The Role of Perceptual Load in Neglect: Rejection of Ipsilesional Distractors is Facilitated with Higher Central Load

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Abstract

Neglect is known to produce a bias towards the ipsilesional side. Here we examined whether this bias is automatic or can be modulated by manipulating perceptual load in a relevant task [e.g., Lavie, N. (1995). Perceptual load as a necessary condition for selective attention. Journal of Experimental Psychology: Human Perception and Performance, 21, 451–468]. Three patients with left neglect and three healthy controls made speeded choice responses to a target letter in the center of the display while attempting to ignore an irrelevant distractor presented on left or right. Perceptual load was manipulated by inducing a search for the target that appeared with another central stimulus, which was either a blob (low load) or a nontarget letter (higher load). Response competition effects from ipsilesional distractors were significantly reduced by higher load. The same increase of load, however, did not decrease distractor effects in the control group, as expected [e.g., Lavie, N., & Cox, S. (1997). On the efficiency of attentional selection: Efficient visual search results in inefficient rejection of distraction. Psychological Science, 8, 395–398]. These results demonstrate that ipsilesional bias in neglect is not fully automated and emphasize an additional restriction of perceptual capacity. Moreover, they supported our prediction that reduced perceptual capacity in neglect can lead to improved distractor rejection with just small increases in perceptual load.

INTRODUCTION

Unilateral neglect of visual stimuli on the contralesional side typically follows a right hemisphere lesion centered on the parietal lobe. Such neglect is most apparent when concurrent stimuli are presented to the ipsilesional side. In fact, neglect typically resolves into extinction: Stimuli on the contralesional side are neglected only in the presence of competing ipsilesional stimuli. Otherwise, when presented alone, contralesional stimuli can be reported. This demonstrates the importance of attention in the deficit, as contralesional perception seems to only suffer when it has to compete for attention with an ipsilesional stimulus.

Indeed, current theories of neglect typically account for the cognitive deficit in terms of a spatial bias in directing "attention" away from stimuli in the contralesional field, and towards stimuli in the ipsilesional field (e.g., Posner, Walker, Friedrich, & Rafal, 1984; Riddoch & Humphreys, 1983). Some researchers have even suggested that neglect may involve hyperattention to the ipsilesional side, not merely inattention for the contralesional side (e.g., Kinsbourne, 1993; Ladavas, 1993).

In this article we ask whether the spatial bias towards ipsilesional stimuli is automatic or whether it can be modulated by manipulations of attention. We suggest that although neglect involves a strong spatial bias to pay attention to ipsilesional stimuli, the processing of ipsilesional stimuli crucially depends on the allocation of attention, and can thus be modulated by manipulations that engage attention in a central task at fixation.

Our approach is based on a recent theory of normal selective attention in which normal distractor processing is not automatic but rather depends on the (unintentional) allocation of attention to distractor processing. Recent studies of normal selective attention have found that an important determinant of distractor processing is the extent to which a relevant task involves sufficiently high perceptual load to engage full attention in relevant processing. Several studies have shown that people typically fail to ignore distractors despite their irrelevancy to a current task as long as the relevant task involves low perceptual load (e.g., very few relevant stimuli are presented). Interference from these distractors was, however, reduced or eliminated by increasing the perceptual load in the relevant task (e.g., presenting many relevant stimuli). These results were found with several measures of distractor effects (e.g., response competition, Lavie, 1995; Lavie & Cox, 1997, negative priming, Lavie & Fox, 2000 and neural responses to

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motion distractors in MT as measured by fMRI, Rees, Frith, & Lavie, 1997) and with various manipulations of perceptual load, which involved either increasing the number of stimuli that were relevant for target perception or increasing the processing requirements for the same stimuli (e.g., by comparing between simple detection and difficult discrimination tasks; for review see Lavie, 2001).

The finding that irrelevant distractor processing was always reduced in conditions of high perceptual load in the relevant task implies that normal processing of irrelevant distractors is not automatic but rather suffers from capacity limits and, thus, depends on the (involuntary) allocation of any spare attention from the relevant task.

This leads to an interesting prediction for the processing of ipsilesional distractors in neglect. If ipsilesional processing is also not fully automated in the sense that it suffers from capacity limits, it should depend on the allocation of attention, and distractor effects from ipsilesional stimuli may be reduced by increasing the perceptual load in the relevant task to exhaust attention. Moreover, neglect may also involve an overlooked reduction in general capacity for perception, in addition to the clear spatial bias (see also Cusack, Carlyon, & Robertson, in press; Duncan, Bundesen, Olson, Humphreys, Chavda, & Shibuya, 1999; Robertson & Manly, 1999). Despite the traditional distinction between ventral and dorsal streams, which attributes object recognition to ventral areas (such as inferotemporal cortex), and representation of space and action to dorsal structures such as the parietal lobe, there is a long-document  
ed clinical evidence of failure to recognize objects (especially from unusual views) after lesions to the parietal lobes (e.g., Driver & Vuilleumier, 2001; Farah, 1990; McCarthy & Warrington, 1990). Indeed, one of the most striking feature of patients’ performance after a "bilateral" parietal lesion is their inability to perceive more than one object at a time (i.e., Balint’s syndrome, Balint, 1909). Finally, a general reduction in capacity might also be expected after a lateralized lesion affecting just the right hemisphere because arousal pathways (an essential component of mental capacity, see Kahneman, 1973) are thought to be right lateralized (see Pardo, Fox, & Raichie, 1991; Oke, Keller, Mefford, & Adams, 1978).

For all these reasons, we hypothesized that right hemisphere neglect patients would suffer from a general nonlateralized loss of capacity, in addition to a rightwards bias. This leads to a counterintuitive prediction (which directly follows from our load hypothesis) regarding the processing of right distractors in neglect. If neglect involves reduced nonlateralized capacity, this should lead to a better ability to ignore right distractors at lower levels of load than those needed for control subjects. Thus, we predicted that just a small increase in relevant perceptual load should be sufficient to reduce irrelevant distractor effects from "ipsilesional" items in neglect patients, but not in a control group, because just a small increase in load should be sufficient to exhaust the more restricted capacity that we hypothesized for neglect.

**EXPERIMENT 1**

To test these claims three patients who had suffered a right hemisphere stroke (see Figure 2) were asked to participate in a response competition task, (e.g., Eriksen & Eriksen, 1974) in which perceptual load was manipulated (Figure 1). The patients were requested to make speeded choice responses to indicate whether an A or a B appeared in the center of the display, while ignoring an irrelevant distractor letter presented on the left or right. Although the present predictions mainly concerned the right ipsilesional distractor, a left distractor was presented as well, to discourage any spatial strategies the patient might use to avoid the right distractor (e.g., shifting gaze to the left). The distractor could either be compatible (eliciting the same response) or incompatible (eliciting the competing response) with the target to allow for a measure of distractor processing.

The manipulation of interest was of perceptual load for the task at fixation. In the low-load condition, the target letter appeared above or below a gray blob in the center of the screen (Figure 1A). In the high-load condition, the blob was replaced with the letter R (Figure 1B). Thus, one more letter was relevant for processing in this condition, as the target now had to be found among a central pair.

Of main interest was the question of whether the increase of perceptual load in the center would reduce the distraction from the irrelevant flankers. In particular, can distractor effects from ipsilesional flankers be re-

![Figure 1](image-url). Example displays from the low load (A) and higher load (B) conditions in Experiment 1. Left flanker on left, right flanker on right.
duced by higher perceptual load around fixation, or is rightward distraction fully automated in neglect?

**Results**

**Ipsilesional Distractor**

Median RTs from each block were calculated for each patient as a function of distractor conditions and load. Trials with errors or with RTs over 2 sec were excluded from this analysis. Figure 3 presents the results averaged across patients. A three-way mixed-design ANOVA (with block as the random factor) was conducted on the factors of patient, load, and distractor condition. This ANOVA revealed a main effect of the distractor condition, $F(1,20) = 10.4, p < .004$. RTs were substantially slower when the ipsilesional distractor was incompatible rather than compatible with the target. More importantly, distractor effects were significantly modulated by load, $F(1,20) = 5.4, p < .03$. As predicted from the load hypothesis, and our claim that neglect involves a general decrease of perceptual capacity, a small increase of load at fixation was sufficient to significantly reduce the distractor effect from the ipsilesional stimuli (see Figure 3, left panel). The increase in load also resulted in some increase of the overall RTs (pooled across distractor conditions, mean RTs were increased from 763 msec in relevant set size one to 807 msec in relevant set size two) an effect that did not reach statistical significance ($p > .10$). As can be seen

![Figure 2. Neuroimage reconstruction for the patients. Note: Patients EB and JB were tested and scanned in a different country than JB, hence the different templates and slices used for lesion reconstruction.](image1)

![Figure 2. (continued)](image2)
tractor condition: Although RTs in the compatible condition were increased by higher load, RTs in the incompatible condition were decreased, due to the reduced distractor interference with higher load.

Error rates showed supportive trends to those found in the RTs. There was an 11.2% increase in the number of errors in the incompatible condition versus the compatible condition, and this distractor effect was reduced to 2.6% by higher load (see Figure 3, right panel). The statistical analysis of the errors was not, however, sufficiently sensitive to reveal any significant effect (all ps > .10).

None of the distractor effects or their interactions with load interacted with patient in either analyses of RTs or error rates (p > .10 for all interactions). Indeed, the pattern of group averages shown in Figure 3 was characteristic of the results found in every single patient. The results of the distractor effects as a function of load per patient are presented in Figure 4. As can be seen in this figure a slight increase in perceptual load has consistently modulated the distractor effects for every patient.1

Contralesional Distractor

Figure 5 presents the contralesional distractor results as a function of distractor conditions and load. A three-way mixed-design ANOVA (with block as the random factor) on the RTs with the factors of patient, load, and distractor condition revealed a main effect of load $F(1,20) = 14.3, p < .001$ (average RTs were increased from 544 in set size one to 661 in set size two), but failed to reveal any significant effect of distractor condition ($F < 1$). When the data of EB who had a field cut were excluded from this analysis there were still no reliable effects of the distractors on RTs ($F < 1$). There was, however, some nonsignificant trend ($F < 1$) towards a compatibility effect of 50 msec on average in the low-load condition for the two patients with intact left visual fields (incompatible RTs were on average 20 msec faster than compatible RTs in the high-load condition for them).

A significant effect of distractor condition was, however, found from the left distractor in the analysis of errors, $F(1,20) = 5.5, p < .03$, on all three patients. This compatibility effect was greater in the low-load condition (error rates were increased by 12% in the incompatible condition) than in the higher load condition (error rates increase of 6% in the incompatible condition, see Figure 2). However, the interaction of distractor condition and load did not reach significance ($F < 1$). There were no interactions with patient in the contralesional RT and error analyses.

To summarize: Although distractor effects from contralesional stimuli were weak and unreliable, the trends found were consistent with the load hypothesis.

In conclusion, these results demonstrate that ipsilesional distractor processing in neglect can be modulated by higher perceptual load in a central task at fixation. Moreover, a small increase in perceptual load involving adding just one more relevant letter in the center was sufficient for a significant modulation of the ipsilesional distractor effects. Previous load studies have shown that distractor effects in young healthy subjects are typically unaffected by such a small increase in set size. Modulation of distractor effects in those studies required more than four stimuli in the relevant set size (e.g., Lavie & Cox, 1997). The present results thus suggest that in addition to the well-documented rightwards bias in left neglect, a general nonlateralized reduction in perceptual capacity is also involved.

However, differences in methods and procedures between the current study and previous load studies preclude a direct comparison of the results between them. Since our claim that neglect involves a general reduction in perceptual capacity has the important implication that this can be usefully employed to reduce distractor effects from ipsilesional stimuli with just a small increase in perceptual load, it was important to
establish the claim more directly. Thus, in the next experiment we ran a control group matched in terms of age and IQ with our neglect patients in the load and flanker task of Experiment 1.

**EXPERIMENT 2**

In Experiment 2, a control group of healthy volunteers matched on age and IQ with the group of patients performed in our flanker task under two conditions of load. In the low-load condition, one of the target letters (A or B) was presented in the center either above or below a circle, in the high-load condition this circle was replaced with a letter (R). As before, subjects were asked to ignore an irrelevant distractor letter, which could be either compatible or incompatible with the central target, and compatibility effects from the distractors were assessed as a function of perceptual load. We

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**Figure 4.** Experiment 1, right flanker. Mean RTs (left panels) and error rates (right panels) as a function of distractor compatibility and load for each patient.
predicted that, by contrast with the performance of the neglect patients, distractor effects in the control group would be unaffected by the small increase in perceptual load in accordance with previous load studies in healthy adults.

Lavie and Cox (1997), for example, manipulated a graded increase in the number of letters among which a target was presented in a response competition task similar to the task used here. They found that distractor effects were unaffected by adding one or three letters to the central task, and were only reduced by a relevant set size of six letters (see also Lavie & Fox, 2000, Experiment 4). Thus, we predicted that distractor effects in the present experiment with healthy subjects will also be unaffected by the small increase of load induced by the addition of one letter. If this prediction is confirmed, we can safely attribute the modulation of the ipsilesional distractor effects found in the neglect patients to a general reduction in perceptual capacity after a right hemisphere lesion (see also Duncan et al., 1999). In addition, since neglect is known to involve a bias towards ipsilesional stimuli, we predicted that the ipsilesional distractor effects in the patients should be greater than those found in the control group.

**Results**

Median RTs from each block were calculated for each subject as a function of distractor conditions, side, and load. Trials with errors or with RTs over 2 sec were excluded from the RT analysis. A four-way mixed-design ANOVA (with block as the random factor) was run on the factors of subject, load, distractor side, and distractor condition. This ANOVA revealed a main effect of distractor condition: Incompatible RTs were significantly slower than compatible RTs, $F(1,24) = 9.6, p < .005$. However as expected for these control group of healthy subjects this flanker effect did not interact with either side or load ($F < 1$ in both cases). The ANOVA also revealed a main effect for load, $F(1,24) = 157, p < .001$, which interacted with subject, $F(2,24) = 14, p < .001$, and no main effect for side, $F(1,24) = 1.25, p > .27$. Note that although the interaction of load and subject indicated that load effects on RTs varied in size between subjects this variation was of no consequence as there were no other significant interactions involving load.

As can be seen in Figure 6 there were very few errors in this control group (average error rate was 2%) with very little variation between experimental conditions. Accordingly, there were no significant effects in the error analysis. Thus, this control experiment confirmed our expectation that distractor effects in a healthy intact group are not affected by an increase of the central load from one to two items (see also Lavie & Cox, 1997).

In addition, a comparison of the distractor effects in the control group and the ipsilesional distractor effects in the neglect group allows us to examine the notion that neglect involves a spatial bias towards the ipsilesional field. Under conditions of low perceptual load, neglect patients are expected to be more distracted than normal from the ipsilesional distractors. As can be seen by comparing the distractor effects between Figures 3 and 6, distractor effect from ipsilesional stimuli in neglect (mean distractor effect of 189 msec) was about six times as large as the average distractor effect in the control group (mean distractor effect of 30 msec).

Moreover, although target RTs were generally slower in the neglect group (average RTs of 784 msec) than in the control group (average RTs of 569 msec) the greater distractor effect from ipsilesional stimuli in neglect cannot be attributed to scaling. When distractor effects are expressed as proportional RT increase by the incompatible distractor for each group, they are still much larger for the neglect group (proportional ipsilesional distractor effect = .24) versus the control group (proportional distractor effect = .05).
In conclusion, taken together the results from these experiments clearly show the well-known rightwards bias in left neglect, but they also demonstrate that neglect involves a general restriction to perceptual capacity. More importantly, the present results show that the general reduction of perceptual capacity after neglect can be usefully employed to reduce distractor effects from ipsilesional stimuli with slight increases in perceptual load, which do not affect distractor processing in healthy controls.

**DISCUSSION**

The present results demonstrated that ipsilesional distractor effects in neglect can be substantially reduced by a slight increase in the perceptual load of a central task. The fairly large response competition effects found from ipsilesional distractors in conditions of low perceptual load were significantly modulated in conditions of slightly higher perceptual load with just one more letter that had to be processed in addition to the target in a central task.

Any effects of the increase in number of relevant letters cannot be attributed to an increase in the level of visual stimulation, as this was controlled by presenting a light gray blob (which was in fact of greater visual energy than the letter) in place of the additional letter in the condition of low perceptual load. Thus, the modulation of distractor effects seems to be attributed to a greater demand on attention, which is induced by the need to "identify" two letters rather than one.

**Processing of Ipsilesional Distractors is Subject to Capacity Limits**

The present results provide support for our hypothesis that ipsilesional distractor processing in neglect is not fully automated, but rather depends on the extent to which a central task leaves spare attentional capacity. In other words although neglect involves a strong spatial bias towards ipsilesional stimuli, ipsilesional processing is not capacity free. Thus, similarly to normal distractor processing (e.g., Lavie, 1995), the processing of ipsilesional distractors may seem inevitable as long as the situation involves very low perceptual load; however, it can be substantially reduced by higher perceptual load.

Unlike normal distractor processing, however, distractor processing in neglect was substantially reduced by a very small increase in load (adding just one more relevant letter), which typically has no effect on normal distractor processing (e.g., Lavie & Cox, 1997), and indeed did not affect distractor processing in the control group in the present study (Experiment 2). Normal processing seems to require more than four stimuli to be loaded, and the finding that capacity for processing in neglect seems to be loaded by a much smaller increase in the number of stimuli (from one to two) supports our prediction that left neglect should result in a general nonlateral reduction of attentional capacity in addition to a spatial bias (see also Duncan et al., 1999; Robertson, 1993).

**Possible Interaction of Spatial Bias and Capacity Limits in Neglect**

We note that a spatial bias towards ipsilesional stimuli was also evident in our study from the findings that the response competition effects from ipsilesional distractor were far greater than the distractor effects from contralateral stimuli in the patient group (these were weak and unreliable on RTs in our study), or the normal distractor effects in our intact control group. Importantly, however, our study shows that once a greater nonlateral restriction in capacity is taken into account, one can modulate the spatial bias and significantly reduce distractor effects from ipsilesional stimuli by slightly increasing the load in a central task.

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**Figure 6.** Experiment 2. Mean group RTs (left panel) and error rates (right panel) as a function of distractor compatibility and load. Flanker effects are averaged across sides.
The present results thus suggest that neglect cannot be fully accounted for by a spatial bias towards the ipsilesional side (e.g., Posner et al., 1984; Riddoch & Humphreys, 1983) or even hyperattention to the ipsilesional side (e.g., Kinsbourne, 1995; Ladavas, 1993). A further nonlateralized restriction in attentional capacity needs to be taken into account as well. Take, for example, a spatial model for neglect recently offered by Driver and Pouget (2000). On their model left neglect involves a spatial gradient of decline in neural activation from right to left. Our suggestion that left neglect involves also a nonlateralized decrease in processing capacity can be incorporated in this model by adding a general decrease in the baseline level of neural activation in neglect versus normal to the model. Importantly such modification would mean that despite relatively greater activation of right versus left stimuli in conditions of very low perceptual load (due to the spatial gradient), one can modulate the activation by rightwards stimuli with greater load at fixation (i.e., relatively left of the distractor, due to a nonlateralized restriction of the processing capacity).

Interestingly, models of spatial attention that also incorporate general capacity limits have been offered for normal attention (Handy & Mangun, 2000), and received support from the findings that attention becomes more spatially selective in conditions of higher perceptual load (see Lavie & Tsal, 1994 for review). Of course, in neglect the major aspect of any spatial attention model is the "lateral" difference in allocation of attention, which results in a tendency to always favor ipsilesional stimuli regardless of their relevancy to task goals. The important implication of applying a spatial attention plus a nonlateralized capacity limit model to account for neglect is that one can modulate the lateralized spatial bias and improve ignoring of irrelevant ipsilesional distractors by slightly loading a central task, due to the nonlateral restriction on capacity, as we have shown.

**The Nature of Nonlateralized Capacity Limits in Neglect**

Our results join a few recent studies that have also emphasized greater general restriction of the capacity for object processing in neglect. Bisiach and Rusconi (1990) reported that only one of two overlapping objects at fixation may be noticed (see also Farah, 1990 for cases of dorsal simultanagnosia). Duncan et al. (1999) have recently found marked reduction in the ability of neglect patients to report letters from a briefly presented array, which held for letters presented in both left and right fields. Our findings that the requirement to discriminate two letters rather than one at fixation resulted in modulating the effects of ipsilesional distractors is consistent with these reports, and along with them can be attributed either to a nonlateralized reduction in the capacity specifically needed for visual shape discrimination, or to a more general restriction on the capacity to attend to multiple objects, in any attention task. The later possibility seems more plausible in light of the strong implication of parietal lobes in various tasks of attention that have not been confined to just shape discrimination in neuroimaging studies (e.g., detection of color and motion, for review see Wojciulik & Kanwisher, 1999) as well as in lesion studies (e.g., the severe deficits found after bilateral parietal lesion in any task that concerns more than one object, e.g., Friedemann-Hill, Robertson, & Triesman, 1995). Moreover, a recent finding that neglect involves reduced discrimination between but not within auditory objects (i.e., sounds, Cusack, Carlyon, & Robertson, 2000) also provides support for a reduction in the general ability to attend to multiple objects (see also Robertson et al., 1993).

However, given that our study has manipulated load only by increasing the demand on shape discrimination, it cannot in itself be conclusive on the exact nature of capacity limits in neglect. Future studies examining different manipulations of load in different tasks (e.g., color, motion, etc.) should prove useful in informing on the exact type of reduction in processing capacity, after neglect.

The important point of our study was to demonstrate how nonlateralized capacity limits in neglect can have the effect of "improving" rejection of distractors on the ipsilesional side with load.

**Possible Boundary Conditions to Perceptual Load Effects**

The modulation of ipsilesional distractor effects by perceptual load in a central task was found with chronic neglect patients either several years, or several months, after the lesion. At this stage, their neglect has already resolved into extinction, and was only apparent in the presence of competing stimuli in the ipsilesional field. It is possible that in more severe cases of neglect, the tendency to orient towards ipsilesional stimuli will overpower any effects of load at a central task. Such patients may not be able to focus attention or hold fixation in the center, and thus always report the ipsilesional stimulus instead of the central one. In other words, although we expect a general reduction of capacity in more severe cases of neglect, it may not be possible to modulate interference from ipsilesional stimuli by load in a central task if the orientation bias is so strong that it disables focusing on a central task. Fortunately, most neglect patients rapidly recover from the early acute stage and in the chronic extinction cases, our study demonstrates that the bias towards ipsilesional distractors can be modulated by load at fixation.

We conclude that although our study has highlighted an additional deficit in neglect, namely a general reduc-
tion of processing capacity, it has also shown how this deficit can be successfully employed to improve the patient’s ability to ignore ipsilesional distractors at lower levels of load than those needed for improving selective attention in brain intact populations.

METHODS

Experiment 1

Patients
Three patients with a right hemisphere lesion after stroke were tested. Lesion reconstruction from MRI (patient CR) and CT (patients JB, EB) scans are presented in Figure 1.

Patient JB. Infarction of right middle cerebral artery, with damage to right parietal and frontal regions, involving both gray and white matter (see reconstruction in Figure 1). No field cut. Thirty-three left-sided omissions in canceling 54 items. IQ score 97. Seventy-two years old when tested.

Patient EB. Infarction of right posterior cortex, involving occipital and posterior parietal and temporal cortices. Left homonymous hemianopia. Only acute clinical CT scan available, full reconstruction awaiting chronic MRI. Nineteen left-sided omissions in canceling 54 items. IQ score 105. Seventy-four years old when tested.

Patient CR. Infarction of R middle cerebral artery, centered on right parietal lobe (see reconstruction in Figure 1). No visual field cut. Reliable visual extinction. Originally had acute clinical neglect, now less severe in chronic state as when tested. Seventy-two years old when tested.

Stimuli and Apparatus
A portable PC with a VGA screen was used to display the stimuli and record the responses. Viewing distance was held fixed at approximately 40 cm. Micro Experimental Laboratory (MEL) software was used to create the stimuli and run the experiment. The letters A or B were presented in upper case 1.8 cm (2.6° of visual angle) above or below the center of each display (measured from the letters’ center). A gray circle of 0.5cm (0.7") in diameter was presented in the other central position in the low-load condition and this was replaced by the letter R in the higher load condition. All the letters subtended 1.1 cm vertically and 0.5 cm horizontally (1.58° by 0.72°). In addition each display contained a flanker (either A or B) on the left or right, with its center positioned 1.8 cm (2.6") from fixation. The target and flanker were equally likely to be incompatible (e.g., an "A" flanker for a "B" target) or compatible (e.g., a "B" flanker for an "A" target). Target and distractor identity and position were fully counterbalanced in each load condition. A fixation cross subtending 0.5 cm (0.7") in width and length was used to direct the patients eyes to the center of the display.

Procedure
Each trial began with a fixation cross presented for 1 sec. The patients were requested to focus their eyes on the fixation cross, and were told that their target will appear above or below fixation. The target and distractor displays were presented for 180 msec. Subjects were instructed that a distractor letter may also be presented on the left or right of the center. They were told that this letter is irrelevant to their task and they were requested to ignore it. The conditions of load were blocked and the patient could rest between each block. Six blocks of 32 trials each were run for each load condition. Of these, one to two blocks were taken for practice (as needed). One patient who was already trained in performing in response competition tasks received alternating blocks of high and low load (starting with high load). The other two patients received the low-load blocks and high-load blocks in different sessions (one started with a low-load session and the other started with a high-load session).

Experiment 2

Subjects
Three subjects aged 71, 73, and 74 years were recruited from the normal subject pool of MRC-CBSU, Cambridge and were paid £5 for participating in this experiment. These subjects scored 20, 20, and 16 in a NART test (corresponding to IQ scores of 106, 106, and 111).

Apparatus Stimuli and Procedure
The same portable PC and the same viewing distance as in Experiment 1 was used. The stimuli and procedure were also the same as in Experiment 1. Subjects received 10 alternating blocks of low and high load. The first two blocks served as practice. Two subjects started with a high-load block and one started with a low-load block.

Acknowledgments
This research was supported by a Biotechnology and Biological Science Research Council (UK) grant number 31/S09509 and a Medical Research Council (UK) career award to the first author. We are indebted to Robert Rafal for providing access to patient CR. We thank Charlotte Russell and Lisa Horsell for their assistance with the analysis and presentation of results and Jon Driver for helpful comments on this research.

Note
1. Note that although the average results across all patients might appear to show a larger effect of load on compatible distractors than on incompatible distractors, this pattern was not consistent across the patients. JB’s RTs, for example, show

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a stronger effect of load on incompatible RTs than on compatible RTs. CR’s RTs show the reverse trend but her error rates show the same trend as JB’s (i.e., greater load effect on incompatible distractor than on compatible distractor). In sum, there was no consistent pattern across the patients of load affecting either just facilitation from compatible distractors or just interference from incompatible distractor. The consistent pattern was that load has always reduced the difference between incompatible and compatible distractors for all patients.

REFERENCES


