

The global precedence effect is not affected in inhibition of return

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This study assessed whether inhibitory processes occurring in IOR affect perceptual processing of hierarchically organised stimuli. Experiment 1 used a global/local task that presented stimuli to the left or the right side. Results showed a global task advantage and a larger interference in the local than in the global task—the global precedence effect (GPE). These effects were larger than in previous studies using centrally presented stimuli, which suggests a greater involvement of low spatial frequency analysis with peripheral than with central stimuli. Experiment 2 combined the global/local task with IOR. Results replicated those of Experiment 1 but there was no interaction with stimulus location. That is, the GPE was not affected in IOR. Thus, we conclude that the GPE and inhibitory processing occurring in IOR are subserved by different mechanisms.

When a cue anticipates the location where the target will be presented, responses to targets appearing in that location will be speeded and more accurately performed than if the target is presented in a previously non-cued location (Posner, 1980). However, if the cue is not informative with respect to where the target will be presented, and the interval between the cue and the target is longer than 300 ms, responses to targets now appearing at cued locations will be slower and less accurate than when targets are presented at non-cued locations. This striking effect has been termed *inhibition of return* (IOR; Posner & Cohen, 1984), and has been thought to reflect a bias in visual attention to explore new locations.

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Note that perseverations of attention to the same locations would seriously impair detection of relevant stimuli in search tasks. Thus, IOR is the inhibition mechanism that helps visual attention to avoid returning to already attended locations (for a review, see Taylor & Klein, 1998).

Research on IOR has shown that IOR is a rather complex phenomenon. The effect has been observed in a great variety of tasks. It manifests when a simple detection of the target is required (e.g., Maylor, 1985; Posner & Cohen, 1984); when mutual detection responses or eye saccades are measured (e.g., Abrams & Dobkin, 1994); or when different kinds of discrimination responses, like colour discrimination (Fuentes, Boucart, Vivas, Alvarez, & Zimmerman, 2000; Law, Pratt, & Abrams, 1995; Vivas & Fuentes, 1999), shape discrimination (Lupiáñez, Milán, Tornay, Madrid, & Tudela, 1997; Pratt, 1995), lexical decisions (Chasteen & Pratt, 1999; Fuentes, Vivas, & Humphreys, 1999a), or target categorisation (Langley, Fuentes, Overmier, Bastin de Jong, & Prod'Homme, 1999) are to be performed. Frame of reference seems to play a role in IOR as well. Researchers have found location-based, object-based, and scene-based IOR, with several factors affecting those components of IOR differentially (Tipper, Driver, & Weaver, 1991; Tipper, Jordan, & Weaver, 1999; Tipper, Weaver, Jerreat, & Burak, 1994; Weaver, Lipiáñez, & Watson, 1998; for a review, see Tipper & Weaver, 1998).

Despite the great variety of situations and frames of reference in which IOR has been observed, few studies have asked what is inhibited in IOR. The key question is, does IOR affect processing of targets presented at inhibited locations? If so, at what processing level are they affected? In a series of recent studies, Fuentes and his co-workers have argued for the possibility that processing of targets presented at locations that are subject to IOR might be affected at different stages of processing depending on the task. The general methodology used in their studies has been to combine in one single experiment procedures that have been found to elicit IOR (e.g., Posner & Cohen, 1984), with procedures that seem to tap different levels of stimulus processing. In one study, Fuentes, Vivas, and Humphreys (1999b) presented prime words at cued or uncued locations followed by related or unrelated target words at different stimulus onset asynchrony (SOA) values. With long prime-target SOAs, standard positive priming emerged from primes at both locations. With the shortest SOA they used, positive priming was observed from uncued primes but priming turned into negative from cued primes. A reversed effect was also found when Eriksen-like flanker interference and IOR were combined in a single experiment (Fuentes et al., 1999b). Incongruent distractors presented at uncued locations produced the standard flanker interference effects on responses to central targets, compared with both neutral and congruent distractors. Interestingly, congruent instead of

incongruent distractors produced the interference effect when they were presented at cued (inhibited) locations. Fuentes et al. (1999b) pointed out that these reversals of the standard semantic priming and flanker interference effects when stimuli were presented at locations that are subject to IOR indicate that a mechanism acting in IOR affected processing of inhibited targets. The authors termed such a mechanism *inhibitory tagging*. The fact that semantic priming reversed solely with the short prime–target interval suggests that inhibitory tagging is a temporary process that resolves with time. Also, the fact that with longer prime–target intervals the negative priming effect turned into positive suggests that inhibitory tagging did not affect the efficiency with which primes contacted their representations in memory. Finally, the fact that the flanker interference reversed so that congruent distractors produced interference, suggests that inhibitory tagging is affecting the access of inhibited stimuli to their associated responses.

These preliminary effects were extended in further studies combining IOR procedures with the Stroop task. The Stroop interference effect reflects competition between an unusual but task-relevant response (colour naming) and a prepotent but task-irrelevant response (word reading). Vivas and Fuentes (1999) found that the Stroop interference effect (incongruent condition vs neutral condition) was affected by IOR. Specifically, the size of Stroop effect reduced when Stroop stimuli were presented at cued compared with uncued locations. The effect vanished completely with stimuli at cued locations when congruent trials were removed from the task (Fuentes et al., 2000). Vivas and Fuentes (see also Fuentes et al., 2000) accounted for that reduction in Stroop interference in terms of the inhibitory tagging mechanism acting in IOR. Inhibitory tags could prevent the prepotent tendency to read the words from damaging less well-learned responses such as naming colours, ameliorating interference effects by words. This means that inhibitory tagging is applied to irrelevant-but-prepotent dimensions of inhibited stimuli. However, inhibitory tagging is not applied to task-irrelevant dimensions, such as shape, in a flanker task where distractors varied with the target in colour, shape, or colour plus shape (Vivas, 1999). When colour-incongruent distractors were presented in inhibited locations, responses to target colours were facilitated instead of interfered with, replicating the reversal of interference effects observed by Fuentes et al. (1999b) in their flanker test. However, no effect was found when the distractor at inhibited locations varied from the target in shape, or colour plus shape.

Taken together, results on inhibitory tagging research suggest that this mechanism, acting in IOR, is applied to task-relevant (Vivas, 1999) as well as to task-irrelevant but especially prepotent (Fuentes et al., 2000;

Vivas & Fuentes, 1999) dimensions of stimuli presented at inhibited locations, by disconnecting them from response processes.

The purpose of the present research was to assess whether inhibitory tagging is also applied in tasks that reflect interference in early perceptual processes, like those occurring in the global/local task (Navon, 1977). In this task, participants are presented with global patterns composed of small, local patterns. Examples of these patterns can be large letters composed of small letters, large geometrical pictures built up with same or different small geometrical pictures, and so forth. There are two critical conditions. In the congruent condition the global and the local patterns are formed with the stimuli that have identical configuration (e.g., letter A composed of small As). In the incongruent condition both patterns are formed from the objects that have different configurations (e.g., letter A composed of small Ss). The usual results are that reaction times (RTs) to name the global pattern are faster than RTs to name the local pattern (the global RT advantage effect), and interference from global patterns when participants name local patterns is larger than the opposite (the global-to-local interference effect). These two effects have been referred to in the literature as the *global precedence effect* (GPE), and constitute a proof that global information is processed faster than local information in hierarchically organised stimuli, a well-established property of the visual perceptual system. The mechanisms underlying the GPE may be multiple but there is ample consensus that spatial frequency plays a relevant role, at least in the global RT advantage effect (for a review, see Hughes, Nozawa, & Kitterle, 1996). The low spatial frequency analysis of stimuli is mediated by the magnocellular pathway in the visual system (Livingston & Hubel, 1988). When low spatial frequency is removed (e.g., Hughes, Fendrich, & Reuter-Lorenz, 1990), or attenuated experimentally by imposing a red background over the patterns (e.g., Breitmeyer & Breier, 1994; Michimata, Okubo, & Mugishima, 1999), the global advantage effect is significantly reduced. In the global-to-local interference effect the role of spatial frequency is less clear. Some researchers have reported a reduction in the effect when spatial frequency is affected (cf., Michimata et al., 1999), although an alternative explanation of this reduction on the basis of the concrete compound stimuli used in that study is still possible.

Importantly for the purposes of the present research, this evidence supports the view that the GPE is mediated by early perceptual processes (for further evidence, see Han, Fan, Chen, & Zhuo, 1997), some depending on the magnocellular pathway. This pathway has close connections with the parieto-occipital lobe, an area that is clearly implicated in processing spatial location, and, as mentioned earlier, some researchers have suggested that this kind of processing might play a part in producing

the GPE (Michimata et al., 1999). Thus, if inhibitory tagging occurring in IOR is a mechanism that shares part of the neural circuitry that is involved in spatial processing, we should observe some kind of interaction with the GPE when targets are presented at inhibited locations compared with when they are presented at uncued locations. Specifically, two hypotheses can be advanced. If inhibitory tagging affects early perceptual processing (e.g., low spatial frequency analysis) of patterns presented at inhibited locations, a similar reduction in the GPE to that reported by the previously mentioned studies should be observed at cued (inhibited) locations compared with uncued locations. If inhibitory tagging does not afford perceptual processing at that level, no reduction in the GEP should be observed at all.

EXPERIMENT 1

In this experiment we sought to reproduce the typical GPE when the patterns are presented peripherally to both sides of fixation. Note that peripheral presentation of stimuli is necessary to combine the global/local task with a spatial IOR paradigm. We did not include central presentations of the stimuli because a direct comparison of the GPE between central and peripheral presentation conditions is beyond the scope of this research. None the less, investigators have reported greater effects when stimuli (large letters composed of small letters) are presented in the periphery than when they are presented centrally (e.g., Lamb & Robertson, 1988). In line with this, we expect greater effects in the present experiment than in that of Michimata et al. (1999), who used similar stimulus patterns to ours but presented centrally.

Method

Participants. Twenty students from the University of Almería volunteered to participate for course credit. All reported normal or corrected-to-normal vision and were naive to the purpose of the experiment.

Stimuli and apparatus. Stimuli were presented on a colour monitor (VGA) of an IBM compatible computer, and responses were recorded through the computer keyboard. Stimuli consisted of eight small squares or diamonds having diameters of $.57^\circ$ that served as elements. Diamonds were created by rotating a square 45° . These small elements were spatially arranged so that they could form a large square or diamond with diameters of 2° that served as global elements. The two global elements combined with the two local elements resulted in the four different patterns that are shown in Figure 1. The stimulus patterns were presented in white on a dark

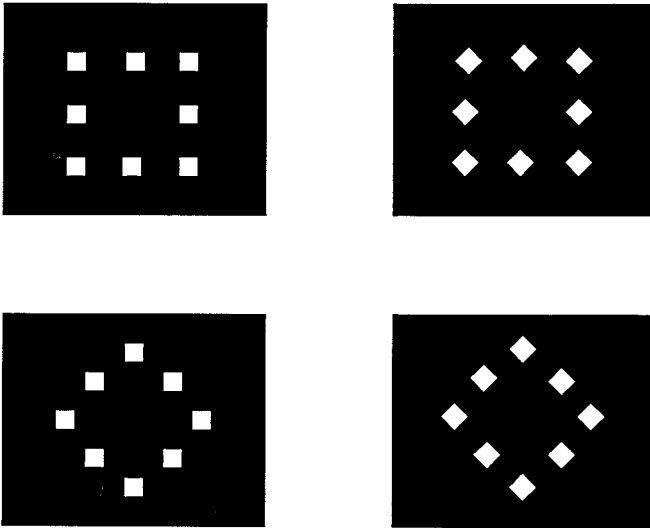


Figure 1. Compound patterns used for the experiments. Left-to-right diagonal: Congruent stimuli with squares and diamonds stimuli, respectively. Right-to-left diagonal: Incongruent stimuli with diamonds and squares, respectively.

background. Two patterns showing similar small and large elements (small squares forming a large square, and small diamonds forming a large diamond, respectively) served as the *congruent condition*. The other two patterns showing mutually different small and large elements (small squares forming a large diamond, and small diamonds forming a large square, respectively) served as the *incongruent condition*.

Procedure. Participants were seated approximately 60 cm from the computer screen and the experimenter explained the task orally. Figure 2 shows the stimuli and exposition duration employed in the experiment. Each trial began with a fixation point (a small cross) presented in the middle of the screen for 500 ms. The fixation point was replaced by three larger crosses presented for 1000 ms. The crosses were arranged horizontally, one in the centre flanked by the other two in the periphery. Crosses subtended $2^\circ \times 2^\circ$ and the distance between the central point of two adjacent crosses subtended 5.9° . After 1000 ms one of the peripheral crosses was replaced by one of the four previously mentioned patterns. The patterns could be randomly presented to the left or the right at the same eccentricity from fixation as the crosses, and participants had 2000 ms to respond. If no response was given during that time, the trial was registered as an error and the next trial was then initiated.

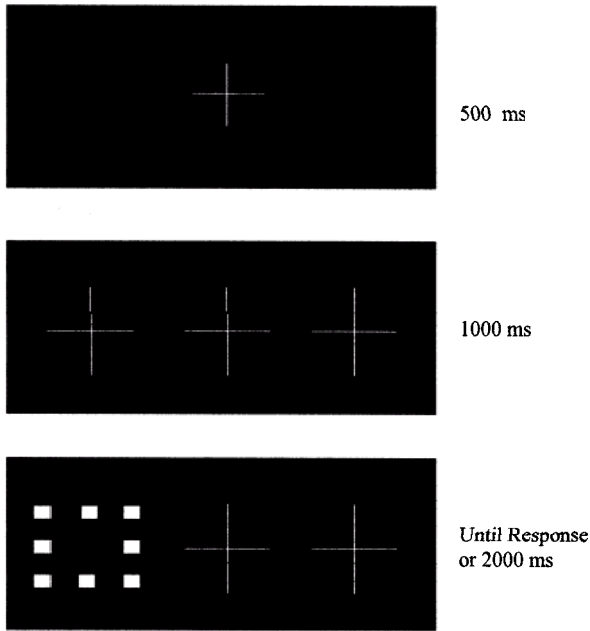


Figure 2. Sequence of events and exposition duration of stimuli in Experiment 1.

There were two blocks of 160 experimental trials preceded by 16 practice trials each. For each block, on half the trials (80 experimental trials, 8 practice trials) the patterns were presented in the left visual field and in the right visual field on the other half. Also, for each pattern location, half the trials contained congruent patterns and half contained incongruent patterns (40 experimental trials, 4 practice trials, each). Finally, equally distributed across the two conditions, there were 80 trials (8 for practice) for *square* judgements and other 80 trials (8 for practice) for *diamond* judgements. Half of participants pushed the key M for square judgements and the key K for diamond judgements, and the opposite was true for the other half of participants. Responses were performed using two fingers of the right hand. In one block, participants responded to the global pattern and on the other block they responded to the local pattern. Half of the participants performed the global task first, followed by the local task. The remaining half of participants performed the two tasks in the opposite order.

Results

Table 1 shows the mean of median RTs for correct responses and the percentage of errors for this experiment. Data were submitted to a

TABLE 1

Mean of median reaction times and percentage of errors (in parentheses) as a function of task, congruency and judgement in Experiment 1

| | <i>Task</i> | | | |
|-------------------|------------------|--------------------|------------------|--------------------|
| | <i>Local</i> | | <i>Global</i> | |
| | <i>Congruent</i> | <i>Incongruent</i> | <i>Congruent</i> | <i>Incongruent</i> |
| <i>Congruency</i> | | | | |
| Judgement | | | | |
| Square | 609 (9.0) | 694 (5.3) | 575 (2.1) | 588 (3.7) |
| Diamond | 664 (3.9) | 671 (2.8) | 596 (2.4) | 584 (3.1) |

$2 \times 2 \times 2 \times 2$ repeated measures analysis of variance (ANOVA) with task (global vs. local), congruency (congruent vs. incongruent), judgement (square vs. diamond), and visual field (left vs. right) as the within-subject factors. Because visual field did not produce any significant effect, data from this factor were collapsed.

The main effects of task and congruency were significant, $F(1, 19) = 41.4$, $p < .0001$, $F(1, 19) = 17.12$, $p < .0001$, respectively. Latencies were shorter for the global than for the local task (586 vs. 600 ms), and shorter for the congruent than for the incongruent condition (611 vs 634 ms). The main effect of judgement was not significant, $F(1, 19) = 1.89$, $p > .10$.

These main effects were modulated by the following significant interactions. The Congruency \times Judgement interaction, $F(1, 19) = 22.21$, $p < .001$, indicated that interference from incongruent stimuli was observed only for the square judgement (49 ms) but not for the diamond judgement (-3 ms). The Task \times Congruency interaction, $F(1, 19) = 13.62$, $p < .01$, showed more interference from incongruent stimuli for the local task (45 ms) than for the global task (1 ms); that is, we observed the global-to-local interference effect. However, this last interaction was qualified by the significant Task \times Congruency \times Judgement interaction (see Figure 3), $F(1, 19) = 11.05$, $p < .01$. The Task \times Congruency interaction was significant for the square judgement, $F(1, 19) = 21.02$, $p < .001$, showing interference from incongruent stimuli just for the local task but not for the global task, $F(1, 19) = 115.28$, $p < .00001$, and $F = 1$, respectively. In contrast, the Task \times Congruency interaction was not significant for the diamond judgement, $F(1, 19) = 1.96$, $p > .10$; that is, the global-to-local interference effect was not observed when participants had to perform diamond judgements.

A similar pattern of results was observed in the error analysis. The main effect of congruency was significant, $F(1, 19) = 8.9$, $p < .01$,

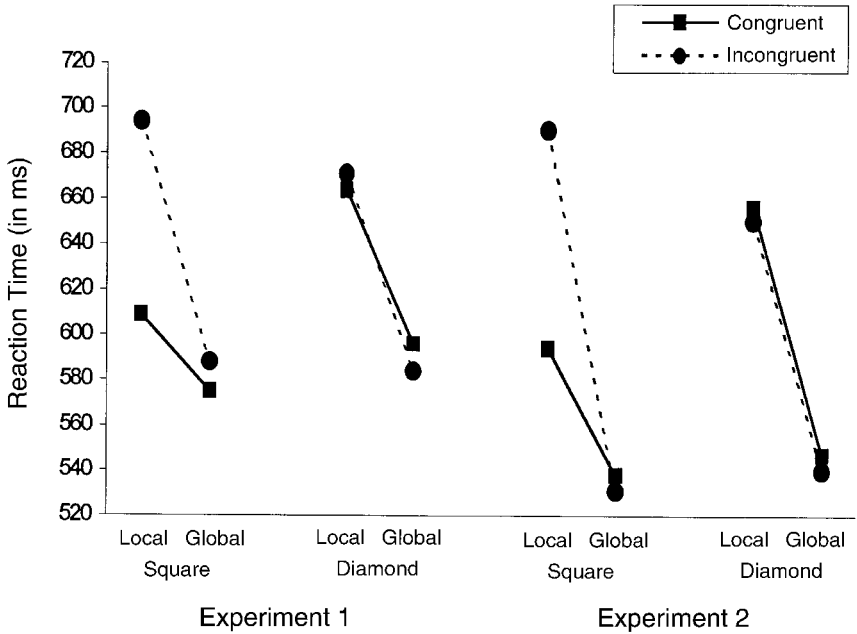


Figure 3. Reaction times as a function of task (local vs. global), congruency (congruent vs. incongruent), and judgement (square vs. diamond) for both experiments.

indicating that incongruent patterns produced more errors than congruent patterns (3.7 per cent vs. 2.3 per cent). The congruency effect was observed with square but not with diamond judgements (3 per cent vs. -0.2 per cent, respectively), as indicated by the significant Congruency \times Judgement interaction, $F(1, 19) = 9.9, p < .01$. The Task \times Congruency \times Judgement interaction was also significant, $F(1, 19) = 6.39, p < .025$. As with RTs, the global-to-local interference effect was observed with the square (2.9 per cent) but not with the diamond judgement (-1.8 per cent). No other effects proved significant.

Discussion

In this experiment, by using peripheral stimuli we replicated the main findings observed in previous studies conducted with centrally presented stimuli. The GPE was observed in the two important effects: (1) the global task produced shorter RTs than the local task (a global RT advantage); and (2) the congruency effect was asymmetrical, that is, global patterns produced more interference on the local task than local patterns did on the global task (a global-to-local interference), and that was true

for both RTs and errors. In addition, the magnitude of these effects was larger with peripherally than with centrally presented stimuli if we compare the size of the present results and those reported by Michimata et al. (1999), replicating previous findings in which other kinds of patterns (large letters made of small letters) were used (cf., Lamb & Robertson, 1988). This difference in the magnitude of the GPE might be due to the different involvement of low spatial frequencies in both studies. As pointed out by Michimata et al., low spatial frequency analysis may play an important role in the GPE so that when that analysis is somehow hindered the GPE is reduced. In their study, the low spatial frequency analysis was hindered by imposing a red background to the stimulus display, and as a consequence the GPE reduced compared with a control (green background) condition. In contrast, in the present study we presented the stimuli in the periphery, a visual region where most of processing is based on low spatial frequency analysis of stimuli.

We also found different results for square compared to diamond judgements (for a similar finding, see Michimata et al., 1999), results that were observed in both RT and error analyses. In contrast to the square judgements, the diamonds produced neither congruency nor global-to-local interference effects, although they produced the global RT advantage as did the squares. Inspection of data displayed in Table 1 shows that the lack of these effects in the diamond judgements was mainly due to long RTs in the congruent-local task condition. In that condition, the global diamond pattern was formed by small diamonds, which participants could misperceive as tilted squares. If that confusion occurred, it can explain why this condition produced longer RTs with diamonds than with squares, eliminating the congruency and the global-to-local interference effects with the former but not with the latter. In any case, the fact that that confusion affected the global-to-local interference effect but not the global RT advantage effect when diamond judgements were involved suggests that some of the mechanisms involved in both effects might be different (for a similar view, see Michimata et al., 1999). In Experiment 2 we assessed whether any of these mechanisms involved in the GPE also play a role in inhibitory processes occurring in IOR.

EXPERIMENT 2

This experiment combined the task used in Experiment 1 with a IOR procedure. Patterns were now peripherally presented either at non-inhibited (uncued) locations or at locations subject to IOR (cued locations). To our knowledge, global/local-like tasks have not been used in a IOR

paradigm, which makes this observation interesting *per se*. However, our main interest is to assess whether inhibitory processes occurring in IOR, such as inhibitory tagging, are involved when different information levels of a stimulus interfere with each other in early perceptual stages of processing.

Briefly, the aim of Experiment 2 was: (1) to test the generality of IOR to tasks that are thought to tap perceptual processing at a rather low (spatial frequency) level; and (2) to assess whether the global RT advantage, the global-to-local interference, or both effects, are affected in IOR.

Method

Participants. Eighteen students from the University of Almeria volunteered to participate for course credit. All reported normal or corrected-to-normal vision and were naive to the purpose of the experiment.

Stimuli and apparatus. The stimuli (see Figure 1) and the apparatus were the same as those described for Experiment 1.

Procedure. The sequence of events and the time intervals are displayed in Figure 4. As in Experiment 1, each trial began with a fixation point (a small cross) presented in the middle of the screen for 500 ms. The fixation point was replaced by three larger crosses presented for 1000 ms. Then, one of the peripheral crosses changed to red (the peripheral cue; shown in bold in Figure 4) for 300 ms. After an interval of 200 ms with all three crosses white again, the central cross changed to red (the central cue; shown in bold) for 300 ms, followed by a further interval of 200 ms before the pattern display was presented. This central cue was used to help participants reorient their attention to the middle before the pattern is presented, a necessary condition to observe IOR effects. The rest of the procedure was exactly the same as described for Experiment 1.

Results

Table 2 shows the mean of median RTs for correct responses and the percentage of errors for this experiment. Data were submitted to a $2 \times 2 \times 2 \times 2$ repeated measures analysis of variance (ANOVA) with task (global vs. local), congruency (congruent vs. incongruent), location (cued vs. uncued), and judgement (square vs. diamond), as the within-subject factors.

The main effects of task, congruency, and location were significant, $F(1, 17) = 45.22, p < .0001$, $F(1, 17) = 12.16, p < .01$, and $F(1, 17) =$

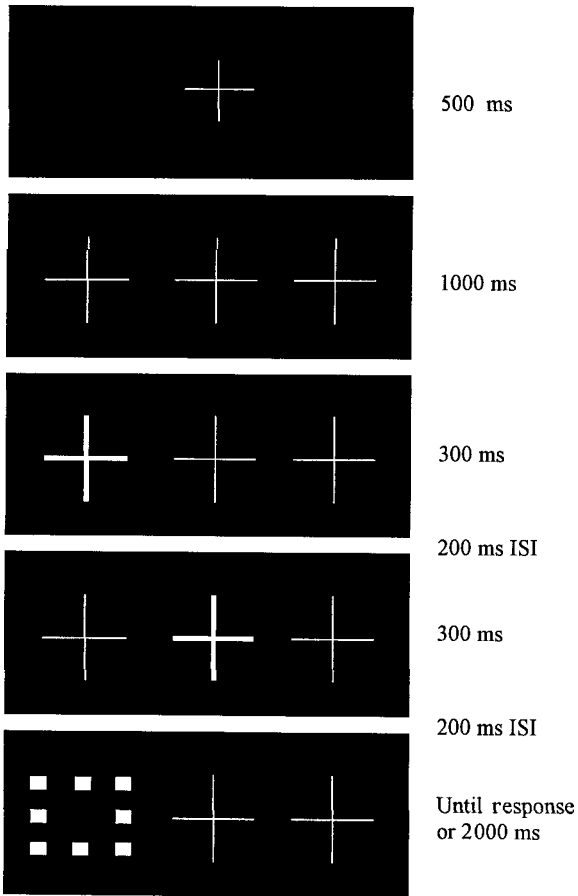


Figure 4. Sequence of events and exposition duration of stimuli in Experiment 2. Red crosses are shown in bold.

44.06, $p < .0001$, respectively. Latencies were shorter for the global than for the local task (539 ms vs. 648 ms), shorter for the congruent than for the incongruent condition (584 ms vs. 603 ms), and shorter for the uncued than for the cued location (571 ms vs. 615 ms); that is, we observed the IOR effect. The main effect of judgement was not significant, $F(1, 17) = 1.04$, $p > .10$.

These main effects were modulated by the following significant interactions. The Congruency \times Judgement interaction, $F(1, 17) = 20.7$, $p < .001$, indicated that interference from incongruent stimuli was observed only for the square judgement (45 ms) but not for the diamond judgement

TABLE 2

Mean of median reaction times and percentage of errors (in parentheses) as a function of task, congruency, location, and judgement in Experiment 2

| <i>Congruency and location</i> | <i>Task</i> | | | |
|------------------------------------|------------------|--------------------|------------------|--------------------|
| | <i>Local</i> | | <i>Global</i> | |
| | <i>Congruent</i> | <i>Incongruent</i> | <i>Congruent</i> | <i>Incongruent</i> |
| Square judgement | | | | |
| Cued | 623 (1.9) | 715 (4.7) | 557 (2.5) | 546 (2.8) |
| Uncued | 566 (1.4) | 667 (3.9) | 518 (1.9) | 515 (4.4) |
| Diamond judgement | | | | |
| Cued | 676 (5.8) | 681 (1.7) | 656 (2.5) | 560 (2.5) |
| Uncued | 635 (3.9) | 619 (3.1) | 529 (1.9) | 520 (2.5) |

(-6 ms). The Task \times Congruency interaction, $F(1, 17) = 17.5, p < .001$, showed more interference from incongruent stimuli for the local task (45 ms) than for the global task (-7 ms); that is, we observed the global-to-local interference effect. However, this last interaction was qualified by the significant Task \times Congruency \times Judgement interaction (see Figure 3), $F(1, 19) = 11.05, p < .01$. The Task \times Congruency interaction was significant for the square judgement, $F(1, 17) = 18.6, p < .001$, showing interference from incongruent stimuli just for the local task but not for the global task, $F(1, 17) = 15.4, p < .01$, and $F(1, 17) = 1.16, p > .10$, respectively. However, the Task \times Congruency interaction was not significant for the diamond judgement ($F < 1$); that is, as was found in Experiment 1, the global-to-local interference effect was not observed when participants had to perform diamond judgements. Interestingly, interactions involving location were not significant (all F s < 1).

Error analysis did not show any significant effect in this experiment.

Discussion

The results of Experiment 2 replicated those observed in Experiment 1. We found an advantage of the global task compared with the local task, and the interference from incongruent stimuli was observed just for the local task. Interestingly, the size of the global RT advantage was greater in this experiment than in Experiment 1, although the difference was due to a greater reduction in global task RTs (586 ms vs. 539 ms) than in local task RTs (660 ms vs. 648 ms). This finding suggests that the alerting state induced by the cues could initiate global-to-local processing activities

before the stimulus pattern was presented, favouring global task performance. This reinforces the idea that the global RT advantage effect is better accounted for as a global processing advantage than a local processing disadvantage. Also, as in Experiment 1, the global RT advantage was observed for both square and diamond judgements, but the global-to-local interference effect was found just for the square judgement, suggesting that participants confused the small diamond with tilted squares.

We also observed IOR in this experiment. This result extends the IOR effect to tasks that tap stimulus processing at a rather low level of perceptual analysis. This is in line with a great amount of studies that have reported IOR when different kinds of discrimination responses are required by the task. However, cueing did not interact with the global RT advantage effect, or with the global-to-local interference effect, which suggests that the mechanisms involved in the GPE are different from those involved in IOR.

GENERAL DISCUSSION

Previous research from our laboratory has demonstrated that semantic processing, flanker interference, and Stroop interference are somehow affected when stimuli causing these effects are presented to locations subject to IOR. Fuentes et al. (1999b) proposed an inhibitory tagging mechanism to account for the reversal of standard positive semantic priming and flanker interference when stimuli were presented at inhibited locations. Further studies showed that this mechanism can also explain the reduction or elimination of Stroop interference from incongruent stimuli at inhibited locations (Fuentes et al., 2000; Vivas & Fuentes, 1999). In these studies, tasks combined with IOR were supposed to tap target processing at the level of either activation of stimulus representations in the memory system (priming experiments), or competition for responses (flanker and Stroop tasks). The present study was aimed at investigating the effects of such inhibitory processes occurring in IOR on a task that is assumed to reflect perceptual processing at a rather low level of analysis, specifically at the level of spatial frequency analysis (Breitmeyer & Breier, 1994; Hughes et al., 1990, 1996; Michimata et al., 1999).

In Experiment 1 we replicated the GPE of previous studies (e.g., Michimata et al., 1999); that is, the global task produced shorter RTs than the local task, and interference from incongruent patterns was larger with the local than with the global task. Although the main interest of the present study was to look at the interactions between the GPE and IOR, other results of this experiment should be noted. For instance we observed the previous effects with peripherally presented patterns that were larger in size

than those observed with similar but centrally presented patterns (see Michimata et al., 1999). Although this pattern is not new (cf., Lamb & Robertson, 1988), we claim that the differences in magnitude may be due to the special relevance that low spatial frequencies have in peripheral vision.

Note also that previous studies have suggested that low spatial frequency analysis is very important to observe the GPE, at least the global RT advantage effect, and this analysis seems to be mediated by the magnocellular pathway (Michimata et al., 1999). As Michimata et al. stated, the magnocellular pathway connects with the parieto-occipital lobe, a part of the so-called dorsal system involved in coding stimulus location. This suggests that location may play a relevant role in processing hierarchically organised stimuli, and for the purpose of the present research, it raised the possibility that the global processing advantage occurring in the global/local task and inhibitory processes occurring in IOR might share some of the mechanisms involved in both tasks. However, results of Experiment 2 indicate that that is not the case. The GPE was fairly similar to that found in Experiment 1 (see Figure 3 for a comparison) but was unaffected by stimulus locations *vis-à-vis* the cueing location. Thus, we want to conclude that the inhibitory tagging process, which we have assumed affects target processing at locations subject to inhibition of return, does not affect the early perceptual processing of compound stimuli presented at those locations. This may suggest that the dorsal system involved in location processing is not part of the neural circuitry involved in inhibitory tagging. Note that this is in line with the pattern of semantic priming reported by Fuentes et al. (1999b). In their study, the authors reported negative semantic priming from prime words presented at inhibited locations, which means that primes fully activated their representations in memory. This suggests intact perceptual analysis of stimuli presented at inhibited locations. Thus, we conclude that inhibitory tagging occurring in IOR does affect a late stage of processing of inhibited stimuli, perhaps at the response level (cf., Fuentes et al., 1999b), possibly mediated by high-level attention.

Finally, Experiment 2 showed a general IOR effect. This result extends IOR to the global/local task, and increases the evidence that shows IOR in a great variety of discrimination responses (for a review, see Taylor & Klein, 1998). This indicates that IOR is a general phenomenon that occurs when participants have to reallocate their attention to a previous attended location, irrespective of the kind of response they are required to perform on targets.

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