lack of replication of Experiment 1 appears to be a result of our placement of the to-be-rated stimulus at a different location—that is, at fixation—than that occupied in the visual search task. However, in Raymond et al. (2003), the

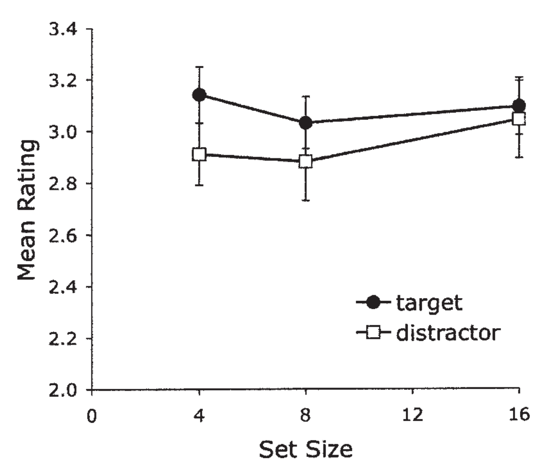

Figure 4. Group mean ratings of targets and distractors obtained in Experiment 2. Vertical lines indicate plus or minus one standard error of the mean.

to-be-rated stimulus was also evaluated at a different location than that occupied in the prior attention task, yet a significant distractor devaluation effect was observed there. Why was this the case? There are two likely explanations. First, in Raymond et al., the distractor was always seen in close proximity to the target during its initial exposure. As we found in Experiment 1, close proximity to the target exacerbates distractor devaluation. Second, in Raymond et al.'s study, the target and distractor were always seen to the immediate left or right of fixation for the attention task, and, for the evaluation task, an item was shifted only very slightly to the central fixation location. This suggests that the magnitude of the location shift between search and evaluation task is a factor. To assess these possible accounts for the lack of an overall attention effect in Experiment 2, we examined the effect of target–distractor proximity and the effect of location shift magnitude.

As in Experiment 1, we found that distractors presented near the target were rated significantly more negatively (a difference of 0.09) than far distractors, $t(21) = 2.12$, $p < .05$. This effect of target–distractor proximity is shown in Figure 5, where the analogous data obtained in Experiment 1 (for the comparable group using the cheery scale) are replotted. Note that the size of the target–distractor proximity effect was similar in the two experiments but that in Experiment 1 distractors were evaluated more negatively, overall, than the identical stimuli seen in Experiment 2. In contrast, the difference in the target ratings obtained in these two experiments was nonsignificant ($F < 1$). The dashed line in Figure 5 therefore represents the mean target rating from both experiments (cheery scale users only). A mixed-model ANOVA using target–distractor proximity as a within-subject factor showed that the group difference in distractor rating was significant, $F(1, 40) = 3.92$, $p = .05$; that the effect of proximity was also significant, $F(1, 40) = 5.69$, $p < .05$; and that the Group × Proximity interaction was not ($F < 1$). The group main effect indicates a significant location-based contribution to distractor devaluation: During evaluation, items appearing in the same location as during search were devalued more than those that appeared in a different location. It is important to note that target proximity affected distractor ratings similarly in both experiments. This indicates the presence of an object-based contribution to distractor devaluation, because distracting objects near targets were devalued in Experiment 2, even though they were seen (at evaluation) at an entirely different location. The overall pattern of data seen in Figure 5 also adds weight to our proposal that the distractor devaluation effect results from a devaluation process specifically applied to distractors. Changing the location of to-be-rated items only impacted ratings of distractors, leaving ratings of targets unaffected.

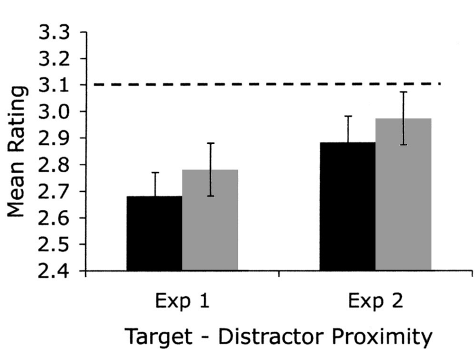

Figure 5. Group mean ratings for near (black bars) and far (gray bars) distractors obtained for the *cheery* group in each experiment. Vertical bars indicate plus or minus one standard error of the mean. The horizontal dashed line represents the mean target rating. Exp = Experiment.

We next examined the effect of the magnitude of location shift on ratings by examining ratings of items that had appeared previously at central versus peripheral locations in the visual search array. The smaller shift between search and evaluation locations for central items might have produced less disruption of location-based processes for these items than for peripheral items, thereby allowing location-based processes to contribute to the distractor devaluation effect for central stimuli. To test this, we conducted an ANOVA on ratings with location (central, peripheral) and attention (target, distractor) as within-subject factors. We found no main effect of location ($F < 1$), which again provided no support for a fluency account of evaluation, and no main effect of attention ($F < 1$). However, we did observe a marginally significant Attention × Location interaction, $F(1, 21) = 4.102$, $p = .06$, which supports the notion that location shift size may be a factor. The distractor devaluation effect (i.e., mean target rating minus mean distractor rating) for centrally presented items was 0.29 points, whereas the effect for peripherally presented items was substantially smaller (0.10 points). This contrast is consistent with the notion that a location-based inhibitory process contributes to emotional appraisal. These findings, together with those of Experiment 1, suggest that distractor devaluation depends on both a location-based and an object-based mechanism.

Taken together, the results of Experiments 1 and 2 provide clear evidence that distractor devaluation occurs regardless of the number of distractors in a search array and is mediated by both object- and location-based processes, with the original proximity of distractors to targets having a particularly robust effect on their subsequent rating. Although these findings are impressive, the extent to which these characteristics of distractor devaluation depend on the use of relatively meaningless stimuli and easy, feature-based search requirements remains unclear. Experiment 3 was therefore conducted to address these considerations.

Experiment 3

Experiment 3 had three main goals. First, we wanted to determine whether the distractor devaluation effect would be obtained with meaningful stimuli as opposed to the abstract Mondrians used previously. We therefore replaced the Mondrian stimuli with gray-scale photographs of human adult faces. Faces are stimuli for which humans have considerable experience, both perceptually and socially, and therefore might be impervious to some forms of attentional modulation. To measure possible modulation of emotional responses to faces, we asked participants to use a scale from 1 to 5 (as used in Experiments 1 and 2) to rate faces for how trustworthy or untrustworthy (instead of cheery or dreary) they appeared. We chose to have participants rate this attribute rather than attractiveness because it more clearly specifies that the judgments should reflect how the participant evaluates the face, not how people in general might evaluate the face. Moreover, such judgments are tied directly to person identity and seem, intuitively at least, to be an object-based (or whole-face) property.

The second goal of Experiment 3 was to determine whether a slow, effortful search task, as opposed to the easy, feature-based search required in the first two experiments, would produce distractor devaluation. For the search task in Experiment 3, we asked participants to detect and then locate a target defined by a conjunction of face gender and tint. In the visual search array, faces were tinted either blue or yellow; targets were yellow men for half of participants and blue men for the remaining participants. Distractors were male faces tinted the nontarget color and female faces tinted the target color. After the search task, a single face (always a man), either a prior target or a prior distractor, was presented at fixation, as in the procedure of Experiment 2, for evaluation. Because the third goal for Experiment 3 was to replicate the target–distractor proximity effect, thereby testing the robustness of object-based effects of attention on an evaluation task, we presented each to-be-evaluated face in grayscale without any color tint. In this experiment, then, not only was prior location information stripped from the to-be-evaluated item, its previous task-relevant color information was also removed, which provided a strong test of an object-based distractor devaluation effect.

Method

Participants. Forty adults (mean age = 23.3 years; 27 women, 13 men) were recruited from the student and community participant panels of the University of Wales, Bangor, and participated in Experiment 3 in exchange for course credit or money. All reported normal or corrected-to-normal visual acuity, and each gave informed consent prior to participation.

Half of the participants searched for blue–male targets among yellow–male and blue–female distractors, and half searched for yellow–male targets among blue–male and yellow–female distractors. Half of each group rated faces using the trustworthy scale, and half used the untrustworthy scale.

Apparatus and stimuli. The apparatus and viewing conditions in Experiment 2 were the same as those used in Experiments 1 and 2. The face stimuli used in Experiment 3 were grayscale images of young men and women composing a pool of 752 exemplars (376 men, 376 women) taken from college yearbooks and the Internet. An example is shown in Figure 1A. All were converted to grayscale and were roughly equated for contrast, mean luminance, resolution, and face size. Faces all had neutral or mildly positive expressions and had hair showing. Each face filled an oval window that subtended 2.9° of visual angle in height. Yellow (RGB: 222/222/197) or blue (RGB: 197/222/222) tints were applied with 50% transparency for presentation in the visual search arrays. When the faces were presented at evaluation, these tints were removed. As in the previous experiments, every target and distractor item was unique and was seen only once in a search display; a subset was seen again in a corresponding evaluation display.

Experimental design and procedure. The experimental design was identical to that used in Experiments 1 and 2, with the following exceptions: Targets were defined by a conjunction of color and gender (blue–male or yellow–male). Half of the distractors were defined by a conjunction of the nontarget color and the target gender. The remaining distractors were defined by a conjunction of the target color and nontarget gender. In this way, blue–male targets appeared among yellow–male and blue–female distractors; yellow–male targets appeared among blue–male and yellow–female distractors. Faces appearing as distractors on each trial were randomly selected for each participant.

Each experimental session lasted approximately 20 min and consisted of 12 practice trials and 48 experimental trials, with 16 trials for each of three set sizes (three, five, and seven). The procedure used in Experiment 3 was identical to that of Experiment 2, with the following exceptions. The interval after the participants indicated the location of the target on the grid and before the to-be-evaluated stimulus was presented was shortened from 1,000 ms to 500 ms. The to-be-evaluated stimulus was presented for 350 ms (as opposed to 500 ms). It was always presented at fixation and in grayscale (i.e., without the original overlay tint). These to-be-rated stimuli (targets and distractors) were always male faces.

Data analysis. Data analysis and the criteria for data inclusion in subsequent analyses were the same in Experiment 3 as those used in Experiments 1 and 2. However, the error rate in Experiment 3 varied significantly with set size, $F(2, 39) = 6.48$, $p < .01$, averaging 5%, 8%, and 10% for Set Sizes 3, 5, and 7, respectively. Approximately 7% of the remaining trials were identified and excluded as target RT or rating RT outliers.

Results and Discussion

Visual search performance. Unlike the previous two experiments, the search slopes that defined mean RTs as a function of set size were steep ($M = 115$ ms/item, $SE = 12$), with a long average intercept (863 ms). The mean RTs were 1,213 ms, 1,426 ms, and 1,673 ms for Set Sizes 3, 5, and 7, respectively. The main effect of set size on RT was highly significant, $F(2, 39) = 54.51$, $p < .01$, indicating effortful search. Participants took, on average, 704 ms ($SE = 24$) after making their target detection response to locate the target's position. This value means that the average interval between the first and second exposure to a face was 2.89 s (i.e., the sum of the average detection and localization RTs plus the duration of the refixation cross and prompt signal).

Rating data. We analyzed the converted ratings using a mixed-model ANOVA with scale as a between-groups factor and prior attention (target, distractor) and set size (three, five, seven) as within-group factors. The main effect of rating scale was nonsignificant, $F(1, 38) < 1$, and did not interact significantly with the effects of either remaining factor. This indicates that any effect of attention on rating was not due to response bias and can be taken to reflect modulation of social–emotional response.

The ANOVA revealed a marginally significant main effect of attention, $F(1, 38) = 2.87$, $p = .09$, with targets eliciting a mean rating of 3.05 ($SE = 0.06$) and distractors a mean rating of 2.94 ($SE = 0.07$), a difference of 0.11 points. Neither the main effect of set size ($F < 1$), nor its interaction with attention, $F(2, 76) = 1.06$, $p > .10$, was significant. These results are generally consistent with those of Experiment 2. The lack of a set size effect, especially for target ratings, suggests that task effort, as reflected by search RT, has little or no consequence, per se, for item evaluation.

As in the previous experiments, we then examined the effects of target–distractor proximity and the effect of location in the search array. Consistent with the previous two experiments, we found that near distractors were rated significantly more negatively (a difference of 0.13) than far distractors, $t(39) = 2.07$, $p < .05$. The effect of target–distractor proximity is shown in Figure 6, together with the mean ratings obtained for faces previously seen as targets. The figure clearly shows that near distractors were rated significantly more negatively than targets, $t(39) = 2.66$, $p = .01$, but the difference between targets and far distractors was nonsignificant.

When we compared ratings given to faces presented centrally versus peripherally in the visual search display, we found a pattern of results that was highly similar to that seen in Experiment 2. An ANOVA on ratings with location (central, peripheral) and attention (target, distractor) as within-group factors revealed a nonsignificant effect of location ($F < 1$), a marginally significant effect

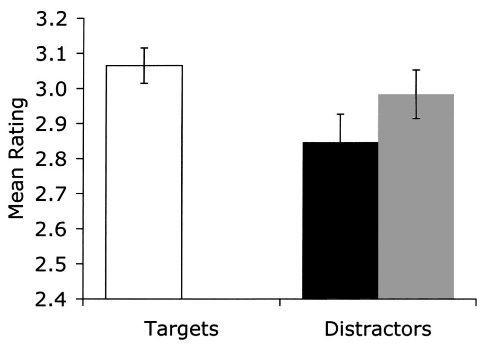

Figure 6. Group mean ratings of trustworthiness–untrustworthiness of faces seen as targets (white bars), near distractors (black bars), or far distractors (gray bars). Vertical bars indicate plus or minus one standard error of the mean.

of attention, $F(1, 39) = 3.27$, $p = .08$, and a significant interaction of attention and location, $F(1, 39) = 4.63$, $p < .05$. For centrally presented items, the distractor devaluation effect was large (0.23 points), whereas for peripherally presented items, the effect was negligible, only 0.02 points. As in Experiment 2, the finding of a nonsignificant main effect of location provides no support for a perceptual fluency account of how prior exposure can modulate emotional appraisal: Centrally presented (high cortical magnification) items were not evaluated more positively than peripheral (low peripheral magnification) ones. That location interacted with prior attention state is consistent with our previous evidence that location-based attentional processes contribute to the distractor devaluation effect. However, our finding of a distractor devaluation effect in this experiment, wherein the previously seen item appeared in both a different color and a different location when presented for evaluation, clearly shows the additional contribution of object-based processes. It is important to note that Experiment 3 provides strong evidence that the deleterious effect of these inhibitory processes on subsequent emotional response impacts stimuli that are highly meaningful, socially and biologically, and is robust following difficult, feature-conjunction search.

General Discussion

In three experiments, we measured the emotional evaluation of a complex stimulus just seen as a target or distractor in a prior visual search task. In the first two experiments, the search task (feature search) and stimuli (Mondrians) were identical; in the third, search involved an effortful conjunction task, and the stimuli were faces. In the first experiment, stimuli were presented for evaluation at the location they had just previously occupied in the search array. In the second and third experiments, all stimuli were evaluated at fixation. A consistent finding in all three experiments was that distractors seen near the target in the search array were rated more negatively than distractors seen far from the target. In all experiments, near distractors were rated more negatively than targets, which thus demonstrates a consistent distractor devaluation effect as a consequence of multi-item visual search.

In the original demonstration of the distractor devaluation effect, Raymond et al. (2003) found that participants rated items just seen as distractors in a simple two-item search task less positively than those just seen as targets and less positively than novel baseline items. They proposed that attentional inhibition directed at stimuli during visual search serves to reduce the emotional salience of distracting stimuli. The results of Fenske et al. (2004) additionally suggest that the extent to which distractors may be devalued depends on the ability of the visual system to readily inhibit them. In the present study, we have extended the general picture of how attentional inhibition acts to depress emotional evaluation in three ways. First, we have demonstrated that the magnitude of distractor devaluation depends on prior target–distractor proximity. Second, we have provided evidence that distractor devaluation results from both location- and object-based processes. Third, we have shown that the distractor devaluation effect can be found with meaningful stimuli (faces) as well as with abstract, meaningless patterns.

The importance of considering the consequences of prior attentional state on subsequent emotional responses to visual stimuli is underscored in our results by the fact that the constituent effects cannot be easily explained by perceptual fluency differences (Reber et al., 1998) or conditioned associations with nonaversive events (Zajonc, 2001). Perceptual fluency theories of how prior exposure might modulate subsequent emotional evaluation predict that targets and distractors in our experiment should be rated equally on emotional scales because both were exposed for the same amount of time during the search task. However, distractors were devalued relative to targets in Experiment 1 as well as in Experiments 2 and 3, when spatial factors that might otherwise affect fluency were controlled for, a finding that is inconsistent with fluency explanations.

Moreover, fluency theories might predict that items presented close to fixation in the search array, thereby receiving greater processing than peripherally presented items, should be evaluated more positively. However, contrary to this expectation, we found that location in the search array had no main effect on subsequent evaluation and only interacted with prior attention in Experiments 2 and 3. The interaction of effects in these experiments appears to be due to the fact that location in the search array was fully confounded with the size of the location shift between presentations in the search and evaluation tasks of each trial. In Experiment 1, where there was no between-presentations shift in location, there was also no effect of search-array location nor any interaction of this factor with prior attention. Indeed, in contrast to the distinctly positive effects of perceptual fluency (e.g., Reber et al., 1998; Winkielman & Cacioppo, 2001), the results of the present studies converge with and extend our previous results by indicating robust distractor devaluation effects. It is important to note that we are not arguing for the absence of perceptual fluency effects on emotional evaluations. Rather, our assertion is that any theory linking the effects of prior perceptual experience to later emotional evaluation is incomplete if it does not consider the attentional status of previously encountered stimuli.

Evaluative Consequences of Location-Based Inhibition

There is now abundant evidence that processes of attentional selection, including inhibition, operate through both object-based and location-based frames of reference (see Lamy & Tsal, 2001; Scholl, 2001, for reviews). We asked whether the affective consequences for items encountered during a visual search task were due to attentional processes tied to the spatial location of an object in the search display or were due to attentional states associated with specific stimuli. Our primary manipulation in this regard was to vary whether targets and distractors just seen in search displays were presented in the same (Experiment 1) or different (Experiments 2 and 3) locations for the emotional evaluation task. Evaluations of items in all experiments were equally susceptible to possible object-based attentional effects because the identity of items from search to evaluation was preserved. However, only in Experiment 1 were items evaluated at their old search location, thereby allowing location-based attention processes to operate fully. If distractor devaluation is produced by prior inhibition, as we propose, then comparison of the results of Experiments 1 and 2 (where the stimuli and task were identical) clearly shows that location-based inhibition plays a substantial role in determining subsequent emotional responses to visual stimuli.

Consider first our finding that there was a robust difference in the overall ratings of targets and distractors only when to-be-rated items were presented in their original search-display locations. This finding resonates with behavioral studies showing slowed responses to dot probes presented during visual search trials at nontarget locations previously containing distractors as opposed to dot probes presented at other nontarget locations (e.g., Cepeda et al., 1998). Distinct from response time effects arising from attentional inhibition, our results, illustrated in Figure 5, indicate that location-based distractor inhibition additionally modulates subsequent emotional evaluation. Here, the overall devaluation of distractors represented in their original search-display location (Experiment 1) can be seen when compared with distractors represented at fixation (Experiment 2), a difference of about 0.31 points on the 5-point scale. Additional evidence of a location-based effect can be found in Experiments 2 and 3 (items evaluated at fixation). In these experiments, we found that search location interacted with prior attention. Items seen near fixation in the search array showed a greater distractor devaluation effect than items seen in the periphery. Because search array location did not interact with prior attention when items were evaluated at their prior search location (Experiment 1), we can assume that the interaction of location and attention in Experiments 2 and 3 resulted because of differences in the magnitude of the location shift between an item's search and evaluation presentations. In the evaluation task, near-fixation items were shifted only slightly from their original location, whereas more peripheral items underwent a large displacement. Given the general, negative emotional impact for distractors appearing at the same location across search and evaluation presentation, our finding of a greater distractor devaluation effect for items with a small location shift (central items) relative to those with a large location shift (peripheral items) suggests that location-based processes contributed to the observed distractor devaluation effect for the near-fixation items.

Researchers have posited that lingering inhibition of locations during visual search may prevent focal attention from being redeployed to areas already deemed irrelevant, as evident in inhibition of return studies (e.g., Klein & MacInnes, 1999; Posner & Cohen, 1984). Our results suggest that location-based inhibition may have an additional, relatively sustained impact (lasting at least 2.5 s) that is affectively deleterious for objects appearing at inhibited locations.

Evaluative Consequences of Object-Based Inhibition

We also report evidence for object-based inhibitory effects on emotional evaluation, here manifested as the devaluation of distractors nearer to, versus farther from, the target location. By definition, this effect must be mediated by a spatially sensitive selection mechanism. Indeed, target–distractor proximity effects have been reported in a number of behavioral studies (e.g., Cave & Zimmerman, 1997; Cutzu & Tsotsos, 2003; Kim & Cave, 1999; Mounts, 2000) and often have been taken as support for the reliance of inhibitory processes on spatially mediated representations. Our Experiments 2 and 3, however, suggest that proximity-related inhibition status may be specifically associated and encoded with information about an object's identity. This is especially true for Experiment 3, wherein the evaluation task required appraisal of a nonrelevant search feature (person identity) of a face stripped of a prior search-relevant feature (color) and appearing at a new location. Indeed, the only way that near versus far distractors could exert a differential effect on ratings in Experiments 2 and 3 was if unique identifying information about individual distractors was encoded into memory along with information about their relative locations. This finding is difficult to reconcile with traditional two-stage models of visual search (e.g., Treisman, 1999; Treisman & Gelade, 1980; Treisman & Sato, 1990; Wolfe, 1994; Wolfe et al., 1989), in which basic features (e.g., color) are first computed in a parallel, preattentive stage. Such models typically maintain that identification of a display element requires attentive processing. Accordingly, localization of the target in a simple feature-search task such as we used in Experiments 1 and 2 should occur preattentively, without participants attending to (or thereby encoding) distractors. Instead, our results converge with those of Starreveld et al.'s (2004) studies to suggest that this may not be the case and that the visual system remains sensitive to distractor identities even when search is highly efficient. Nevertheless, it may be the case that distractor identity is encoded only after the target item is fixated. Although we have no direct evidence to assess this possibility, the similarities in the results of Experiment 2 and 3 could be taken as indirect support for this conjecture, if only because the effortful search task in Experiment 3 presumably would have required fixation of the target. Regardless of when the identifying features of individual distractors were encoded, our results suggest that when these items are encountered again, even if in a new location, some elements of their prior inhibitory status seem to be retrieved in processing of item-specific perceptual information. Whether there are conditions in which pure object-based (nonspatially mediated) inhibition is sufficient, on its own, to produce a robust distractor devaluation effect for difficult-to-individuate items, such as the Mondrian patterns used here, remains an open question for future research. Our results suggest that such object-based effects may be stronger for highly meaningful stimuli, such as faces, perhaps because these are objects with which humans have considerable expertise in processing.

Social–Emotional Consequences of Inhibition

In Experiment 3, we found a robust, deleterious effect of prior attentional status on subsequent social–emotional evaluations of previously unfamiliar faces. This finding converges nicely with the results of another recent study (Fenske, Raymond, Kessler, Westoby, & Tipper, 2005), in which participants were shown pairs of face images and were asked to withhold a response if a transparent stop-action cue appeared over one of the faces. This served to associate the cued face with an inhibitory state. Later, when asked to make social–emotional choices about these face pairs, participants chose uncued (noninhibited) faces more often as more trustworthy and cued (inhibited) faces as less trustworthy. In contrast, when participants were asked to make choices on the basis of the brightness of the background, there was no effect of how the question was framed (which was lighter vs. which was darker), which suggests that perceptual judgments were not influenced by the prior inhibitory status of the different faces of each pair. These results, taken together with our findings from Experiment 3, have potentially important implications for the study of social interactions, especially concerning influences guiding first impressions. For example, when you introduce yourself to someone while he or she is engaged in another task, is his or her impression of you likely to be biased negatively because you were initially encountered as a distractor? Are people seen standing near talking dignitaries subjected to emotional devaluation by viewers simply because their faces offer an attentionally distracting stimulus? There are a number of speculations that arise out of distractor devaluation of human faces, many of them testable.

The important finding we report here is that the attentional state used when stimuli (either abstract or socially relevant, recognizable images) are encountered initially can have specific, persisting effects on the affective and social–emotional judgments of those stimuli. These findings tell us that visual search for objects has collateral consequences for the evaluative fate of searched-through items and indicates that visual orienting and attention may play an important role in the genesis of emotional response.

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