Inhibition of return for the discrimination of faces

Tracy L. Taylor
Dalhousie University, Halifax, Nova Scotia, Canada

and

Megan E. Therrien
University of Ottawa, Ottawa, Ontario, Canada

When a target appears unpredictably in the same rather than a different location relative to a preceding onset cue, reaction times (RTs) of participants tasked with responding to the target are slowed. This pattern of results, referred to as inhibition of return (IOR), is believed to reflect the operation of a mechanism that prevents perseverative search of nontarget locations. On the grounds that an evolved mechanism might be sensitive to social stimuli, Taylor and Therrien (2005) examined IOR for localization responses under conditions in which cues and targets could be intact face configurations or nonface configurations; contrary to their predictions, there was no influence of cue or target configuration on the magnitude of IOR, indicating that the mere occurrence of task-irrelevant face and nonface stimuli does not alter IOR. In the present study, we further examined this issue in a task that required a face/nonface target discrimination. When target configuration was thereby made task relevant, we found that IOR differed for face and nonface targets in terms of magnitude (when a single cue–target stimulus onset asynchrony was employed) and time course. We suggest that the RT delay associated with IOR may enable additional processing time and/or response selection when a task-relevant face is presented at the cued location.

When an onset cue appears in the visual periphery, it orients covert and/or overt attentional mechanisms exogenously (see, e.g., Rafal, Calabresi, Brennan, & Sciolto, 1989). Targets that appear in the cued location after a brief delay benefit from this exogenously oriented attention (see, e.g., Berger, Dori, & Henik, 1999; Jonides, 1981): They are localized and discriminated more quickly than otherwise identical targets that appear in an uncued location. However, if no target is found in the cued location, then, in the absence of an incentive to maintain attention at the peripheral location, attentional resources are withdrawn. The withdrawal of attention from the cued location reveals an inhibitory aftereffect of the initial cuing (cf. Danziger & Kingstone, 1999; Posner & Cohen, 1984). This aftereffect, referred to as inhibition of return (IOR; Posner, Rafal, Choate, & Vaughan, 1985), is reflected in the slower localization (see, e.g., Maylor, 1985; Taylor & Klein, 2000) and discrimination (see, e.g., Lupiáñez, Milán, Tornay, Madrid, & Tudela, 1997; Lupiáñez, Milliken, Solano, Weaver, & Tipper, 2001; Pratt, Kingstone, & Khoe, 1997) of targets that appear, after a relatively long delay (≥300 msec; Samuel & Kat, 2003), in the cued versus the uncued location.

The mechanism that underlies IOR has been ascribed potential evolutionary significance. In visual search, IOR has been depicted as a foraging facilitator (Klein, 1988; Klein & MacInnes, 1999), on the grounds that it represents the tagging of locations at which attention has been allocated and subsequently withdrawn, such that nontarget locations that have already been searched are not likely to be reinspected. In addition, the response delay associated with IOR may provide additional time for ongoing behavior to be modified in light of sudden environmental changes (Ivanoff & Taylor, 2006). In both cases, IOR is thought to represent the outcome of an adaptive process that limits perseveration of unwanted responses.

To the extent that the mechanism underlying IOR may have evolved to subserve adaptive behavior, one might expect it to be flexible. In this vein, Taylor and Therrien (2005) questioned whether IOR might be differentially sensitive to biologically relevant and irrelevant visual stimuli used as cues and targets. Under the premise that the social context of human evolution has led us to be particularly sensitive to social stimuli, Taylor and Therrien argued that IOR might be modulated by face versus nonface stimuli, even when such stimuli are task irrelevant. Following the view that face processing is special (see, e.g., Kanwisher, McDermott, & Chun, 1997; Tong, Nakayama, Moscovitch, Weinrib, & Kanwisher, 2000), Taylor and Therrien suggested that face stimuli as cues might be particularly likely to attract and hold attention (thereby reducing the magnitude of IOR generated by face cues compared with that generated by nonface cues) and that face stimuli as targets might be apt to escape the effects of inhibitory spatial tagging (thereby reducing the magnitude of IOR measured by face targets compared with that measured by nonface targets).

T. L. Taylor, tracy.taylor.helmick@dal.ca

In a series of experiments, Taylor and Therrien (2005) presented participants with face and nonface stimuli as cues and targets in an IOR paradigm. Whereas the magnitude of IOR can be reduced when face cues carry angry or threatening expressions (Fox, Russo, & Dutton, 2002), and, when face stimuli are presented simultaneously with nonface stimuli, the former preferentially capture attention (Theeuwes & Van der Stigchel, 2006), Taylor and Therrien found that emotionally neutral faces presented singly as cues and/or targets in a localization task had no effect on the magnitude of IOR. They concluded, therefore, that the mechanism underlying IOR is "blind" to the social significance of visual stimuli, at least when those stimuli carry neutral expressions and are task irrelevant.

The purpose of the present investigation was to extend this analysis of the effects of face stimuli on IOR from the localization task used by Taylor and Therrien (2005) to a discrimination task; we wanted to determine whether making target identity task-relevant would reduce the IOR effect for face relative to nonface targets. To this end, we were interested only in the manipulation of target, not cue, configuration.[1] The importance of a face/nonface target manipulation in the context of a discrimination task is suggested by the fact that IOR for target localizations may be functionally dissociable from IOR for target discriminations (see, e.g., Taylor & Donnelly, 2002; Taylor & Ivanoff, 2005). Indeed, Taylor and Donnelly showed that IOR was sensitive to the identities of the target stimuli when a discrimination (e.g., reporting the shape of a horizontally or vertically oriented target) was required, but not when a localization was required. Thus, it is possible for target identity to have an effect on IOR in a face/nonface discrimination task even when identity has no effect in a target localization task (Taylor & Therrien, 2005).

EXPERIMENT 1

Experiment 1 examined IOR in a speeded, face/scrambled face target discrimination task. IOR was calculated as the difference in reaction times (RTs) for discrimination targets that appeared at the cued versus at the uncued location. Postulating that IOR should reflect the operation of a flexible mechanism capable of being influenced by the potential biological relevance of social stimuli, we expected that the special status of face stimuli (see, e.g., Kanwisher et al., 1997; Tong et al., 2000) as targets would allow them to escape or override the deleterious effects of the spatial tagging associated with IOR. We predicted, therefore, that the IOR effect for face targets would be reduced in magnitude (or even eliminated altogether) compared with that for nonface targets. This is not what we found.

Method

Participants. Thirty-eight Dalhousie undergraduate students volunteered to take part in this experiment in exchange for credit in a psychology course. Participants were tested individually in a single session that lasted no more than 1 h. All were naive to the purpose of the experiment, and all had normal or corrected-to-normal vision.

Stimuli and Apparatus. Stimuli were displayed on a 17-in. ViewSonic PT775 or an Apple Studio Display color monitor attached to a Macintosh G4-400; responses were polled using a standard Macintosh universal serial bus keyboard. PsyScope 1.5.2 (Cohen,

MacWhinney, Flatt, & Provost, 1993) was used to control stimulus presentation and data collection.

All stimuli were black and were presented on a uniform white field. Three 2-point outline stimulus boxes were aligned horizontally across the center of the computer monitor. At a viewing distance of approximately 57 cm, each box was 2º of visual angle on a side, with 2º of white space between each box. Fixation crosshairs were 0.5º of visual angle, centered in the fixation box. A 2-point outline circle that filled the stimulus box was used for both the peripheral and the fixation cue stimuli. The target stimulus was a single, high-pass filtered image of a human face that revealed the essential features—eyes, nose, and mouth. This image was presented either intact as a face target or with the features rearranged to make a scrambled face target (as shown in Figure 1).

Procedure. Trial events are depicted in Figure 1. Each trial began with the presentation of fixation crosshairs. These remained visible throughout the trial duration, except when the fixation cue was presented. An 800-msec delay followed the initial appearance of the crosshairs, after which the peripheral cue was presented for 200 msec. This cue appeared with equal probability in the left or right stimulus box. After a 300-msec delay, the fixation cue was presented in the middle box for 200 msec, followed by a second 300-msec delay. If participants responded to any of these events, an error message appeared in the center of the computer monitor for 1,200 msec, and the trial was aborted and randomly recycled later in the block. Otherwise, following the second 300-msec delay, the target stimulus was presented for 200 msec. The target appeared in the left or the right stimulus box with equal probability and was equally likely to be a face or a scrambled face configuration. The scrambled face configuration was intended to provide a baseline measure against which the magnitude of IOR for face targets could be compared; it was identical in all respects to the face stimulus except that the individual features were not organized into a holistic representation of a face.

Participants were instructed to make a face/scrambled face discrimination as quickly and as accurately as possible. Half of the participants pressed the M key with the right index finger to report a face and the Z key with the left index finger to report a scrambled face; the key designation was reversed for the other half of the participants. Correct responses made within 1,000 msec of target onset were accompanied by distinct auditory feedback. Incorrect responses (i.e., depression of the wrong key) resulted in an error message lasting 1,200 msec, as well as auditory feedback. Failure to hit either response key within 1,000 msec of target onset resulted in auditory feedback accompanied by a persisting visual message that reported the lack of a valid response; participants were required to press the space bar in order to clear the message and continue the experiment. None of these trials was recycled.

No attempt was made to constrain or prohibit eye movements, on the grounds that IOR would have evolved to operate under naturalistic viewing conditions; indeed, the very nature of IOR is affected by the imposition of eye movement monitoring (see, e.g., Taylor & Klein, 2000). Therefore, the present study did not monitor eye movements, both to ensure naturalistic viewing and to maintain comparability with Taylor and Therrien's (2005) work, which also did not constrain eye movements.

Prior to beginning the experimental block, participants first completed practice trials drawn randomly from the experimental block. Participants worked through the practice trials until they reported feeling confident about the task demands. Practice data were neither saved nor analyzed. The experimental block contained a total of 320 trials consisting of 40 repetitions of the factorial combination of peripheral cue presentation (left, right), target presentation (left, right), and target configuration (face, scrambled face). As noted in Taylor and Therrien (2005; see note 1), the decision to maintain naturalistic viewing meant that overt orienting to the cues and/or targets probably occurred on at least some trials. Since a constant central fixation could not, therefore, be assumed, any analysis of visual field effects would be meaningless. Thus, for the purpose of analysis, cue presentation and target presentation were collapsed into a single factor, referred to as target location,
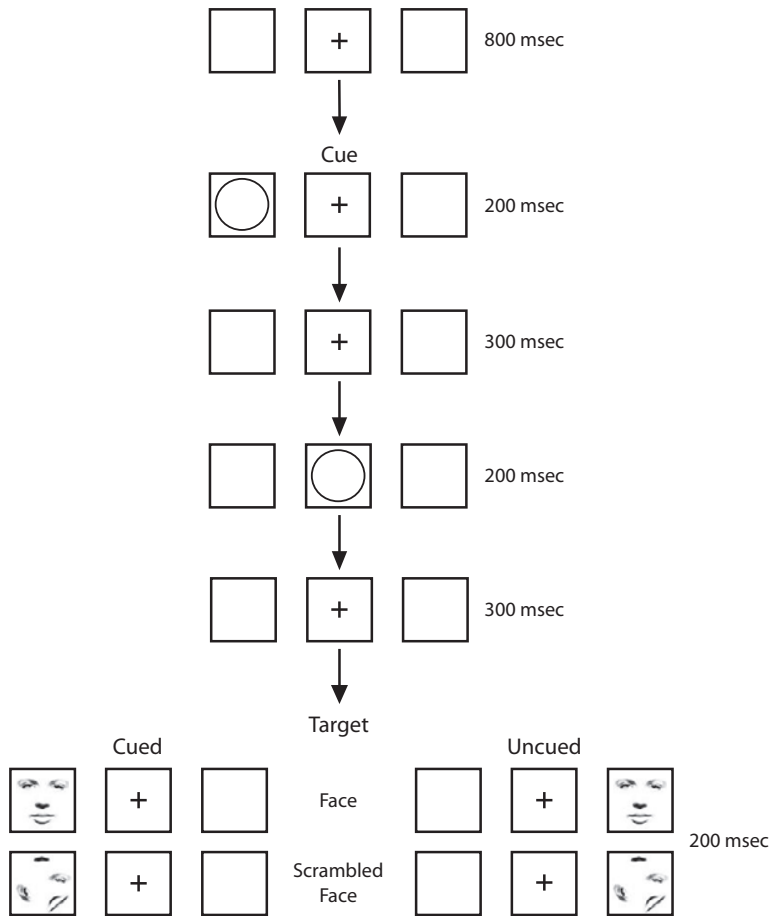
Figure 1. Schematic of the methods used in Experiment 1. Although the cue is shown inside the left box, it occurred equally often in the left and the right boxes. The drawing is not to scale. See text for further details. From "Inhibition of Return for Faces," by T. L. Taylor and M. E. Therrien, 2005, *Perception & Psychophysics*, p. 1416. Copyright 2005 by the Psychonomic Society.

with two levels: cued (left–left, right–right) and uncued (left–right, right–left). The occurrence of IOR was revealed as an effect of target location; IOR was calculated as cued RTs minus uncued RTs, with positive values indicating IOR and negative values indicating facilitation.

Results

Data from two participants were eliminated from consideration, in one case (face = Z response condition) because of an error rate of more than 30% in two of the four experimental cells, and in the other case (face = M response condition) due to the apparent performance of the task as a localization rather than a discrimination (this individual responded to all targets on the left with a left keypress and to all targets on the right with a right keypress, regardless of target configuration). The data from the remaining 36 participants were included in the analysis.

The analysis of RTs was performed only for those trials on which a correct response was executed within 100–1,000 msec of target onset. Mean RTs are shown in Figure 2, along with the percentage of total trials upon which each mean RT is based.

A repeated measures ANOVA was performed on the RT data, with target location (cued, uncued) and target configuration (face, scrambled face) as factors. This analysis revealed a significant main effect of target location [$F(1,35) = 39.26$, $MS_e = 214.08$, $p < .01$], with slower RTs to cued ($M = 533$ msec) than to uncued ($M = 518$ msec) targets. There was also a significant main effect of target configuration [$F(1,35) = 4.47$, $MS_e = 810.99$, $p < .05$], with overall faster discrimination responses to face ($M = 520$ msec) than to scrambled face ($M = 530$ msec) targets. These effects were qualified by a significant two-way interaction between target location and target configuration [$F(1,35) = 11.89$, $MS_e = 86.12$, $p < .01$], which indicated that the magnitude of IOR for face targets [21 msec; $F(1,35) = 88.81$, $p < .01$] was significantly larger than that for scrambled face targets [10 msec; $F(1,35) = 20.68$, $p < .01$].

A similar ANOVA on the accuracy data (shown in Figure 2) revealed only a significant effect of target location [$F(1,35) = 5.89$, $MS_e = 6.10$, $p < .03$]. Although the difference was small (~1%), responses were less accurate

for cued than for uncued targets. No other effects were significant ($ps > .22$).

Discussion

The results of Experiment 1 revealed a critical interaction between target location and target configuration. However, this interaction was not in the expected direction: IOR for face targets was significantly larger in magnitude than was IOR for scrambled face targets. Indeed, the 21-msec IOR effect for face targets was numerically more than twice as large as the 10-msec IOR effect for scrambled face targets. Interestingly, of these two effects, the 10-msec one for scrambled faces is most comparable to the values Taylor and Therrien (2005) obtained using the same targets. In their localization task, Taylor and Therrien found IOR effects of 7–9 msec for face targets and 13–14 msec for scrambled face targets (Experiments 2 and 3). Thus, in comparison, IOR for the discrimination of face targets in the present experiment is unusually large.

In light of our initial predictions, the larger magnitude IOR effect for the discrimination of face targets seems somewhat surprising. To the extent that IOR reflects the operation of a flexible mechanism that is sensitive to social stimuli, one might expect that when target configuration is task relevant, face targets would be subject to less inhibition—and would therefore reveal a smaller IOR effect—than scrambled face targets. This reasoning is based on the view that face stimuli are special (see, e.g., Kanwisher et al., 1997; Tong et al., 2000) and that preferential processing may allow them to be relatively less affected by inhibitory spatial tagging than are configurations that lack a holistic face representation. Clearly, this is not what we observed.

Given that IOR is a subtractive measure that compares RTs to targets at cued versus uncued locations, it is important to consider whether the difference in the magnitude of IOR for face versus nonface targets was due to postulated inhibitory processes operating at the cued location and/or to potential facilitatory processes operating at the uncued location. As Figure 2 shows, face targets were discriminated more quickly ($M = 510$ msec) than were nonface targets ($M = 525$ msec) at the uncued location, but there was no difference in discrimination RTs to face ($M = 530$ msec) and nonface ($M = 535$ msec) targets at the cued location. Although one might be tempted to argue that the larger IOR effect for face than for nonface targets was attributable, at least in part, to relative facilitation of face RTs at the uncued location, we think that any such contributions were small. First, although a facilitatory effect opposite the cued location does sometimes occur (cf. Pratt, Spalek, & Bradshaw, 1999), there is no evidence that this effect is the mechanism that underlies the IOR effect (Sumner, 2006), since facilitation at the opposite, uncued location is neither reliable nor robust (Posner & Cohen, 1984; Snyder, Schmidt, & Kingstone, 2001). Second, it is typical for RTs to be faster for the discrimination of face stimuli than for nonface stimuli when there is no prior location cuing (see, e.g., Bentin & McCarthy, 1994; Bentin & Moscovitch, 1988). This suggests that the larger IOR effect for face targets compared with that for nonface targets results because an RT advantage for face targets
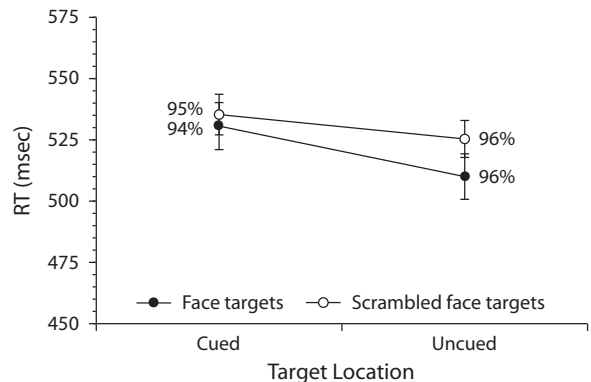

Figure 2. Discrimination reaction times (RTs) in Experiment 1 as a function of target location (cued, uncued) and target configuration (face, scrambled face). Error bars show the standard errors of the mean. The percentage of correct trials upon which each RT is based is shown beside the relevant plot.

that would otherwise occur is reduced or eliminated at the cued location. Therefore, we postulate that the larger IOR effect for face targets compared with that for nonface targets is due primarily to processes operating at the cued rather than the uncued location.

Before considering this result further, we thought it prudent to replicate Experiment 1 to strengthen our finding of a difference in IOR for face and nonface targets in a discrimination task. To maintain consistency with the methods used by Taylor and Therrien (2005), Experiment 1 utilized a scrambled face target against which to compare discrimination responses to face targets. Even though the scrambled face target was not configured as a holistic face, it nevertheless contained facial features (e.g., eyes; see Gallup, Nash, & Ellison, 1971) that may have been salient to observers, particularly in light of the mixed-blocks design. If this were the case, the observed difference between the IOR effect for face and scrambled face targets may actually have underestimated the difference between the IOR effect for face and truly nonface targets. To test this, Experiment 2 replicated the methods of Experiment 1 but compared IOR effect for face targets with that for pixelated, randomized nonface targets.

EXPERIMENT 2

Experiment 2 replicated the methods of Experiment 1 except that the scrambled face target was replaced with a nonface stimulus that was created by randomizing the arrangement of pixels contained within the face image. This allowed for a target that was equivalent to the face target in overall luminance but that contained no discernible facial features.

Method

Participants. Twenty Dalhousie University undergraduates volunteered to participate in this experiment in exchange for credit in a psychology class. All reported normal or corrected-to-normal vision and all were naive to the experimental purpose. None had participated in Experiment 1.

Stimuli and Apparatus. The stimuli and apparatus were identical to those used in Experiment 1 except that the scrambled face stimulus was replaced by a single randomized-pixel nonface stimulus (see Figure 3, inset).

Procedure. The procedure and design were identical to those of Experiment 1.

Results

Only those trials on which a correct discrimination response was executed within 100–1,000 msec of target onset were used to calculate mean RTs. Mean RT data and associated percentage accuracies are shown in Figure 3.

A two-way repeated measures ANOVA was performed on the RT data, with target location (cued, uncued) and target configuration (face, nonface) as factors. This analysis revealed a significant main effect of target location [$F(1,19) = 30.05$, $MS_e = 213.35$, $p < .01$] with overall slower responses to cued ($M = 485$ msec) than to uncued ($M = 467$ msec) targets. Unlike in Experiment 1, the RT advantage for face targets ($M = 471$ msec) versus nonface targets ($M = 481$ msec) was not significant [$F(1,19) = 2.69$, $MS_e = 717.64$, $p > .11$]. Importantly, however, there was a significant two-way interaction between target location and target configuration [$F(1,19) = 13.20$, $MS_e = 74.87$, $p < .01$]. As in Experiment 1, this interaction reveals that the magnitude of IOR for face targets [25 msec; $F(1,19) = 83.01$, $p < .01$)] was significantly larger than that for nonface targets [11 msec; $F(1,19) = 15.79$, $p < .01$].

An analogous ANOVA performed on the accuracy data revealed no significant effects (all ps > .19).

Discussion

The results of Experiment 2 reveal an IOR effect for the pixelated nonface targets (11 msec) that is nearly identical to that obtained for the scrambled face targets of Experiment 1 (10 msec). This suggests that the pixelated nonface and scrambled face stimuli were functionally equivalent, despite the potential for participants to discern eyes in the latter. Thus, the results of Experiment 1 likely did not un-

derestimate the difference in IOR between face and nonface targets. Using randomized pixelated nonface targets, Experiment 2 replicated the nature and direction of the critical interaction that was observed in Experiment 1: There was a significantly larger IOR effect for the discrimination of face targets (25 msec) than for the discrimination of nonface targets (11 msec). Also, as in Experiment 1, IOR was larger for face than for nonface targets because the RT advantage that existed for face targets relative to nonface targets at the uncued location ($M_{face} = 459$ msec; $M_{nonface} = 475$ msec) was eliminated at the cued location ($M_{face} = 484$ msec; $M_{nonface} = 486$ msec). We would again argue that the primary mechanism that underlies this difference in IOR magnitude operates at the cued location, producing a larger slowing effect on face discriminations than on nonface discriminations (see Discussion of Experiment 1).[2]

The results of Experiments 1 and 2 suggest that the mechanism underlying IOR is sensitive to the identity of a discrimination target. Although a relative difference in the magnitude of IOR was observed, it is possible that this magnitude difference reflects a different time course in the development of IOR for face and nonface targets. To determine whether this is true, Experiment 3 manipulated cue–target stimulus onset asynchrony (SOA).

EXPERIMENT 3

Experiment 3 examined IOR at four different cue–target SOAs: 250 msec, 500 msec, 1,000 msec, and 2,000 msec. The goal was to determine whether IOR develops at a different rate for face than for nonface targets. In this case, the nonface targets were the randomized pixelated stimuli used in Experiment 2.

Method

Participants. Twenty-five Dalhousie undergraduate students participated in this experiment in exchange for course credit. All participants reported normal or corrected-to-normal vision. Participants were tested individually in an experimental session that lasted less than 1 h. None had participated in Experiment 1 or 2, and all were naive to the purpose of the experiment.

Stimuli and Apparatus. The stimuli and apparatus were identical to those used in Experiment 2 with one exception. We did not want to confound our manipulation of cue–target SOA with the manipulation of the interval between the peripheral cue and the fixation cue or the interval between the fixation cue and the target. We therefore eliminated the intervening fixation cue from all trials of the present experiment. Although eliminating the fixation cue might reduce the magnitude of IOR at the shortest SOA relative to a condition that included this intervening cue (especially if it occurred in the middle or near the end of the cue–target interval), the magnitude of IOR at SOAs beyond 400 msec should be unaffected by the presence or absence of a fixation cue (Pratt & Fischer, 2002). Even if this were not true (e.g., due to the use of a target discrimination task rather than the target detection task employed by Pratt & Fischer, 2002), the goal of the present experiment was to compare IOR for face versus nonface targets in a within-subjects design. Any influence that the elimination of a fixation cue might have on the overall magnitude of IOR (in comparison with a condition that included a fixation cue) would not affect our ability to compare the relative magnitude and time course of IOR for face and nonface targets.

Procedure. The procedure was identical to that of Experiment 2 except that the fixation cue was eliminated and the target
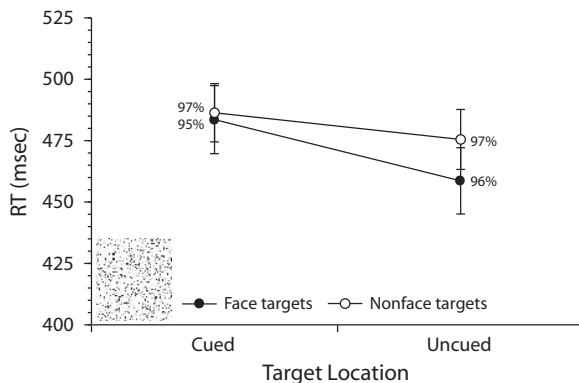

Figure 3. Discrimination reaction times (RTs) in Experiment 2 as a function of target location (cued, uncued) and target configuration (face, pixelated nonface). Error bars show the standard error of the mean. The percentage of correct trials upon which each RT is based is shown beside the relevant plot. The pixelated nonface target stimulus is shown in the lower left corner.

could be onset at intervals of 250 msec, 500 msec, 1,000 msec, and 2,000 msec relative to cue onset. A total of 320 trials was presented in a single block consisting of 10 replications of the factorial combination of cue presentation (left, right), target presentation (left, right), target configuration (face, pixelated nonface), and cue–target SOA (250, 500, 1,000, 2,000 msec). For the purpose of analysis, cue presentation and target presentation were collapsed into a single factor, referred to as target location, with two levels: cued (left–left, right–right) and uncued (left–right, right–left). Twelve participants pressed the M key with the right index finger to report the discrimination of a face and the Z key with the left index finger to report the discrimination of a nonface; the key assignment was reversed for the remaining 13 participants.

Results

Trials on which a correct discrimination was made within 100–1,000 msec of target onset were used to calculate mean RTs. Mean RT data for correct trials are shown in Table 1 as a function of target location, target configuration, and cue–target SOA. The RT data were used to calculate IOR; negative values represent facilitation, and positive values represent IOR. Associated accuracies are shown in Table 2.

A three-way repeated measures ANOVA was performed on the RT data, with target location (cued, uncued), target configuration (face, nonface), and cue–target SOA (250, 500, 1,000, 2,000 msec) as factors. This analysis revealed a main effect for target location [$F(1,24) = 8.23$, $MS_e = 1,202.10$, $p < .01$], with overall slower responding to cued ($M = 510$ msec) than to uncued ($M = 500$ msec) targets. There was also a main effect of target configuration [$F(1,24) = 16.55$, $MS_e = 2,496.36$, $p < .01$] due to overall faster RTs to face ($M = 495$ msec) than to nonface ($M = 515$ msec) targets. There was no main effect of cue–target SOA ($F < 1$), and none of the two-way interactions was significant (all $ps > .10$). There was, however, a significant three-way interaction between target location, target configuration, and cue–target SOA [$F(3,72) = 3.62$, $MS_e = 353.42$, $p < .02$].

This interaction confirms that the development of IOR followed a different time course for face than for nonface targets, as Table 1 indicates. Contrasts on the omnibus three-way interaction indicated that for face targets, there was a nonsignificant −5-msec (facilitatory) effect at the 250-msec SOA ($F < 1$), a nonsignificant 4-msec IOR effect at the 500-msec SOA ($F < 1$), a significant 11-msec IOR effect at the 1,000-msec SOA [$F(1,72) = $

4.92, $p < .03$], and a significant 23-msec IOR effect at the 2,000-msec SOA [$F(1,72) = 19.30$, $p < .01$]. For nonface targets, there was a nonsignificant 10-msec IOR effect at the 250-msec SOA [$F(1,72) = 3.23$, $p > .07$] that became a significant 17-msec IOR effect at the 500-msec SOA [$F(1,72) = 9.87$, $p < .01$], remained a significant 12-msec IOR effect at the 1,000-msec SOA [$F(1,72) = 4.99$, $p < .03$], and became a nonsignificant 7-msec IOR effect again at the 2,000-msec SOA [$F(1,72) = 1.47$, $p > .22$]. Together, these findings demonstrate that IOR emerges on a different time course for face than for nonface targets. IOR first became significant at the 500-msec SOA for nonface targets but did not become significant until the 1,000-msec SOA for face targets. Moreover, given the continued upward trend in the face data (i.e., an increase in IOR from 11 msec at the 1,000-msec SOA to 23 msec at the 2,000-msec SOA; see Table 1), IOR may also last longer for face than for nonface targets. Unfortunately, this cannot be confirmed by the present data.

A three-way ANOVA performed on the percentage correct accuracy scores shown in Table 2 revealed only a significant main effect of target location [$F(1,24) = 10.09$, $MS_e = 25.32$, $p < .01$] resulting from slightly more accurate discrimination of cued ($M = 97\%$) than uncued ($M = 95\%$) targets. No other effects were significant (all $ps > .08$).

Discussion

The results of Experiment 3 demonstrate a different time course for the emergence of the IOR effect for face targets than for nonface targets: the IOR effect for face targets takes longer to develop than that for nonface targets. As it happens, the crossover point for the face and nonface time course functions was at a cue–target SOA of 1,000 msec (see Table 1). This may seem surprising, given that a face/nonface IOR difference existed at the fixed 1,000-msec cue–target SOA that was used in Experiments 1 and 2. However, there is liable to be some variability in the crossover point, depending on trial events. In the present case, for example, it seems likely that even if the magnitude of IOR were not affected by the absence of the fixation cue (especially at longer SOAs, where there should have been no effect of its elimination; Pratt & Fischer, 2002), the time course function might have been.

Without this external stimulus to draw attention back to fixation, the withdrawal of attention from the periph-

Table 1
Discrimination RTs (in Milliseconds) in Experiment 3 As a Function of
Target Location (Cued, Uncued), Target Configuration (Face, Nonface), and
Cue–Target Stimulus Onset Asynchrony (SOA: 250, 500, 1,000, 2,000 msec)

| Target Configuration | Target Location | Cue–Target SOA | | | | | | | |
| | | 250 msec | | 500 msec | | 1,000 msec | | 2,000 msec | |
		M	SE	M	SE	M	SE	M	SE
Face	Cued	494	10	495	11	502	12	505	10
	Uncued	499	10	491	11	491	12	482	10
	IOR (cued − uncued)	−5		4		11*		23*	
Nonface	Cued	527	10	523	10	516	11	518	9
	Uncued	517	9	506	10	504	12	511	9
	IOR (cued − uncued)	10		17*		12*		7	

*$p < .05$.

Table 2
Discrimination Accuracy (in Percentages) in Experiment 3 As a Function of
Target Location (Cued, Uncued), Target Configuration (Face, Nonface), and
Cue–Target Stimulus Onset Asynchrony (SOA: 250, 500, 1,000, 2,000 msec)

Target Configuration	Target Location	Cue–Target SOA							
		250 msec		500 msec		1,000 msec		2,000 msec	
		M	SE	M	SE	M	SE	M	SE
Face	Cued	96	0.8	96	1.3	97	1.0	96	0.7
	Uncued	96	1.1	96	0.7	95	1.5	94	1.2
Nonface	Cued	98	0.7	98	0.7	98	0.6	97	0.8
	Uncued	96	1.3	95	1.0	96	1.1	95	1.2

eral cue location would have required endogenous mechanisms. Endogenous shifts of attention are known to be slower than exogenous shifts (Müller & Rabbitt, 1989). Given that IOR is generally not revealed until attention is removed from the cued location (cf. Danziger & Kingstone, 1999), it seems likely that IOR would have taken longer to develop in Experiment 3 than in Experiments 1 and 2—for both face and nonface targets.[3] It is therefore understandable that, in Experiment 3, IOR for face and nonface targets was equivalent at a cue–target SOA for which it had previously been shown to be different. Despite this presumed variability in time course functions due to trial events, it nevertheless remains the case that when IOR for face targets was tested at the same intervals and under the same conditions, it followed a different time course than IOR for nonface targets.

An important question arising from these data is whether the different time course of IOR for face versus nonface targets was due to the overall faster RTs to the former. Perhaps at early SOAs, IOR has not yet had a chance to develop by the time the faster responses are made to face targets, whereas it has had time to develop by the time the slower responses are made to nonface targets. By similar reasoning, perhaps at long SOAs, IOR is still present by the time the faster responses are made to face targets, whereas it has dissipated by the time the slower responses are made to nonface targets. To test this possibility, cumulative distribution functions were obtained on a subject-by-subject basis by taking the 10th, 25th, 50th, 75th, and 90th RT percentiles as a function of target location (cued, uncued), target configuration (face, nonface), and cue–target SOA (250, 500, 1,000, 2,000 msec). If overall RT affected the time course of IOR, then, in a repeated measures ANOVA, percentile ranking should have entered into a significant four-way interaction with target location, target configuration, and cue–target SOA. This did not occur ($F < 1$). Thus, there is no reason to believe that the different time course functions for the development of IOR for face and nonface targets were due to differences in overall speed of responding to these targets.

A second important consideration is whether the data from Experiment 3 can speak to the role of any potential facilitatory effects operating at the uncued location. At first blush, the data in Table 1 seem to suggest that IOR for faces is due to a simultaneous slowing of cued RTs and speeding of uncued RTs. The data further suggest that IOR for nonfaces is due primarily to a speeding of un-

cued RTs. Unfortunately, this pattern of data is somewhat misleading because superimposed on any cuing effects is the influence of increasing SOA on RTs, which generally produces an overall speeding effect due to decreasing temporal uncertainty and general alerting/preparatory effects (e.g., see Niemi & Näätänen, 1981).

Therefore, to get a better sense of these findings, we collapsed each data set over the two SOAs at which IOR was obtained and the two SOAs at which IOR was *not* obtained. Thus, for the face data, we collapsed RTs over the 1,000- and 2,000-msec SOAs and over the 250- and 500-msec SOAs; for the nonface data, we collapsed RTs over the 500- and 1,000-msec SOAs and over the 250- and 2,000-msec SOAs. We then analyzed cued and uncued RTs separately, as a function of whether they were associated with IOR (yes, no) and as a function of target configuration (face, nonface). If the larger magnitude IOR effect for face targets as compared with that for nonface targets was due, in part, to differential facilitatory effects operating at the uncued location, this analysis would result in a significant two-way interaction. It did not ($F < 1$). When significant IOR was obtained, RTs at the uncued location were 487 msec to face targets and 505 msec to nonface targets; when significant IOR was *not* obtained, RTs at the uncued location were 495 msec to face targets and 514 msec to nonface targets. In other words, at the uncued location, faces were discriminated 19 msec faster than nonfaces, whether IOR was obtained or not. Thus, IOR was not associated with differential speeding of responses to face targets relative to nonface targets at the uncued location.

In contrast, there was a significant interaction in an equivalent analysis of cued RTs [$F(1,24) = 6.18$, $MS_e = 144.56$, $p < .03$]. When significant IOR was obtained, RTs at the cued location were 504 msec to face targets and 520 msec to nonface targets; when significant IOR was *not* obtained, RTs at the cued location were 495 msec to face targets and 522 msec to nonface targets. In other words, faces were discriminated 16 msec faster than nonfaces when IOR was obtained, but 28 msec faster when IOR was *not* obtained. Importantly, this significant interaction is not easily accounted for by the collapsing of data across different SOAs in the case of face and nonface targets. This is because any systematic effects of increasing SOA would have contributed to the RT data obtained at both the cued and uncued locations. Yet the interaction was significant only at the cued location. This is consistent with the suggestion

that the larger magnitude IOR effect for face targets than for nonface targets is due to processes operating primarily at the cued location. Again, it appears that an RT advantage that would otherwise occur for discriminating face targets versus nonface targets is reduced at the cued location.

The finding that the time course of IOR that emerges for the discrimination of face targets differs from that for nonface targets leads to the question of whether a similar difference occurs in the localization of these same targets. Taylor and Therrien (2005) found no difference in the magnitude of IOR for their localization task, but this could be because their single 1,000-msec SOA fell at the time course crossover point in the development of IOR for face and nonface targets. Experiment 4 tested this possibility.

EXPERIMENT 4

Experiment 4 repeated the methods of Experiment 3 except that a target localization task rather than a target discrimination task was used. The goal was to determine whether a different time course function for the development of IOR would also emerge for face and nonface targets when target configuration was made task irrelevant in a localization task (cf. Taylor & Therrien, 2005).

Method

Participants. Twenty-three Dalhousie University undergraduate students participated in this experiment in exchange for course credit. All reported having normal or corrected-to-normal vision and none had participated in Experiments 1–3. Participants were tested individually in an experimental session that lasted less than 1 h. All participants were naive to the purpose of this experiment.

Stimuli and Apparatus. The stimuli and apparatus were identical to those used in Experiment 3.

Procedure. The procedure was identical to that of Experiment 3 except that the target required a localization response, and hence target configuration was made task irrelevant. Whether the target was a face or a nonface, participants were required to make a speeded localization. They pressed the Z key with the left index finger to report a target to the left and the M key with the right index finger to report a target to the right.

Results

Trials on which a correct localization response was made within 100–1,000 msec of target onset were used in the analysis of RTs. Mean RTs for correct trials are shown in Table 3 as a function of target location, target configu-

ration, and SOA. RTs were used to calculate IOR; negative values reflect facilitation, and positive values reflect IOR. Associated accuracies are shown in Table 4.

The localization RT data shown in Table 3 were analyzed in a repeated measures ANOVA as a function of target location (cued, uncued), target configuration (face, nonface), and cue–target SOA (250, 500, 1,000, 2,000 msec). This analysis revealed a main effect for target location [$F(1,22) = 49.95$, $MS_e = 504.92$, $p < .01$], with overall slower RTs to cued ($M = 388$ msec) than to uncued ($M = 372$ msec) targets. There was also a main effect for target configuration [$F(1,22) = 19.09$, $MS_e = 346.26$, $p < .01$], with overall faster localization of face ($M = 376$ msec) than nonface ($M = 384$ msec) targets—despite the fact that target configuration was task irrelevant. There was no main effect for cue–target SOA [$F(3,66) = 2.40$, $MS_e = 723.38$, $p > .07$]. The effect of SOA did, however, enter into a significant two-way interaction with target location [$F(3,66) = 3.32$, $MS_e = 310.18$, $p < .03$]. This reflects a tendency for the overall IOR effect (i.e., the IOR effect collapsed across face and nonface targets) to increase from the shortest to the longest SOAs. There was no significant two-way interaction of target location and target configuration ($F < 1$) and no significant two-way interaction of target configuration and SOA [$F(3,66) = 1.95$, $MS_e = 214.27$, $p > .12$].

Critically, there was also no significant three-way interaction between target location, target configuration, and cue–target SOA ($F < 1$). This means that there was no significant variation in the magnitude of IOR for face and nonface targets across cue–target SOAs. In other words, the time course of IOR for localizing face targets was statistically indistinguishable from the time course of IOR for localizing nonface targets. For the localization of face targets, IOR was significant at all cue–target SOAs: 8 msec at the 250-msec SOA [$F(1,66) = 4.18$, $p < .05$], 14 msec at the 500-msec SOA [$F(1,66) = 12.76$, $p < .01$], 27 msec at the 1,000-msec SOA [$F(1,66) = 50.73$, $p < .01$], and 18 msec at the 2,000-msec SOA [$F(1,66) = 21.44$, $p < .01$]. For the localization of nonface targets, IOR was likewise significant at all cue–target SOAs: 10 msec at the 250-msec SOA [$F(1,66) = 6.59$, $p < .02$], 14 msec at the 500-msec SOA [$F(1,66) = 12.32$, $p < .01$], 22 msec at the 1,000-msec SOA [$F(1,66) = 29.69$, $p < .01$], and 20 msec at the 2,000-msec SOA [$F(1,66) =$

Table 3
Localization RTs (in Milliseconds) in Experiment 4 As a Function
of Target Location (Cued, Uncued), Target Configuration (Face, Nonface),
and Cue–Target Stimulus Onset Asynchrony (SOA: 250, 500, 1,000, 2,000 msec)

Target Configuration	Target Location	Cue–Target SOA							
		250 msec		500 msec		1,000 msec		2,000 msec	
		M	SE	M	SE	M	SE	M	SE
Face	Cued	385	10	377	11	390	9	384	10
	Uncued	377	10	363	12	363	10	366	11
	IOR (cued − uncued)	8*		14*		27*		18*	
Nonface	Cued	395	12	390	12	397	12	388	11
	Uncued	385	11	376	11	375	10	368	11
	IOR (cued − uncued)	10*		14*		22*		20*	

*$p < .05$.

Table 4
Localization Accuracy (in Percentages) in Experiment 4 As a Function of
Target Location (Cued, Uncued), Target Configuration (Face, Nonface),
and Cue–Target Stimulus Onset Asynchrony (SOA: 250, 500, 1,000, 2,000 msec)

Target Configuration	Target Location	Cue–Target SOA							
		250 msec		500 msec		1,000 msec		2,000 msec	
		M	SE	M	SE	M	SE	M	SE
Face	Cued	98	0.7	99	0.4	100	0.0	99	0.8
	Uncued	97	0.8	99	0.4	100	0.0	99	0.5
Nonface	Cued	99	0.6	98	0.5	99	0.4	100	0.0
	Uncued	98	0.6	99	0.4	99	0.5	100	0.3

27.23, $p < .01$]. As this analysis shows, the magnitude of IOR was similar at all cue–target SOAs tested.

A three-way ANOVA was performed on the percentage correct accuracy data shown in Table 4. This analysis revealed a significant main effect for cue–target SOA [$F(3,66) = 7.82$, $MS_e = 6.57$, $p < .01$], reflecting a small but significant tendency for accuracy to be lower at the shortest cue–target SOAs than at the longest ones ($M_{250} = 98\%$; $M_{500} = 99\%$; $M_{1,000} = 100\%$; $M_{2,000} = 100\%$). None of the other main effects approached significance (all $Fs < 1$). The two-way interaction between target configuration and cue–target SOA was significant [$F(3,66) = 3.57$, $MS_e = 5.34$, $p < .02$]. This reflects the fact that localization of face targets was slightly less accurate than localization of nonface targets at the 250 and 2,000-msec SOAs but was the opposite for the two middle SOAs. Neither the two-way interaction between target location and target configuration ($F < 1$) nor the two-way interaction between target location and SOA [$F(3,66) = 2.27$, $MS_e = 4.26$, $p > .08$] was significant. There was also no significant three-way interaction between target location, target configuration, and cue–target SOA ($F < 1$).

Discussion

Whereas Experiment 3 showed a difference in the development of the time course of IOR for face versus nonface target discriminations, Experiment 4 revealed no such difference for face versus nonface target localizations. Thus, when Taylor and Therrien (2005) reported no difference in the magnitude of IOR for localizing face and nonface targets, it was not due to the chance sampling of a crossover point for two different time course functions. Instead, the results of Experiment 4 suggest that IOR for the localization of face targets and IOR for the localization of nonface targets are statistically indistinguishable. Therefore, the results from Experiments 3 and 4 indicate that the mechanism underlying IOR does appear to be "blind" to the social significance of target stimuli when those stimuli are task irrelevant, but not when they are task relevant.

GENERAL DISCUSSION

Experiments 1 and 2 revealed larger magnitude IOR effects for face than for nonface target discriminations. In Experiment 3, IOR for face targets emerged later than did IOR for nonface targets. There was also a suggestion that IOR may last longer for face than for nonface targets. Interestingly, time course differences for face and nonface targets occurred only when target configuration was task relevant; when target configuration was made task irrelevant in Experiment 4 by requiring a localization rather than a discrimination response, an identical time course of IOR for face and nonface targets was obtained.

At the outset of this investigation, we expected the magnitude of the IOR effect to be modulated by target configuration. We presumed that the special status afforded to social stimuli such as human faces might give such stimuli priority processing that would allow them to escape the deleterious effects of prior unpredictive exogenous cuing. Our premise was clearly incorrect. Instead of observing reduced IOR effects for face targets, we observed the opposite: Once the target configuration was made task relevant by virtue of a discrimination task, IOR emerged on a different time course and, at a fixed SOA, at a different magnitude for face than for nonface targets. Clearly, these face/nonface differences in IOR cannot be explained by events that occur prior to target onset. Given the mixed-blocks design, there was nothing to distinguish face trials from nonface trials until after the onset of the target; it is therefore unreasonable to argue that the cue generated different inhibitory effects for the two types of targets. Instead, the conclusion has to be that the face/nonface IOR differences stem from mechanisms operating at or after target onset.

One possibility is that the face/nonface IOR differences are related to the relative difficulty of the face versus nonface discrimination: More difficult discriminations lead to the later emergence of IOR (Lupiáñez et al., 2001). This account does not seem to explain our data, however. In no experiment was the discrimination of face targets slower or less accurate than the discrimination of nonface targets. Instead, even though the difference in RTs to face and nonface targets was not always significant within individual experiments, it was always in the direction of RTs being faster to face than to nonface targets (see also Bentin & McCarthy, 1994; Bentin & Moscovitch, 1988).

The tendency for RTs to be faster to face than to nonface targets was confirmed in a between-experiments analysis that pooled RT data from Experiment 1, Experiment 2, and the 1,000-msec SOA of Experiment 3. An analysis of these data revealed a significant main effect of experiment [$F(2,78) = 5.82$, $MS_e = 10,865.42$, $p < .01$], with overall fastest RTs in Experiment 2 and overall slowest RTs in Experiment 1. Critically for present purposes,

there was an overall main effect of target configuration [$F(1,78) = 12.24$, $MS_e = 765.85$, $p < .01$] that did not interact with experiment ($F < 1$). This main effect of target configuration resulted from overall faster RTs to face ($M = 501$ msec) than to nonface ($M = 512$ msec) targets. Finally, in the context of overall faster RTs to face than to nonface targets, there was also an interaction between target configuration and target location [$F(1,78) = 7.34$, $MS_e = 175.74$, $p < .01$] that did not interact with experiment [$F(2,78) = 1.86$, $MS_e = 175.74$, $p > .16$]. This interaction confirmed overall larger IOR effects for face ($M = 19$ msec) than for nonface targets ($M = 11$ msec). Given these observations, it is clear that IOR differences for face and nonface targets cannot be explained readily by discrimination difficulty during target processing. Therefore, they must be due to other factors related to posttarget processing and/or responding.

Despite the nomenclature, IOR does not always reflect the inhibited return of attention to a cued location (see Berlucchi, 2006, for recent consideration of the difficulties associated with the term *IOR*). Although IOR is generated reflexively by an onset cue (Tipper & Kingstone, 2005) that is also capable of attracting covert and/or overt attention (Rafal et al., 1989), this does not mean that the inhibitory *effect* that is generated by the cue also has to be on attention (see Taylor & Klein, 1998). There is certainly evidence to suggest that the IOR effect reflects inhibited attention under some circumstances (see, e.g., Handy, Jha, & Mangun, 1999; Klein & Dick, 2002; Prime & Ward, 2004; Reuter-Lorenz, Jha, & Rosenquist, 1996). Nevertheless, the inhibition of attention is not a foregone conclusion (see Taylor & Klein, 1998, for a review). Indeed, under naturalistic viewing conditions (e.g., when the eyes are free to move) such as those used in the present study, there is evidence that IOR likely has a motor basis (Hunt & Kingstone, 2003; Kingstone & Pratt, 1999; Taylor & Klein, 2000; cf. Klein & Taylor, 1994).

According to one view (Klein & Taylor, 1994; Taylor & Klein, 1998), this motor effect reflects a criterion shift against responding to targets that appear at the cued versus the uncued location (Ivanoff, 2004). In other words, IOR does not reflect slowed perceptual processing of targets at the cued location. Instead, there is a bias to respond more slowly to targets that occur at the cued location than to targets that appear at the uncued location. Because responses to targets at the cued location are relatively delayed, information about the perceptual identities of those targets can continue to accumulate between the time of their initial presentation and the final execution of a response (cf. Ivanoff & Klein, 2004). Herein may arise the potential source of the larger/later-emerging IOR effect for the discrimination of face targets compared with that for nonface targets.

To the extent that a face has biological significance, it behooves the observer to process it fully before making a response that explicitly depends on its correct discrimination. Thus, to the extent that IOR reflects a criterion shift that slows responses to targets at the cued location, it may coincidentally provide additional time for the processing of a task-relevant face target. Just as the mechanism that gives rise to IOR can delay responses long enough to allow for the successful cancellation of unwanted prepotent responses (Ivanoff & Taylor, 2006), it may also delay responses sufficiently to allow for a detailed perceptual analysis of target stimuli. In this way, the mechanism that gives rise to IOR may operate serendipitously in the service of evolutionary goals, according to the following manner. Attention is attracted by a sudden change in the visual periphery, but the change is irrelevant and thus attention is withdrawn. Following this withdrawal, another change occurs in the same location. In the context of ongoing behavior, it seems necessary or important to discriminate this stimulus to determine if it is human. If this stimulus turns out to be a human face, the delay in making a response (i.e., IOR) enables an additional accumulation of information, such as the determination of emotional valence and intention. If, instead, the stimulus is a nonface, a response can be executed once sufficient evidence has accumulated to make this clear.

Under the view that IOR reflects motor processes when the eyes are free to move but attentional processes when eye movements are constrained (cf. Taylor & Klein, 2000), it is possible that our results are limited to natural, unconstrained viewing. Allowing this caveat, the present results are consistent with the view that a criterion shift underlying IOR converges with the evolutionary goal of maximizing the information accumulated from task-relevant face stimuli. To wit, we believe that biological relevance underlies the larger magnitude IOR effect for the discrimination of face targets than for nonface targets. Nevertheless, one might postulate that the relative meaningfulness of the target stimuli is more critical than their biological relevance per se. We think that this is unlikely, however, given the results of a lexical decision task reported by Chasteen and Pratt (1999, Experiment 1), who found, on the basis of data from 10 participants, that IOR was 60 msec for high-frequency words, 119 msec for low-frequency words, and 58 msec for pronounceable nonwords. Although the magnitude of IOR depended on the frequency of the words presented, the important finding for our purposes is that IOR for words did not exceed IOR for nonwords. Clearly, then, word frequency was a more important influence on the magnitude of IOR than whether letters were arranged to form meaningful words or meaningless nonwords. We are currently conducting studies to further explore the potential role of target meaningfulness, but on the basis of Chasteen and Pratt's findings and our own preliminary findings (which reveal a trend similar to theirs), we expect that meaningfulness will not prove to be a strong determinant of IOR magnitude.

In the meantime, it is certainly the case that the delay in executing a response to events at the cued location can aid effective responding when speed is not the critical issue: The greater accumulation of information at the cued location reduces the number of false alarms made to nontarget events (Ivanoff, 2004; Ivanoff & Klein, 2001, 2004; Taylor & Ivanoff, 2003), increases the likelihood that unwanted responses will be prevented (Ivanoff & Taylor, 2006), and allows for the engagement of top-down expectancies about likely target events (Ivanoff & Klein, 2004; Taylor, 2006).

To the extent that a delay in responding also allows for the greater accumulation of response-relevant information from biologically relevant stimuli, IOR can be seen to not only subserve effective visual search (Klein, 1988; Klein & MacInnes, 1999) but also support adaptive responding.

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NOTES

1. To the extent that the speed of making a face/nonface discrimination was the dependent measure of interest, it was impossible to also manipulate cue configuration. This is because, as Taylor and Donnelly (2002; see also Taylor & Ivanoff, 2005) reported, the repetition of object features from cue to target (as in the case of face/face or nonface/nonface cue–target combinations) reduces or eliminates IOR in a discrimination task via repetition priming. Indeed, we confirmed this in a pilot investigation that presented face and nonface stimuli as both cues and targets: Facilitation (i.e., faster responding to targets in the cued location than in the uncued location) was obtained when the cue and target configuration were identical and IOR was observed when they were not.

2. In another investigation from our lab, we replicated exactly the methods of Experiment 2 except that a face or pixelated nonface target could occur with equal probability in any one of the three stimulus boxes, including the center one. Targets could therefore occur at a cued peripheral location, an uncued peripheral location, or an uncued center location. In an analysis that included only the peripheral locations, the results ($n = 42$) provided a third replication of the critical interaction observed in Experiments 1 and 2, between target location (peripheral cued, peripheral uncued) and target configuration (face, nonface) [$F(1,41) = 5.73$, $MS_e = 191.96$, $p < .03$]. This interaction stemmed from significantly larger IOR for face targets [21 msec; $F(1,41) = 47.34$, $p < .01$] than for nonface targets [11 msec; $F(1,41) = 12.22$, $p < .01$]. This larger IOR effect for face targets than for nonface targets occurred in the context of a relatively reduced face versus nonface RT difference at the cued location. This was confirmed in an analysis of face − nonface difference scores, which revealed a significant effect of location [$F(2,82) = 3.12$, $MS_e = 353.44$, $p < .05$]: The face RT advantage was 17 msec at the peripheral uncued location ($M_{face} = 450$ msec, $M_{nonface} = 467$ msec), 13 msec at the central uncued location ($M_{face} = 470$ msec, $M_{nonface} = 483$ msec), and only 7 msec at the peripheral cued location ($M_{face} = 471$ msec, $M_{nonface} = 478$ msec). Given that there is no evidence that facilitation along the cued–uncued axis can account for the IOR effect (cf. Snyder et al., 2001; Sumner, 2006), it seems to us that the most parsimonious account of these data is that the inhibition operating at the cued location exerted a larger relative effect on face targets than on nonface targets, thereby reducing the face RT advantage that would otherwise have occurred.

3. In an additional control experiment, 20 participants completed a task that was identical to that of Experiment 2 (i.e., face and nonface targets were presented at a fixed, 1,000-msec cue–target SOA) except that the cue back to fixation was eliminated. RTs to face targets were 480 msec at the cued location and 467 msec at the uncued location; RTs to nonface targets were 484 msec at the cued location and 476 msec at the uncued location. An analysis of these data revealed that, consistent with the results of the 1,000-msec SOA in Experiment 3, the IOR effects for face [13 msec; $F(1,19) = 8.98$, $p < .01$] and nonface targets [8 msec; $F(1,19) = 3.57$, $p = .07$] were not significantly different ($F < 1$).