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Implicit Perception and Level of Processing in Object Substitution Masking

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Abstract

Object substitution masking (OSM, Enns, & Di Lollo, 1997) refers to reduced target discrimination when the target is surrounded by a sparse mask that does not overlap with the target in space but trails it in time. In four experiments, we used a novel paradigm to investigate the extent of processing of a masked target in OSM. We measured response compatibility effects between target and mask, both when the offsets were simultaneous and when the mask offset was delayed. Evidence for both OSM and a dissociation between perception and awareness was found when detecting the match between the target and the mask required feature but not categorical analyses. Our results suggest that the locus of disruption in OSM is likely to be beyond feature analysis of an unreported target.

Visual perception requires activation of neurons at multiple cortical areas that are interconnected through both feedforward projections from lower to higher processing areas and feedback, reentrant processes (see Lamme & Roelfsema, 2000, for a review). Whereas feedforward projections are primarily concerned with visual information transfer, feedback projections are involved in perceptual decision making (Leon & Shadlen, 1998; Zhang, Riehle, Requin, & Kornblum, 1997), the sharpening of neurons' tuning curves (Cottaris & De Valois, 1998), and the perceived salience of a stimulus feature (Knierim & van Essen, 1992; Rossi, Rittenhouse, & Paradiso, 1996).

Feedback projections also play an essential role in visual awareness (Bullier, 2001; Ro, Breitmeyer, Burton, et al., 2003). Pascual-Leone and Walsh (2001) reported that whereas participants who received transcranial magnetic stimulation (TMS) at V1 before receiving it at V5 reported seeing moving phosphenes (specks of light), this motion perception was severely disrupted when TMS was applied to V1 after it was applied to V5. This finding suggests that reentry to V1 is critical for conscious awareness. Related results were observed by Cowey and Walsh (2000), who stimulated the middle temporal MT/V5 area of a patient who had a damaged primary visual cortex in one hemisphere. When TMS was applied to the MT area in the patient's intact hemisphere, moving phosphenes were elicited. However, when it was applied to the corresponding area in the hemisphere with the lesioned V1, no stimuli were seen. These findings suggest that visual awareness depends on intact feedback projections from higher to lower level cortical areas.

Feedback projections are also thought to underlie object substitution masking (OSM, Enns & Di Lollo, 1997), the phenomenon of reduced target discrimination when the target is surrounded by a sparse mask that trails it in time. In a typical experiment, a target is presented briefly, surrounded by a four-dot mask. On some trials, target and mask have simultaneous offsets (the simultaneous condition). On other trials, the mask trails the target in offset (the delayed condition). Despite identical target duration, target identification is substantially impaired in the delayed condition, suggesting that feedback from the delayed mask disrupts target perception.

Unlike pattern or metacontrast masking (see Enns & Di Lollo, 2000, for a review), OSM is relatively insensitive to the spatial proximity between target and mask (Enns & Di Lollo, 1997; Di Lollo, Enns, & Rensink, 2000) or to the preview duration of the mask (Neill, Hutchison, & Graves, 2002). However, it is sensitive to the spatial distribution of attention (Enns & Di Lollo, 1997; Kahan & Mathis, 2002), the duration of the trailing mask (Di Lollo et al., 2000), and the feature similarity between mask and target (Jiang & Chun, 2001a; Gellatly, Pilling, Cole, & Skarratt, 2006). Remarkably, OSM has been observed even when the mask occurred to one side of the target (Jiang & Chun, 2001b), or when the mask moved from one location to another upon target offset (Lleras & Moore, 2003).

These features of OSM are consistent with a reentrant processing model proposed by Di Lollo and colleagues (Di Lollo et al., 2000). According to the model, perception is the result of ongoing communication between neurons at different cortical levels. Sensory information is sent from lower to higher processing areas. However, because activation patterns generated at the lower level are often consistent with more than one perceptual hypothesis, iterative reentrant processing from the higher level is required for accurate perception. When target and mask have simultaneous offsets, there is no mismatch between the ongoing activities at the lower level and the feedback projections from the higher level. However, when the mask trails the target, the incoming visual information (which contains no target) cannot match the feedback projections (which contain both the target and the mask). This results in the conscious perception of the mask alone, rather than of the mask plus the target. Because attention reduces the number of iterations between the different levels of processing, it increases the chance that the target will still be present when the reentry process is finishes and consequently reduces or eliminates OSM.

In this paper we ask to what extent the masked target in OSM is processed. Several studies have investigated this issue. Woodman and Luck (2003) measured event-related potentials (ERPs) in a visual search task where the target was defined by shape. When a target was present, it occurred at one of two locations indicated by masks. The masks either had simultaneous offsets with the target or were delayed in offset. The participants' ERPs showed a significant N2pc component on the target-present trials in both the simultaneous and the delayed conditions regardless of whether the target was detected or missed. Because the N2pc component is known to reflect the deployment of attention when the target is among competing distractors (Luck & Hillyard, 1994), this finding indicates the implicit perception of an object's shape despite the lack of conscious perception.

However, evidence for implicit perception was not found in other studies. Reiss and Hoffman (2006) measured the N400 component of ERPs in a word identification task. The target was preceded by a semantically related or unrelated word (the prime), and the mask either offset together with the target or was delayed in offset. Because N400 reflects semantic incongruity (Kutas & Hillyard, 1980), its occurrence would indicate the detection of a mismatch in meaning between the target and the prime, implying that the target had been perceived. Although a significant N400 component was found in the simultaneous condition (when the word was consciously perceived), it was not present in the delayed condition. A similar result was reported by Carlson, Rauschenberger, and Verstraten (2007), who found no evidence of implicit processing of shape in the lateral occipital cortex when the target was successfully masked.

Given the many differences in the above studies, it is difficult to determine the critical factors that gave rise to the different results. In the experiments reported here, we used a novel approach to investigate the extent of processing of the unreported target in OSM. We varied the response compatibility between target and mask, both when their offsets were simultaneous and when the mask offset was delayed. Our participants responded to both target and mask. In some experiments, half the targets and masks matched at a feature level and half mismatched, and in the other experiments, half the targets and masks matched at a categorical level and half mismatched. The presence of a response compatibility effect (RCE) in responses to the mask would be evidence that the target was processed, even on trials when the target was not reported. The level of compatibility required (feature or category) would reveal the level to which the target was processed, either explicitly (when the target was reported) or implicitly (when it was missed). Because we used the same behavioral paradigm in the experiments, we were able to examine the effects of processing level while minimizing methodological differences across the experiments.

EXPERIMENT 1

In Experiment 1 ($N = 13$), participants performed a speeded discrimination task regarding the mask (whether the arrows pointed left or right), and then an accuracy only detection task concerning the target (whether the target arrow was present or not). Of particular interest was whether a significant RCE would be found in mask responses on target-present trials when participants indicated no conscious perception of the target.

Figure 1 shows the stimuli and procedure. All stimuli were presented in black against a white background on a computer screen. The target display consisted of three sets of foils (pound signs) and a critical fourth set, which consisted of a central double arrow (the target) and four single arrows (the mask) located at the corners of an imaginary square measuring 1.43^0 on a side. On target-present trials (50% of the trials), target and mask were equally likely to point in the same direction (the compatible trials) or in different directions (the incompatible trials). On half the trials, target and mask had simultaneous offsets (the simultaneous condition). On the rest of the trials, the mask trailed the target in offset (the delayed condition), which was expected to result in OSM. Participants used their right hand to identify the mask by pressing one of two labeled keys on the keyboard. The mask response triggered a question mark, prompting the participants to respond to the target by using their left hand to press one key if a target was present and a different key if it was absent. All the trial types were randomly mixed within a block.

Figure 2a shows the effect of OSM on target detection. On target-present trials, targets were detected less often in the delayed than in the simultaneous condition, $F(1, 12) = 10.70$, $P_{rep} = 0.96$, $\eta_p^2 = .47$. Thus we replicated the finding of OSM on detection of targets, with about one quarter being missed when the mask trailed the target. The effect of compatibility was not significant, $F(1, 12) = 2.08$, $P_{rep} = 0.75$, $\eta_p^2 = .15$, nor was the interaction between compatibility and offset, $F(1, 12) < 1$] .

Next we assessed the implicit perception of the target by examining the effect of target-mask response compatibility on reaction time (RT) to the mask as a function of whether the target was detected on target-present trials. Because there were few incorrect responses to the target in the simultaneous condition, our analyses were confined to the delayed condition (see Figure 2b).[1] When the target was correctly detected, participants showed a strong RCE, with faster RTs on compatible than on incompatible trials, $t(12) = 4.88$, $P_{rep} = .98$, $d = 1.35$. A similar effect was found when the target was missed, $t(12) = 2.29$, $P_{rep} = .89$, $d = 0.64$. A combined analysis on the two types of trials showed main effects of target response (detected vs. missed), $F(1, 12) = 10.86$, $P_{rep} = 0.96$, $\eta_p^2 = .48$, and compatibility, $F(1, 12) = 9.51$, $P_{rep} = 0.95$, $\eta_p^2 = .44$, but no interaction, $F(1, 12) < 1$. Thus the magnitude of the RCE was comparable regardless of whether the target was reported.[2] The match between target and mask was registered even when participants missed the target. These results converge with Woodman and Luck's (2003) finding that an N2PC was elicited even when the target was not perceived in an OSM paradigm.

EXPERIMENT 2

In Experiment 2 ($N = 15$), we examined whether categorical information would also survive OSM. Participants performed a speeded letter categorization task (consonant vs. vowel) on the mask before they reported the presence or absence of the target. Target and mask were both upper-case alphabetical letters (omitting Q). The mask consisted of 4 instances of a randomly selected consonant or vowel, and the target, if present, was a single vowel. On half the trials its category matched that of the mask (another vowel) and on half it did not (the mask was a consonant). To match the target detection accuracy to that of Experiment 1, we increased the target duration to 53 ms, and the mask offset delay to 120 ms. The three foils each consisted of one pound sign.

As in Experiment 1, we manipulated the response compatibility and the offset between the target and mask. Because the letters were drawn from a large pool, responding on the basis of simple features would be difficult. Thus, implicit perception of the target would indicate that relatively high-level analyses could occur before target perception was disrupted by OSM.

Figure 3a illustrates the effect of OSM[3] on target detection, which, once again, was more accurate in the simultaneous than in the delayed condition, $F(1, 11) = 17.42$, $P_{rep} = 0.98$, $\eta_p^2 = .61$. The effect of compatibility was not significant, $F(1, 11) = 1.26$, $P_{rep} = 0.65$, $\eta_p^2 = .10$, nor was the interaction between compatibility and offset, $F(1, 11) < 1$.

To assess the implicit perception of the target, we again examined the RCE on mask RTs as a function of target responses on target-present trials (see Figure 3b). A significant RCE was found when the target was correctly detected, $t(11) = 5.89$, $P_{rep} = .90$, $d = 0.70$, but not when it was missed, $t(10) < 1$. Contrary to Experiment 1, Experiment 2 yielded no evidence of implicit perception (in this case, categorization) of the masked target. Our results are consistent with the findings of Reiss and Hoffman (2006), who observed no evidence for implicit perception in their experiment requiring semantic analyses.[4]

EXPERIMENTS 3A and 3B

Experiments 1 and 2 used different stimulus sets. Consequently, they differed not only in the level of processing, but also in stimulus type, response mapping, and processing load. In Experiments 3a and 3b, we used identical stimuli (the letters *E*, *F*, *O*, and *C*) to control for the latter three factors. The mask consisted of four identical letters (as in Experiment 2), and the target, if present, was equally often a vowel and a consonant. Participants made a speeded response on the mask before they reported the presence or absence of the target. In Experiment 3A, the mask response was based on features (whether the letters consisted of straight or curved lines). In Experiment 3B, it was based on categorization (vowels or consonants).[5] In both experiments, the target, if present, matched the mask on half the trials (the compatible condition), and mismatched on the other half (the incompatible condition). Because identical stimuli were used in the two experiments, evidence of implicit processing in Experiment 3A but not in Experiment 3B would support the level of processing account of our results in Experiments 1 and 2.

Experiment 3a

Experiment 3a ($N = 19$) was similar to Experiment 2 except for the stimuli and the mask response, which was whether the letters consisted of straight or curved lines. The target and mask could be compatible (e.g. *O* and *O*, or *O* and *C*) or incompatible (e.g. *O* and *E*, or *O* and *F*).

Figure 4a shows the effect of OSM on target detection, which was again higher in the simultaneous than in the delayed condition, $F(1, 13) = 23.19$, $P_{rep} = 0.99$, $\eta_p^2 = .64$. In this experiment for the first time, target detections were higher in the incompatible than in the compatible condition, $F(1, 13) = 40.15$, $P_{rep} = 0.99$, $\eta_p^2 = .76$, particularly when the mask offset was delayed, $F(1, 13) = 40.51$, $P_{rep} = 0.99$, $\eta_p^2 = .76$. Subsequent analyses indicated a significant inverse compatibility effect in the delayed condition, $t(13) = 6.95$, $P_{rep} = .99$, $d = 1.86$, but not in the simultaneous condition, $t(13) = 0.88$, $P_{rep} = .78$, $d = 0.23$. Thus, detection was impaired rather than facilitated when the target and mask were identical or compatible. We discuss this reversal in the General Discussion.

The mask responses again provide evidence for implicit processing of the target, even on trials when it was not reported (see Figure 4b). A significant positive RCE was found both when the target was correctly detected, $t(13) = 3.49$, $P_{rep} = .97$, $d = 0.95$, and when it was missed, $t(13) = 2.21$, $P_{rep} = .88$, $d = 0.59$. Thus, Experiment 3a replicates and confirms the finding in Experiment 1, in which the physical features of target and mask also matched on compatible trials.

Experiment 3b

All aspects of the method in Experiment 3B ($N = 19$) were identical to those of Experiment 3A except that the response to the mask was based on categorization (vowel or consonant). Again the target and mask could be compatible (e.g. *O* and *O*, or *O* and *E*), or incompatible (e.g. *O* and *F*, or *O* and *C*).

The results are shown in Figure 5a. Target detection accuracy was again higher in the simultaneous than in the delayed condition, $F(1, 17) = 41.36$, $P_{rep} = 0.99$, $\eta_p^2 = .71$. However this time there was no significant effect of compatibility, $F(1, 17) < 1$, and no compatibility by mask delay interaction, $F(1, 17) = 1.25$, $P_{rep} = 0.66$, $\eta_p^2 = .07$.

The mask responses mirrored those of Experiment 2 (see Fig. 5b). A significant RCE was found when the target was correctly detected, $t(17) = 2.22$, $P_{rep} = .89$, $d = 0.52$, but not when it was missed, $t(17) < 1$. Given the findings of Experiments 3a and 3b, it seems unlikely that the differential results observed in Experiments 1 and 2 were due to differences in stimulus type, response mapping, or processing load.[5] Instead, our results suggest that the locus of disruption in OSM is probably beyond the analysis of features but in general before categorical processing.

General Discussion

The preceding experiments provide evidence for a dissociation between perception and awareness in OSM at a feature level, but not at a categorical level. Although the effect of processing level has been investigated in prior OSM research (e.g., Reiss & Hoffman, 2006; Woodman & Luck, 2003), the critical conditions differed not only in the level of processing, but also in other ways. Using a novel OSM paradigm that required participants to respond to both the mask and the target, we investigated the level at which an unreported target was processed, while controlling other factors. Using the RCE in mask responses as an indication of implicit processing of the target, we found evidence for implicit perception of a target's physical features, but not its category.

We link our results with the role of feedback projections in conscious perception in general and with the reentrant theory of OSM in particular. The reentrant theory attributes masking in the delayed condition to a mismatch between ongoing feedforward projections from lower processing areas and reentrant iterations from higher processing areas. Because masking arises during reentrant processes, some analyses of the target during the feedforward projections have already occurred. However, because intact feedback projections are important for visual awareness (Bullier, 2001; Lamme & Roelfsema, 2000; Pascual-Leone & Walsh, 2001), disruption during the reentrant processes leads to the loss of conscious perception of the target, giving rise to a dissociation between perception and awareness. In the present experiments, implicit processing resulted in significant RCEs of the mask responses in the delayed conditions of Experiments 1 and 3a, even when the participants indicated no conscious perception of the target.

The inverse, or negative compatibility effect (NCE) we observed in the target detection task of Experiment 3A is also consistent with the reentry theory, and with the object updating theory recently put forward by Lleras and Enns (2004, 2006). Lleras and Enns (2004) propose that the visual system interprets objects in close spatiotemporal proximity as different instantiations of the same object, particularly if they are sufficiently similar. A similar process may explain the NCE in the delayed condition of Experiment 3a. In this experiment the compatible target and mask were either identical or highly similar (*O* and *C*, or *E* and *F*). We suggest that OSM was more effective in the compatible than in the incompatible condition because the visual system would have been more likely to treat the target, which was very similar to the mask, as part of the mask in the object updating process, thereby eliminating the target from conscious perception. In fact, on target-missed trials in the delayed condition, participants missed 54.8% of the targets that were identical to the mask and 50.1% of the targets that were similar to the mask. This low level of performance should also have occurred when the target and mask were identical in Experiment 3b (vowel and consonant discrimination), and it did:

Participants missed 60.7% of the identical targets and only 33.1% of the physically different but categorically compatible targets in the delayed condition. In contrast, in Experiments 1 and 2, the target and mask were different in both the compatible and the incompatible conditions, which presumably reduced the likelihood that the target would be assimilated into the mask. (Note that in Experiment 1, the mask consisted of single arrows and the target was a double arrow). Consequently, no inverse compatibility effects were found in those experiments.

Our finding of implicit processing at a feature but not at a categorical level helps to localize the level at which OSM occurs. It lends support to the proposal that OSM is unlikely to occur at the earliest visual areas. Using a functional magnetic resonance adaptation technique, Carlson et al. (2007) found evidence of masking in the lateral occipital cortex but not in V1 when participants performed a feature discrimination task. These findings are consistent with the idea that OSM is likely to occur beyond basic feature extraction in V1.

Our results provide converging evidence to a growing body of literature that shows a dissociation between perception and awareness in normal healthy people. Prior research has found that an unreported target in the attentional blink paradigm (Raymond, Shapiro, & Arnell, 1992) can prime the recognition of a subsequent target (Shapiro, Driver, Ward, & Sorenses, 1997). Similarly, unseen stimuli in the inattentional blindness paradigm (Mack & Rock, 1998) can still influence participants' choice of words in stem completion tasks (Mack & Rock, 1998) or their judgment of size in line discrimination tasks (Moore & Egeth, 1997). Furthermore, a nonreportable prime can facilitate target identification in some circumstances (Neumann & Klotz, 1994; Vorberg, Mattler, Heinecke et al., 2003) and impair it in others (Eimer & Schlaghecken, 1998; Klapp & Hinkley, 2002; Verleger, Jaskowski, Aydemir et al., 2004). Together, these findings demonstrate that substantial processing of an object can occur without its reaching the threshold of consciousness.

In conclusion, the present experiments expand the realm of previous OSM research. We demonstrated RCEs between an “unseen” target and the mask when the compatibility of the target and mask was determined by their features. Our results suggest that the locus of disruption in OSM is likely to be beyond feature analysis, although before categorization.

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Notes:

1. In all the experiments, error rates for the mask responses in the delayed conditions were low (<6%). The between-condition differences in error rates either were in the same direction as the between-condition differences in RTs or were not statistically significant.
2. One should be cautious in interpreting this result as indicating that visibility and masked priming are dissociated (cf: Lleras & Enns, 2006), because the RCE was larger in the simultaneous than in the delayed condition.
3. Several participants' data (3 in Experiment 2, 5 in Experiments 3a, and 1 in Experiment 3b) were excluded from analyses because of high error rates in the mask responses (>4 *SD* above the mean of the rest of the participants), high false alarm rates in the target absent trials (>20 %), missing data or cells with too few trials.
4. In an experiment (N = 11) reported elsewhere (Chen & Treisman, 2007), we tested the hypothesis that the reduced perception of the target in our delayed offset condition might have been caused by dual task interference, rather than OSM. Using a dual-task paradigm similar to the one reported here, we manipulated the distribution of attention (focused or distributed, in separate sessions) and the duration of the trailing mask (0, 40, or 80 ms). In the distributed-attention session, target and mask appeared at one of four locations. In the focused-attention session, they occurred at a central location. Target discrimination was more accurate when attention was focused than when it was distributed, and accuracy decreased when the duration of the trailing mask was

prolonged. Given these results, it seems most parsimonious to attribute the impaired perception of the target in our experiments to OSM.

It is also unlikely that the absence of the compatibility effect on the target-missed trials in Experiment 2 was due to the longer delay in the mask's offset, relative to Experiment 1. We increased the delay duration in Experiment 2 to ensure comparable performance in target detection in the two experiments. A combined analysis of Experiments 1 and 2 confirmed that accuracy of target detection did not differ between the two experiments, $F(1, 23) < 1$. Moreover, no two-way or three-way interactions that involved the experiment factor were significant, $F(1, 23) < 1$ in all cases.

5. In both Experiments 3a and 3b, we also divided the trials in the compatible condition into identical trials (e.g., *F* and *F*, or *O* and *O*) and congruent trials (e.g. *E* and *F* for the straight/curved judgment, *O* and *E* for the vowel/consonant judgment). There was no difference between these two types of trials.

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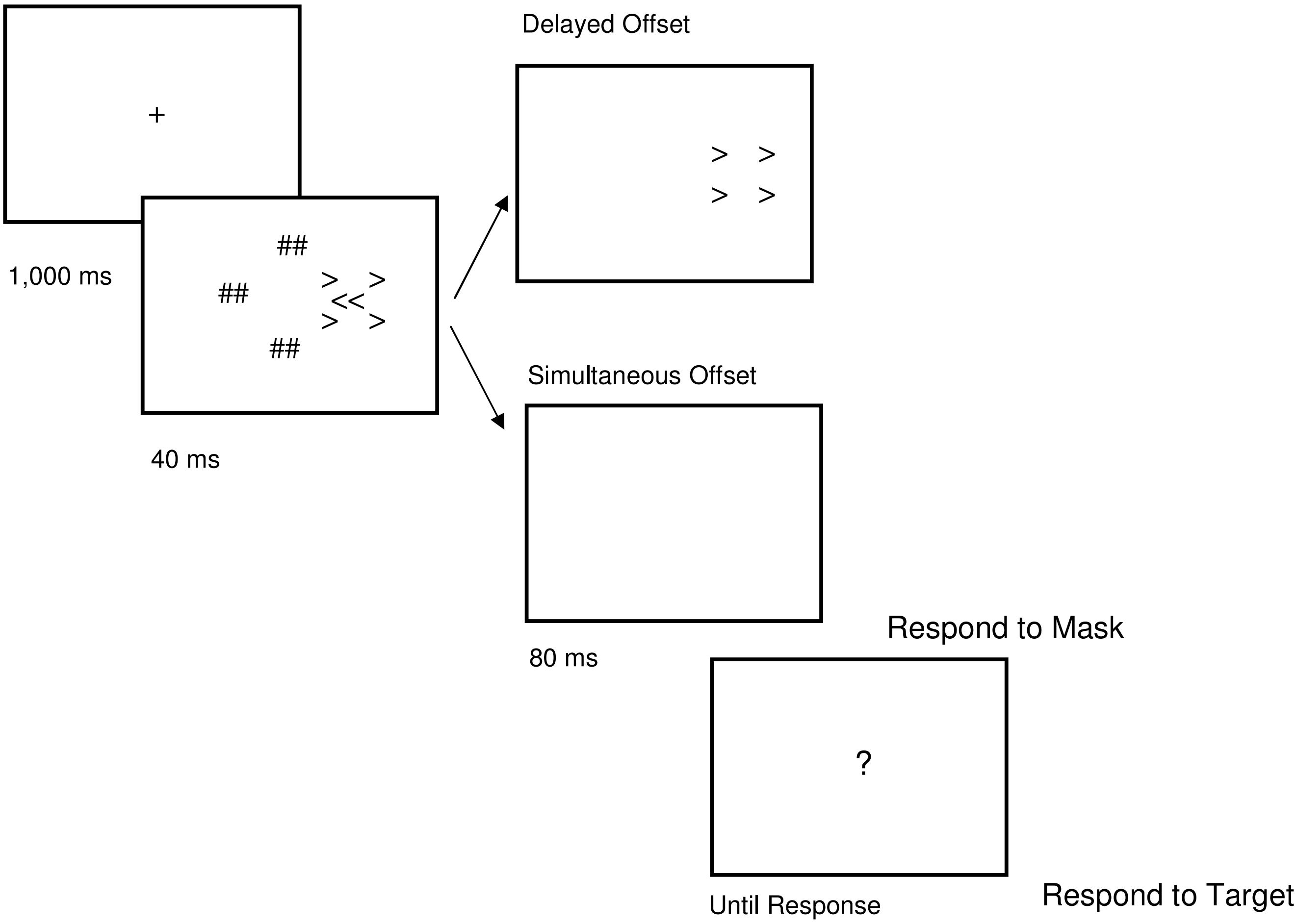
Figure Captions

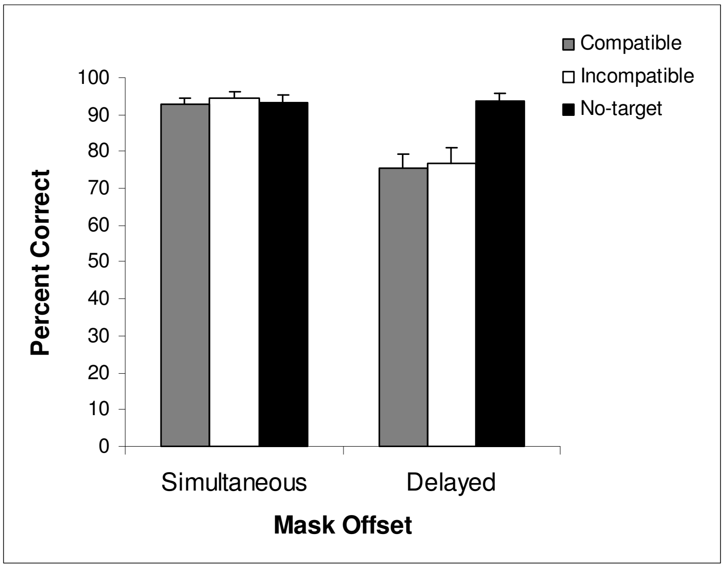
1. Illustration of the display sequence in Experiment 1. Targets (centered 2.4^0 from fixation) and masks matched (i.e., pointed in the same direction) or differed (i.e., pointed in different directions, as shown here). They were equally likely to appear at one of four locations, with the other three locations occupied by three sets of foils. In addition, either the target and mask had simultaneous offsets, or the mask's offset trailed the target's by 80 ms. Participants performed a speeded discrimination task regarding the mask (indicating whether the arrows pointed left or right) and then an accuracy only detection task concerning the target (indicating whether the target was present, as in the example shown here, or absent).
2. Results from Experiment 1. The graph in (a) shows the percentage of trials on which the target was correctly detected as a function of mask offset (simultaneous with the target's offset or delayed) and target condition (target compatible with the mask, incompatible with the mask, or not present). The graph in (b) presents mean reaction times (RTs) to the mask on delayed-offset, target-present trials as a function of whether or not the target was detected and whether the target was compatible or incompatible with the mask. Error bars indicate within-subjects standard errors (Cousineau, 2005).
3. Results from Experiment 2. The graph in (a) shows the percentage of trials on which the target was correctly detected as a function of mask offset (simultaneous with the target's offset or delayed) and target condition (target compatible with the mask, incompatible with the mask, or not present). The graph in (b) presents

mean reaction times (RTs) to the mask on delayed-offset, target-present trials as a function of whether or not the target was detected and whether the target was compatible or incompatible with the mask. Error bars indicate within-subjects standard errors (Cousineau, 2005).

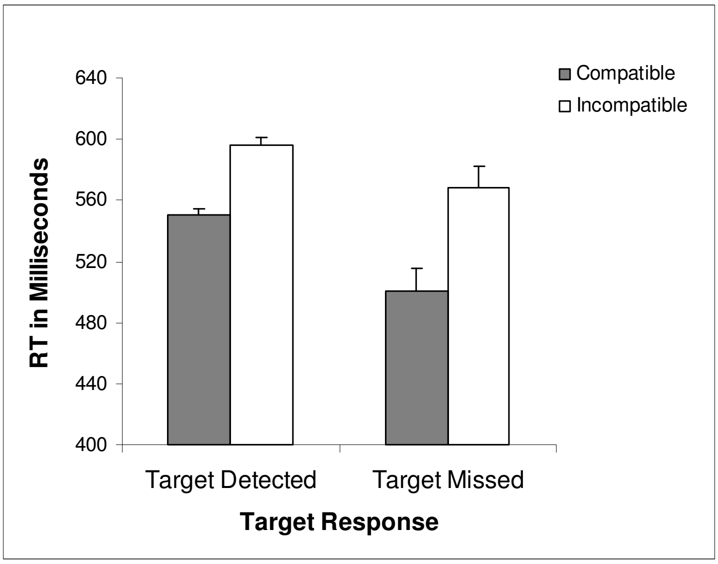
4. Results from Experiment 3a. The graph in (a) shows the percentage of trials on which the target was correctly detected as a function of mask offset (simultaneous with the target's offset or delayed) and target condition (target compatible with the mask, incompatible with the mask, or not present). The graph in (b) presents mean reaction times (RTs) to the mask on delayed-offset, target-present trials as a function of whether or not the target was detected and whether the target was compatible or incompatible with the mask. Error bars indicate within-subjects standard errors (Cousineau, 2005).
5. Results from Experiment 3b. The graph in (a) shows the percentage of trials on which the target was correctly detected as a function of mask offset (simultaneous with the target's offset or delayed) and target condition (target compatible with the mask, incompatible with the mask, or not present). The graph in (b) presents mean reaction times (RTs) to the mask on delayed-offset, target-present trials as a function of whether or not the target was detected and whether the target was compatible or incompatible with the mask. Error bars indicate within-subjects standard errors (Cousineau, 2005).


+
1,000 ms
##
##
##
> >
<<
> >
40 ms
Delayed Offset
> >
> >
Simultaneous Offset
80 ms
Respond to Mask
?
Until Response
Respond to Target

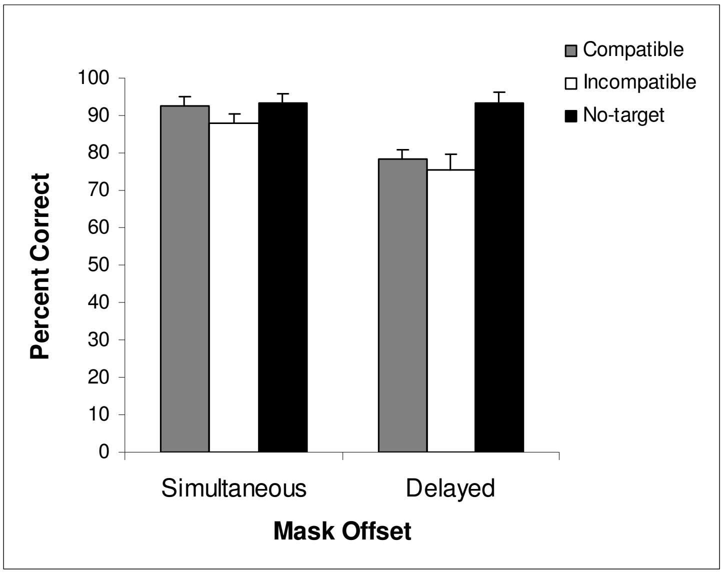
A.


Compatible
Incompatible
No-target
100
90
80
70
60
50
40
30
20
10
0
Percent Correct
Simultaneous
Delayed
Mask Offset

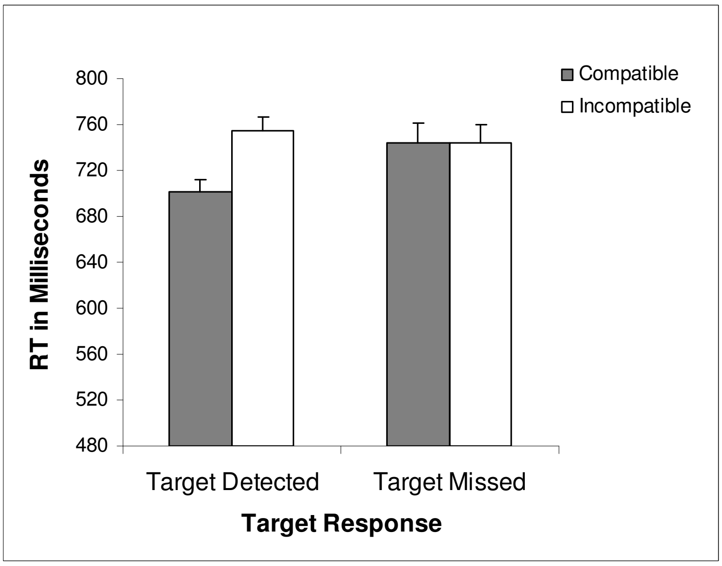
B.


Compatible
Incompatible
640
600
560
520
480
440
400
RT in Milliseconds
Target Detected
Target Missed
Target Response

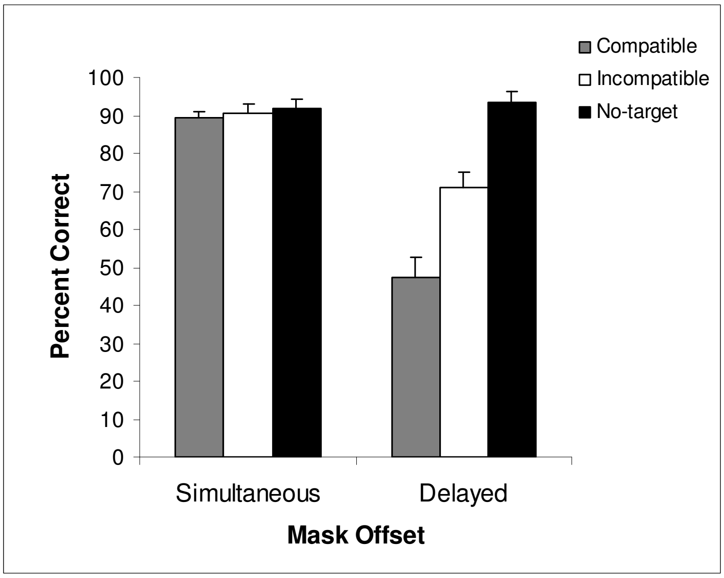
A.


Compatible
Incompatible
No-target
Percent Correct
100
90
80
70
60
50
40
30
20
10
0
Simultaneous
Delayed
Mask Offset

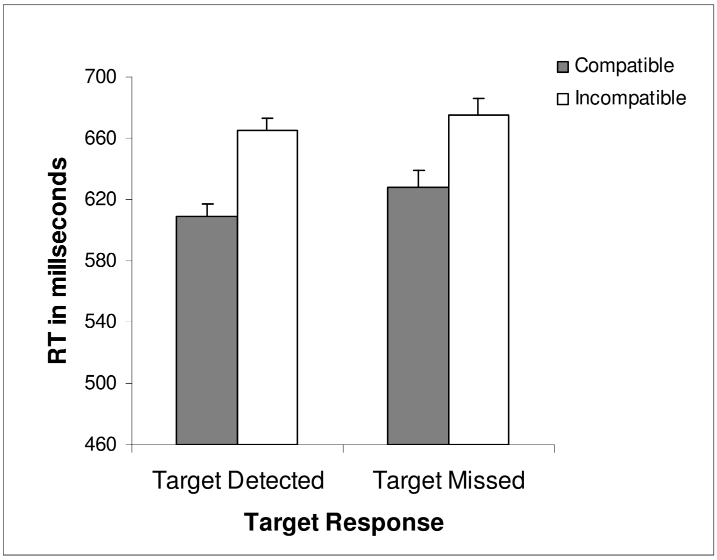
B.


Compatible
Incompatible
RT in Milliseconds
800
760
720
680
640
600
560
520
480
Target Detected
Target Missed
Target Response

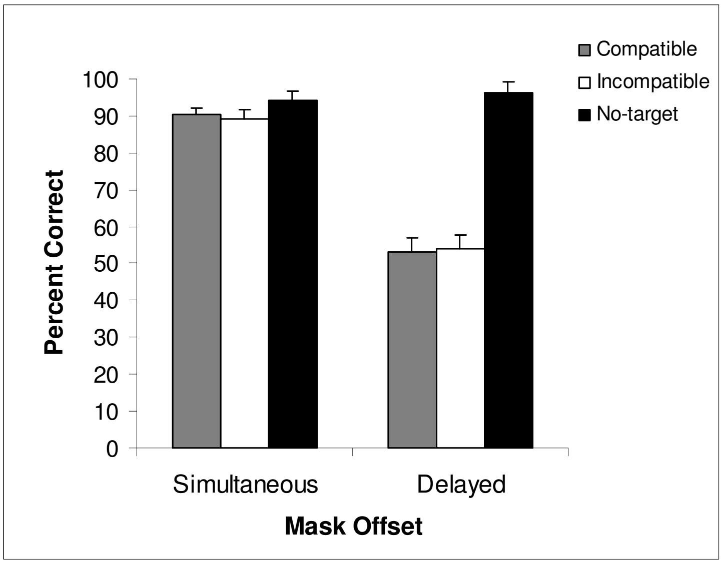
A.


Compatible
Incompatible
No-target
100
90
80
70
60
50
40
30
20
10
0
Percent Correct
Simultaneous
Delayed
Mask Offset

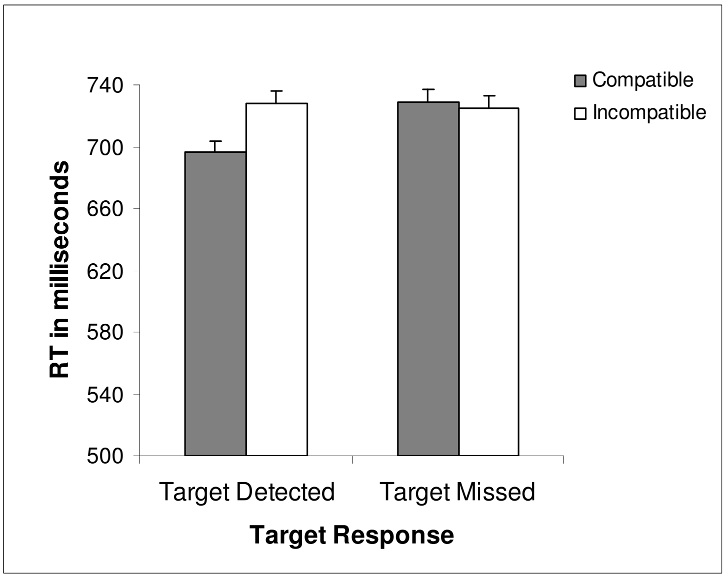
B.


Compatible
Incompatible
700
660
620
580
540
500
460
RT in millseconds
Target Detected
Target Missed
Target Response

A.


Compatible
Incompatible
No-target
Percent Correct
100
90
80
70
60
50
40
30
20
10
0
Simultaneous
Delayed
Mask Offset

B.


Compatible
Incompatible
RT in milliseconds
740
700
660
620
580
540
500
Target Detected
Target Missed
Target Response