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Eliminating flanker effects and negative priming in the flankers task: Evidence for early selection

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Reports of negative priming in the absence of flanker effects (Fox, 1995) provide support for the notion that unattended stimuli are identified. I evaluated the hypothesis that such results are the outcome of attentional leakage to the flanker location. In Experiment 1, I assessed flanker effects and negative priming as a function of target–flanker proximity (.9° and 2.7° for near and far flankers, respectively) and of attention cuing to the target location (precued vs. uncued) on the prime trials. I report larger flanker effects in uncued than in precued conditions, and larger effects for near than for far flankers. More critically, when attention was precued, both flanker effects and negative priming vanished for far flankers. In Experiment 2, I show that the latter result was not linked to prime–probe contextual similarity (Neill, 1997). These results demonstrate that selective target processing is possible when attention is optimally focused to the target location.

One lasting controversy in attention concerns whether or not unattended stimuli are identified. The *late selection* view assumes that unattended stimuli receive full analysis leading to identification (van der Heijden, 1992). In contrast, the *early selection* view proposes that unattended stimuli receive a coarse analysis that does not include identification (Broadbent, 1982). The "flankers task" of Eriksen and Eriksen (1974) has frequently been used to investigate this issue. The subject sees a linear array of letters and decides whether, say, H or I has appeared in the center of the array (target). Flankers on either side of the target must be ignored. The flankers are either compatible (HHH) or incompatible (IHI) with the target. Typically, subjects are slower under the incompatible than under the compatible condition. On the basis of this finding, it has often been stated that unattended flankers are processed to the point of identification.

Alternatively, Yantis and Johnston (1990) argued that flanker effects could be the product of attentional leakage to the flanker location. They used uncrowded (3.2° center-to-center separation between items) circular arrays, and they predirected attention to the target with a 100% valid exogenous precue. Although residual flanker effects were found for flankers adjacent to the target, no flanker effect was apparent for flankers located farther away from the target. Similarly, Paquet and Craig (1997) reported flanker effects for near (.3°) but not for far flankers (5° away from the target). These converging results suggest that flanker identification may not occur when the possibility of attentional leakage to the flanker location is reduced.

In contrast with the preceding interpretation, Driver and Tipper (1989) pointed out that null flanker effects do not necessarily reflect a lack of identification. In their experiment, two circular alphanumeric arrays were presented in rapid succession, and subjects had to report, for each array, the number of red items (target) and to ignore the black items (flankers). The first array was referred to as the *prime* and the second was termed the *probe*. For the prime displays, flanker identification was inferred by examining whether or not performance was affected by the identity relationship between the digit flankers and the number of red items. In addition, a second index of prime flanker identification (labeled *negative priming*) was provided by varying the identity of the prime flankers in relation to the probe target. More specifically, the prime flankers and the probe target were identical in an ignored repetition condition, whereas in a control condition, the probe target had not appeared in the prime display. The key result was that although prime display performance was unaffected by prime flankers, negative priming was obtained for the probe trials (i.e., latency was longer in the ignored repetition than in the control condition). The investigators concluded that unattended flankers are identified but that flanker effects are avoided through flanker inhibition.

However, Fox (1995) noted that the target and flankers for Driver and Tipper's (1989) prime displays were presented in close proximity (within 1° of visual angle). Therefore, attentional leakage during prime display processing might have been responsible for flanker identification. Fox used prime displays consisting of two letters 1.9° apart, presented on either side of fixation. For the probe displays, the letters appeared above and below fixation. Attention allocation on the prime trial was manipulated by varying whether or not the target location was precued. On cued prime trials, the target location was precued 150 msec in advance by a plus sign presented .8° next to

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the target location.[1] For the uncued prime trials, a plus sign was displayed for 150 msec at fixation. For the cued and the uncued trials, presentation of the plus sign was followed by a prime display presenting a bar marker simultaneously beside the target. Note that target location was never precued for the probe trials. Fox reported that precuing prime target location eliminated flanker effects on the prime trials, but not negative priming on the probe trials. This result is important, because it discredits the attentional leakage account of Driver and Tipper's findings, hence providing strong evidence of flanker identification for apparently unattended flankers.

Although Fox's (1995) data are consistent with the late selection view, some caution seems warranted. One major concern is that the precue may not have effectively narrowed attention to the target location (Ruthruff & Miller, 1995). First, precuing the target location did not reduce RT. This result is at odds with previous cuing studies, which have shown that target processing is improved with a 100% valid precue (Castiello & Umiltà, 1990; Cheal & Lyon, 1991). Second, the claim that attention precuing eliminated flanker effects on the prime trials appears unjustified, because clear flanker effects were present in the error data. Therefore, the possibility remains that the negative priming result reported by Fox occurred because the conditions for complete focusing of attention on the target location remained suboptimal. In fact, Ruthruff and Miller have shown that negative priming is affected by how narrowly attention is concentrated on a target location. Their subjects identified a target and ignored a flanker displayed in a different color. Although negative priming was found when target and flanker locations were uncertain, no negative priming was observed when both locations were fixed across trials. Unfortunately, it is difficult to assess flanker identification on the basis of these results, because, contrary to Fox (1995), their experiment did not permit the measurement both of negative priming and of flanker effects during the prime trial. In fact, if negative priming and flanker effects are negatively related, it is possible that flanker effects were present in the absence of negative priming (Kramer, Humphrey, Larish, Logan, & Strayer, 1994). In any case, because the relationship between negative priming and prime trial flanker effects remains an unresolved issue, it seems preferable to obtain both measures of flanker processing from the same subjects before reaching conclusions regarding flanker identification.[2]

Given the preceding considerations, I examined flanker processing, using both flanker effects and negative priming as indices of flanker identification. I used Fox's (1995) procedure, and I varied the conditions for efficient attentional focusing on the prime trial by manipulating both target–flanker proximity (0.9° and 2.7° for near and far flankers, respectively) and attention cuing (precued vs. uncued) on the prime trials only. As in Fox's study, attentional precuing was not used on the probe trials, and the flanker always appeared near (0.9°) the probe target. In sum, my hope was to obtain independent evidence that the precue was effective by showing that prime target identification was faster in the precued than in the uncued condition. This would suggest that attention was more narrowly focused on the prime target when attention was predirected to the prime target location. A replication of Fox's results under such conditions would provide clear evidence that flanker identification occurs even when attentional concentration on the target location is enhanced.

EXPERIMENT 1

Method

Subjects. The subjects were 60 students fulfilling a course requirement.

Apparatus and Stimuli. Stimuli appeared on a Zenith VGA monitor controlled by a 486 microcomputer. Each display consisted of two letters, each measuring 0.51° vertically and 0.25° horizontally, from a viewing distance of 127 cm. The display was preceded by the 150-msec presentation of a thick (0.1°) cross identical in size to the letters. For the precued groups, the cross indicated the prime target location, and it was displayed 1.0° to the left or right of the target. For the uncued groups, the cross was displayed at fixation.

In order to control for acuity differences between the target and the flanker, the two letters of the prime trial were equidistant from fixation and they appeared on either side of the fixation point. As in Fox's experiment and irrespective of attentional cuing, a bar marker was presented simultaneously with the letter display to the left of the left-side targets and to the right of the right-side targets, and it indicated the position of the target. On probe trials, attention was never precued to the target location. The probe letters were displayed above and below the fixation point, and the bar marker revealing the target location appeared simultaneously with the display to the left of the probe target. For the prime displays, angular distances of 0.9° and 2.7° separated the two letters in the near and far target–flanker proximity condition, respectively. In contrast, target–flanker proximity and attentional precuing remained constant for the probe trials, on which only the near condition was employed.

The letters A–D were used. The subjects responded by pushing one of four computer keys (the "d," "f," "j," or "k" keys of the keyboard, respectively labeled "A," "B," "C," and "D").

Design. For the prime trials, attention cuing (precued vs. uncued) and target–flanker proximity (near vs. far) were between-subjects variables. Fifteen subjects were randomly assigned to each combination of the levels of these factors. The resulting groups were the near-precued, near-uncued, far-precued and far-uncued groups. For each group, attention was uncued for the probe trials and the probe flanker always appeared near (.9°) the probe target.

For the prime displays, the relationship between the identity of the target and that of the flanker (compatible vs. incompatible) was manipulated within subjects. Similarly, the probe target and the prime flanker identity relationship (ignored repetition vs. control) was varied within subjects and is referred to as the *priming* condition. For the ignored repetition condition, the flanker on the prime display was identical to the probe target. In contrast, the probe target was not included in the prime display for the control condition.

Procedure. Each subject served in two blocks of trials. The first block consisted of 60 practice prime trials (30 compatible and 30 incompatible), each followed by a control probe display. The second block was made of 120 experimental prime–probe trials, (60 compatible and 60 incompatible prime trials). The order of presentation of the compatible and incompatible prime trials was randomized. Following the procedure outlined by Fox (1995), the 60 probe trials that were preceded by a compatible prime display were not included in data analyses. Of the 60 remaining probe trials, 30 were ignored repetition and 30 were control displays. The order of presentation of the priming conditions was randomized. As was the case in Fox's design, the flanker used for the probe display was always incompatible with the probe target and it never appeared in the prime display.

Each trial began with the presentation of a fixation point, which appeared at the center of the screen for 500 msec. The fixation point was replaced by a cross presented for a 150-msec duration, followed by a 50-msec prime display. For the precued groups, the cross appeared to either the left or the right of fixation, whereas for the uncued groups, it appeared at fixation. Subjects in the uncued groups were informed that a cross, centered at fixation, would replace the fixation point and that they were to fixate that cross. They were told that, upon presentation of the letters, a bar marker would appear beside the target letter to be identified. On the other hand, subjects in the precued groups were told that, on alternating trials (i.e., for the prime trials, but not the probe trials), the cross would be displayed off fixation (on prime trials), and it would indicate which letter they had to identify upon presentation of the letters. As with the uncued groups, the cued subjects were told that, upon presentation of the letters, a bar marker would appear beside the target letter. For each group, a blank screen replaced the prime display. Response to the prime display was followed by a 350-msec blank interval. For each group, the probe target location was never precued, and the sequence of events for the probe display was identical to that of the uncued prime trials.

Results and Discussion

Prime display flanker effect. RT and error analyses were conducted. However, for considerations of space and because, in contrast to Fox (1995, Experiment 3), the error analysis failed to uncover significant effects, only the RT analysis is reported. The results are shown in Table 1. A three-way mixed analysis of variance (ANOVA) (attention cuing × target–flanker proximity × target–flanker identity relationship) revealed a significant effect of attention cuing [$F(1,56) = 22.91$, $p < .01$], such that latency was 110 msec faster for the precued than for the uncued groups. Thus, the precue used in the present experiment was effective in improving performance. The analysis also revealed a significant effect of target–flanker proximity [$F(1,56) = 7.13$, $p < .01$], with faster responses in the near than in the far conditions (565 vs. 626 msec). There was also a significant effect of target–flanker identity relationship [$F(1,56) = 29.93$, $p < .01$], indicating the presence of flanker effects. Furthermore, there was a reliable interaction between target–flanker proximity and target–flanker identity relationship [$F(1,56) = 5.49$, $p < .05$], with larger flanker effects for near (25 msec) than far (10 msec) flankers. Finally, a significant interaction was observed between attention cuing and target–flanker identity relationship [$F(1,56) = 4.87$, $p < .05$], showing larger flanker effects for the uncued (24 msec) than for the precued (10 msec) conditions.

Table 1
Means of Median Correct Reaction Times (RTs, in Milliseconds) and Mean Error Rate (E) to Compatible and Incompatible Prime Displays for Near and Far Flankers as a Function of Attention Cuing Conditions

	Target–Flanker Proximity							
	Near				Far			
	Precued		Uncued		Precued		Uncued	
Identity Relationship	RT	E	RT	E	RT	E	RT	E
Experiment 1								
Incompatible	496	3.7	659	3.0	596	3.2	666	4.1
Compatible	480	3.7	625	2.3	590	3.7	652	6.4
Flanker effect	15*		34**		6		14*	
Experiment 2								
Different Context								
Incompatible					655	3.7		
Compatible					659	3.9		
Flanker effect					−4			
Same Context								
Incompatible					567	3.6		
Compatible					569	4.4		
Flanker effect					−2			

Note—The flanker effect was computed by subtracting the compatible trials latency from the incompatible trials latency. $*p < .05$. $**p < .01$.

Planned comparisons between compatible and incompatible prime displays for each of the four groups of subjects revealed significant flanker effects for the near-uncued (34 msec), near-precued (15 msec), and far-uncued (14 msec) groups. More importantly, a null flanker effect (6 msec) was observed for the far-precued group.

Probe display negative priming. As in Fox (1995), incorrect probe trials or correct probe trials preceded by an incorrect prime trial response were discarded. The results are displayed in Table 2. These data were subjected to a mixed ANOVA in which the factors were attention cuing on the prime trial, target–flanker proximity on the prime trial, and priming condition. The analysis revealed a significant effect of target–flanker proximity [$F(1,56) = 5.51$, $p < .05$], such that RTs to probe targets were 48 msec faster when the flankers on the prime trials were near rather than far. There was also a significant effect of priming condition [$F(1,56) = 17.71$ $p < .01$], showing substantial negative priming (22 msec) in the ignored repetition condition.

Planned comparisons between ignored repetition and control probe trials for each of the four groups of subjects revealed significant negative priming for the near-uncued (34 msec), near-precued (22 msec), and far-uncued (29 msec) groups. More critically, no negative priming was evident in either the latency data (3 msec) or the accuracy data for the far-precued group.[3]

Could the disappearance of negative priming in the far-precued group have been linked to the low contextual similarity between the prime and the probe displays (Fox & de Fockert, 1998; Neill, 1997; Neill & Mathis, 1998)? Recall that for the far-precued group, attentional precuing and far flankers were used on the prime trials, whereas the probe trials were always uncued and used near flankers. Evidence that contextual similarity (defined by target–flanker separation on the prime and probe trials) affects negative priming in the flankers task has been reported by Neill and Valdes (1996) in a study in which attention was not precued to the target location. Negative priming was obtained when the prime–probe context was the

Table 2
Means of Median Correct Reaction Times (RT, in Milliseconds) and Mean Error Rate (E) for Ignored Repetition and Control Probe Displays for Near and Far Flankers as a Function of Attention Cuing Conditions

	Target–Flanker Proximity							
	Near				Far			
Priming	Precued		Uncued		Precued		Uncued	
Condition	RT	E	RT	E	RT	E	RT	E
	Experiment 1							
Ignored repetition	624	2.7	640	2.4	700	2.8	648	4.1
Control	602	2.3	606	1.2	697	3.2	619	2.1
Negative priming	22*		34**		3		29**	
	Experiment 2							
Different Context								
Ignored repetition					646	3.6		
Control					644	3.5		
Negative priming					2			
Same Context								
Ignored repetition					574	4.3		
Control					573	3.9		
Negative priming					1			

Note—The negative priming effect was computed by subtracting the control trials latency from the ignored repetition trials latency. $*p < .05$. $**p < .01$.

same (i.e., *near*-uncued prime/*near*-uncued probe or *far*-uncued prime/*far*-uncued probe conditions), whereas positive priming was found when the prime–probe context was different (i.e., *near*-uncued prime/*far*-uncued probe and *far*-uncued prime/*near*-uncued probe conditions). To rule out this alternative, Experiment 2 was conducted to determine whether the impact of far-precued prime flankers on the probe trials could be revealed when the prime and probe displays were identical in terms of target–flanker separation and cuing.

EXPERIMENT 2

In Experiment 2, I manipulated contextual similarity (defined by target–flanker separation and attention precuing on the prime and probe trials) between subjects. A *different-context* group provided an exact replication of the far-precued condition of Experiment 1. For that group, attention was precued on the prime trials, and the prime target appeared with a far flanker. In contrast, attention was uncued for the probe trials, and the probe flanker always appeared near (.9º) the probe target. A *same-context* group was also employed, which received the same prime trials as did the different-context group (i.e., far-flankers and attention precuing), but for which probe target location was precued and far probe flankers were displayed. The contextual similarity account (Fox & de Fockert, 1998; Neill & Valdes, 1996) would seem to predict that negative priming should be observed in the same-context condition (i.e., *far-precued* prime/*far-precued* probe), but not in the different-context condition (i.e., *far-precued* prime/*near-uncued* probe).

Method

Subjects. Thirty new subjects were recruited. Fifteen subjects were assigned to the same-context condition and 15 participated in the different-context condition.

Stimuli and Procedure. The stimuli were the same as in Experiment 1. The procedure for the prime and probe trials for the different-context group and for the prime trials for the same-context group was identical to that of Experiment 1. However, the procedure for the probe trials for the same-context group differed in the following way. Subjects were informed that before each probe display, a cross would be presented briefly to indicate which letter they had to identify. In addition, the target and the flankers for the probe displays were separated by an angular distance of 2.7º (i.e., far flankers were used).

Results and Discussion

As shown in Table 1, prime trials latency was significantly shorter for the same- than the different-context condition [$F(1,28) = 6.59$ $p < .02$]. However, null flanker effects were obtained on the prime trials [−3 msec; $F(1,28) < 1$], this irrespective of contextual similarity [$F(1,28) < 1$]. More critical were the findings displayed in Table 2, which show that contextual similarity did not affect the priming pattern on the probe trials ($F < 1$). A two-way mixed design ANOVA (with context and priming as variables) failed to reveal any significant effects. Hence, replicating the findings of Experiment 1, no negative priming (2 msec) emerged when the prime–probe context was different (i.e., *far-precued* prime/*near-uncued* probe). More importantly, this pattern of results was also observed in the same-context condition (i.e., *far-precued* prime/*far-precued* probe), in which the ignored repetition condition was only 1 msec slower than the control condition.[4] Therefore, it would appear reasonable to conclude that the contextual change that was occurring between the prime and probe trials for the far-precued group of Experiment 1 was not responsible for the disappearance of negative priming in that condition. Instead, it appears that the priming pattern was unaffected by prime–probe contextual similarity.

GENERAL DISCUSSION

The results of this study replicate my previous findings (Paquet & Craig, 1997) concerning flanker processing. First, they confirm that considerable flanker processing takes place when attention is not precued to the target location. Thus, flanker effects and negative priming were found for the near-uncued and far-uncued conditions. Second, the presence of flanker effects for the far-uncued group suggests that large target–flanker separation is insufficient to eliminate flanker effects. Third, flankers located within 1º of the target are processed for meaning, whether or not attention is directed in advance to the target location. Thus, reliable flanker effects and negative priming were found with near flankers, regardless of attention cuing.

However, the results above should not be viewed as decisive evidence for semantic processing of unattended flankers. Instead, it seems likely that attentional leakage was responsible for the flanker effects and negative priming obtained for the near-uncued, far-uncued, and near-precued groups. Support for this idea comes from the results of the far-precued group, in which the conditions for efficient narrowing of attention to the target were presumably optimized. Under such conditions, the present study failed to reveal either flanker effects or negative priming. In sum, the present results confirm those of Ruthruff and Miller (1995), who also failed to uncover evidence for the identification of unattended flankers when attention was efficiently narrowed to the target location.

Although the null results of the far-precued groups are compatible with the notion that unattended flankers are not identified, it can be argued that the flankers were identified, but that it was simply easier to select the precued target against far than against near flankers (Allport, 1989; Baylis & Driver, 1992; Duncan, 1989). Moreover, if negative priming reflects distractor inhibition preventing irrelevant stimuli from disrupting performance (Strayer & Grison, 1999; Tipper & Cranston, 1985), distractor inhibition (and therefore negative priming) should be restricted to difficult prime–target selection conditions (i.e., near-uncued, near-precued, and far-uncued conditions). However, this account would seem to predict positive priming when target selection is easy (i.e., the far-precued conditions), because the internal representation of the flankers should have remained highly activated. Clearly, the present results did not support this prediction; no hint of positive priming was observed in the far-precued conditions. But perhaps positive priming simply cannot emerge when, as in Experiment 1, there is target–flanker conflict on the probe trial (Lowe, 1979; Milliken, Joordens, Merikle, & Seiffert, 1998; Moore, 1994). Recall that the target and the incompatible flanker of the probe trials were in close proximity and that attention was not directed in advance to the probe target location. Therefore, one could ask whether positive priming from far-precued prime flankers would emerge if target selection were made easier on the probe trial by using far flankers and attentional precuing. However, the results of the same-context condition of Experiment 2 argue against this notion, because neither positive nor negative priming emerged. In sum, although the hypothesis that the flankers of the far-precued conditions were identified cannot be directly ruled out, the notion that the flankers were filtered out before they were identified provides a parsimonious account of the null findings provided by the two indices of flanker identification that I used.

The present results contrast with those obtained by Driver and Tipper (1989), who reported negative priming in the absence of flanker effects. However, as discussed earlier, their results were inconclusive because the target and flankers were either spatially overlapping or presented within 1º of visual angle. The present findings also contrast with the results obtained by Fox (1995), who failed to eliminate negative priming from far flankers under precued conditions. This discrepancy can be explained by a difference in the precue efficiency between the two studies. In contrast to Fox, I observed shorter latency for the precued than for the uncued groups, suggesting that the present attention cuing manipulation was effective. But, why could the present procedure successfully precue attention, whereas Fox's procedure was inefficient? Although our cuing procedures were very similar, the precue used in the present study might have been more salient than Fox's cues because I increased the thickness of the lines composing the cross in comparison with the lines used for the letters. Furthermore, I placed the precue 1º away from the target location, which may have been sufficient to minimize the possibility of forward masking of the target by the cue that was reported by Fox when using a precue placed .8º away from the target location.

In conclusion, the present results are consistent with the proposal that flanker effects observed in the flankers paradigm are often the results of attentional leakage. Consequently, such effects cannot be seen as decisive evidence in favor of the late selection hypothesis that unattended stimuli are processed for meaning. Instead, the present results suggest that semantic processing of the flankers is greatly limited when attention is narrowly focused on the target location. This result lends credence to the notion that the flankers are selected against before they are identified (Ruthruff & Miller, 1995; Yantis & Johnston, 1990).

REFERENCES

Allport, D. A. (1989). *Visual attention.* In M. I. Posner (Ed.), *Foundations of cognitive science* (pp. 631-682). Cambridge, MA: MIT Press.

Baylis, G. C., & Driver, J. (1992). Visual parsing and response competition: The effect of grouping factors. *Perception & Psychophysics*, **51**, 145-162.

Broadbent, D. E. (1982). Task combination and selective intake of information. *Acta Psychologica*, **50**, 253-290.

Castiello, U., & Umiltà, C. (1990). Size of the attentional focus and efficiency of processing. *Acta Psychologica*, **73**, 195-209.

Cheal, M. L. & Lyon, D. R. (1991). Central and peripheral precuing of forced-choice discrimination. *Quarterly Journal of Experimental Psychology*, **43A**, 859-880.

Driver, J., & Tipper, S. P. (1989). On the nonselectivity of selective seeing: Contrasts between interference and priming in selective attention. *Journal of Experimental Psychology: Human Perception & Performance*, **15**, 304-314.

Duncan, J. (1989). Boundary conditions on parallel processing in human vision. *Perception*, **18**, 457-469.

Eriksen, B. A., & Eriksen, C. W. (1974). Effects of noise letters upon the identification of a target letter in a nonsearch task. *Perception & Psychophysics*, **16**, 143-149.

Fox, E. (1994). Interference and negative priming from ignored distractors: The role of selection difficulty. *Perception & Psychophysics*, **56**, 565-574.

Fox, E. (1995). Pre-cuing target location reduces interference but not negative priming from visual distractors. *Quarterly Journal of Experimental Psychology*, **48**, 26-40.

Fox, E., & de Fockert, J. W. (1998). Negative priming depends on prime–probe similarity: Evidence for episodic retrieval. *Psychonomic Bulletin & Review*, **5**, 107-113.

Kramer, A. F., Humphrey, D. G., Larish, J. F., Logan, G. D., & Strayer, D. L. (1994). Aging and inhibition: Beyond a unitary view of inhibitory processing in attention. *Psychology & Aging*, **9**, 491-512.

Lowe, D. G. (1979). Strategies, context, and the mechanism of response inhibition. *Memory & Cognition*, **7**, 382-389.

Milliken, B., Joordens, S., Merikle, P. M., & Seiffert, A. E. (1998). Selective attention: A reevaluation of the implications of negative priming. *Psychological Review*, **105**, 203-229.

Moore, C. M. (1994). Negative priming depends on probe-trial conflict: Where has all the inhibition gone? *Perception & Psychophysics*, **56**, 133-147.

Neill, W. T. (1997). Episodic retrieval in negative priming and repetition priming. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, **23**, 1291-1305.

Neill, W. T., & Mathis, K. M. (1998). Transfer-inappropriate processing: Negative priming and related phenomena. In D. L. Medin (Ed.), *The psychology of learning and motivation: Advances in research and theory* (Vol. 38, pp. 1-44). San Diego: Academic Press.

Neill, W. T., & Valdes, L. A. (1996). Facilitatory and inhibitory aspects of attention. In A. F. Kramer, M. G. H. Coles, & G. D. Logan (Eds.), *Converging operations in the study of visual selective attention* (pp. 77-106). Washington, DC: American Psychological Association.

Paquet, L., & Craig, G. L. (1997). Evidence for selective target processing with a low perceptual load flankers task. *Memory & Cognition*, **25**, 182-189.

Ruthruff, E., & Miller, J. (1995). Negative priming depends on ease of selection. *Perception & Psychophysics*, **57**, 715-723.

Strayer, D. L., & Grison, S. (1999). Negative identity priming is contingent upon stimulus repetition. *Journal of Experimental Psychology: Human Perception & Performance*, **25**, 24-38.

Tipper, S. P., & Cranston, M. (1985). Selective attention and priming: Inhibitory and facilitatory effects of ignored primes. *Quarterly Journal of Experimental Psychology*, **37A**, 581-611.

van der Heijden, A. H. C. (1992). *Selective attention in vision*. London: Routledge.

Yantis, S., & Johnston, J. C. (1990). On the locus of visual selection: Evidence from focused attention tasks. *Journal of Experimental Psychology: Human Perception & Performance*, **16**, 135-149.

NOTES

1. In Fox (1994, 1995, Experiments 1 and 2) an asterisk presented at the target location was used as a precue. However, this precueing method produced forward masking of the prime target, which reduced the efficiency of the cue.

2. Ruthruff and Miller (1995) attempted to address this issue by conducting a separate control study in which the flanker was either neutral or incompatible with respect to target identity. They found that performance was unaffected by this variable when target and flanker locations were fixed. Unfortunately, the authors did not also include a negative priming measure in this experiment. Therefore, the two indices of flankers processing that were provided in this study came from different individuals.

3. Power analyses showed that the probability of detecting small (7-msec) flanker effects and negative priming effects was at least .8 for each comparison.

4. Power analyses showed that the probability of detecting small (7-msec) flanker effects and negative priming effects was at least .9 for each comparison.

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