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ScienceDirect
Brain and Language 99 (2006) 8–219
Brain and Language
www.elsevier.com/locate/b&l

Activation vs. inhibition accounts of semantic blocking effects in production and comprehension

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Accepted 6 July 2006

Introduction

Recent studies have revealed longer naming times for pictures in sets blocked by semantic category than for unblocked pictures, with the effect growing over repeated presentations. Schnur, Schwartz, Brecher, and Hodgson, in press recently demonstrated that, in terms of error rates, left frontal lesion patients show a greater semantic blocking effect than posterior lesion patients. According to one view, the blocking effect is caused by over-activation of the lexical representations of category members, due to spreading activation, making selection difficult. Frontal lesion patients are assumed to have particular difficulty with selection (Schnur et al.). Another account takes an opposing view, with the effect attributed to the inhibition of competing lexical representations during word selection, with the inhibition persisting across trials. Exaggerated effects for patients occur because inhibition is abnormally great and persists longer (McCarthy & Kartsounis, 2000). The present study addressed the activation versus inhibition accounts by examining the performance of patients with difficulty inhibiting irrelevant verbal information. Another aim was to compare the semantic blocking effect in production and comprehension, as most studies have assumed that the effect is due to processes specifically involved in word selection in production; however, similar blocking effects have also been reported in comprehension for some patients (e.g., Crutch & Warrington, 2005).

Patient backgrounds

Four aphasic patients were tested. Two (ML, AR) have lesions including left frontal regions and two (LW, JJ) have left posterior lesions. Not all patients were tested on all tasks. ML has been previously reported in a number of studies. He is argued to have a semantic STM deficit, which may arise from a deficit in inhibiting irrelevant verbal representations, as he shows greatly exaggerated effects on verbal inhibition tasks (Hamilton & Martin, 2005). AR also shows evidence of an inhibition deficit; however, the evidence for a semantic STM deficit is less clear-cut for him. The two other patients (LW, JJ) show evidence of a phonological STM deficit. Testing on inhibition tasks is in progress for these two. All of the patients show good single word production or comprehension on tasks where semantic blocking is not involved.

Method and results

Semantic blocking effects in picture naming

Two experiments have been completed, one manipulating rate of presentation (1 s vs. 4 s response-stimulus interval) and the other using only the fast rate. Subjects named semantically blocked or unblocked sets of six pictures, with each picture being presented four times. Reaction times for control subjects replicated the effects reported previously for young and old subjects, with a semantic blocking effect that grew over presentations. As all of the patients were highly accurate, reaction times rather than errors were analyzed. ML showed a greatly exaggerated semantic blocking effect increasing markedly over presentations. AR showed an even greater effect than ML. The patients with phonological STM deficits (LW, JJ) showed smaller effects within the normal range. Fig. 1a shows the results in terms of the difference in log reaction time for blocked and unblocked sets for patients and controls.

Semantic blocking effect in spoken word-picture matching

Two different versions of this task have been carried out. In one version, an array of six pictures was presented, with the pictures semantically blocked or unblocked. A spoken word was presented and the subjects pressed a key corresponding to the picture. The name for each picture was presented four times at both fast and slow presentation rates. In the other version, the subject saw a single picture and judged whether a spoken word matched the picture. In both tasks, controls showed longer times for the semantically blocked than the unblocked condition; however, unlike in naming, there was only weak and inconsistent evidence that the effect grew over repeated sampling. In contrast, patient ML showed a very large effect of semantic blocking for both tasks that grew dramatically across presentations, with larger effects in the fast presentation condition (see Fig. 1b). Patient AR showed a similar pattern as ML in the single picture-word matching task. The other patients all showed larger than normal main effects of semantic blocking, but there was no evidence that the effect grew over presentations.

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doi:10.1016/j.bandl.2006.06.057

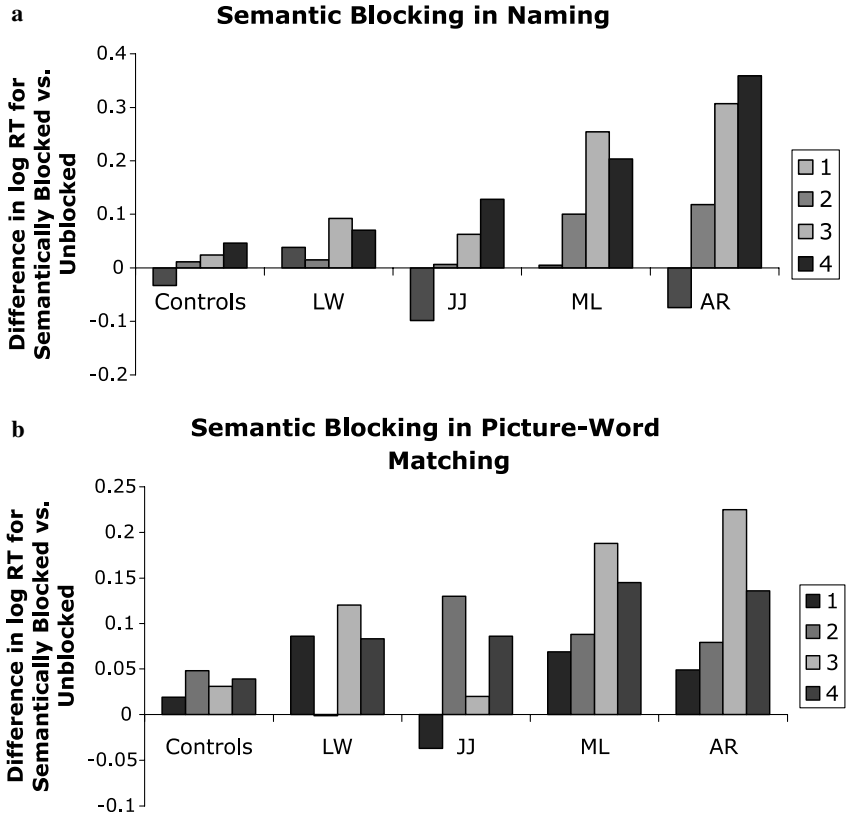

Fig. 1. (a) Effects across presentation cycle in picture naming. (b) Effects across presentation cycle in picture-word matching.

Conclusions

Two patients with left frontal lesions showed exaggerated effects of semantic blocking that grew over presentation cycle at a rate much greater than for controls in both production and comprehension tasks. Given that these patients have a *deficit* in inhibition, it seems highly unlikely that their exaggerated effects could be due to over-inhibition of semantic competitors. Instead, the results are more consistent with the over-activation account, with these patients being unable to suppress (through inhibition) the activation of related but inappropriate representations. With regard to the comparison of production and comprehension, the controls showed an increasing semantic blocking effect over presentations for naming but not word-picture matching. For the patients with inhibition deficits, however, a similar increasing effect was observed in production and comprehension. Thus the control data suggest a word selection locus for the semantic blocking effect whereas the patient data suggest a semantic locus. However, it is possible that the patients, more so than the controls, used naming of the pictures to perform the comprehension tasks. Follow-up tests will assess semantic blocking effects in comprehension where naming is not plausibly involved.

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