



# Combining language and space: Sentence bisection in unilateral spatial neglect <sup>☆</sup>



Laura Veronelli <sup>a,b,\*</sup>, Maria T. Guasti <sup>a</sup>, Lisa S. Arduino <sup>c,d</sup>, Giuseppe Vallar <sup>a,e,f</sup>

<sup>a</sup> Department of Psychology, Università di Milano-Bicocca, Milano, Italy

<sup>b</sup> Department of Neurorehabilitation Sciences, Casa Cura Policlinico, Milano, Italy

<sup>c</sup> Department of Human Sciences, Università LUMSA, Roma, Italy

<sup>d</sup> ISTC-CNR, Roma, Italy

<sup>e</sup> Neuropsychological Laboratory, IRCCS Istituto Auxologico Italiano, Milano, Italy

<sup>f</sup> Laboratory of Cognitive Neuroscience, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland

## ARTICLE INFO

### Article history:

Accepted 24 July 2014

Available online 20 August 2014

### Keywords:

Left spatial neglect  
Sentence bisection  
Line bisection  
Neglect dyslexia  
Reading habits

## ABSTRACT

In line bisection right-brain-damaged patients with left spatial neglect show a rightward deviation, with respect to the line's physical center. In word bisection ortho-phonological features of the stimulus' final (right-sided) part modulate performance of both patients and healthy participants (Veronelli, Vallar, Marinelli, Primativo, & Arduino, 2014). We investigated the role of linguistic factors in sentence bisection, in patients with and without neglect, and control participants. The effects of information in the right-sided part of the sentence (Experiment #1), and of lexical and syntactic violations (Experiment #2) were assessed. Neglect patients showed an overall rightward bias, larger than those of patients without neglect and controls. The neglect patients' bias was modulated by stimulus type, decreasing from lines, to letter strings and to all types of sentences. In sum, in visuo-manual sentence bisection a basic linguistic mechanism, such as sentence readability, brings about a more leftward appreciation of the stimulus, reducing the neglect patients' rightward bias.

© 2014 Elsevier Inc. All rights reserved.

## 1. Introduction

Right-brain-damaged patients with left spatial neglect fail to report sensory events occurring in the side of space contralateral to the hemispheric lesion, and fail to perform actions in that portion of space (Bisiach & Vallar, 2000; Husain, 2008; Vallar, 1998; Vallar & Bolognini, 2014).

Right-brain-damaged patients with left spatial neglect may show a rightward bias in line bisection, a task widely used for both the clinical assessment and experimental investigations of neglect (Bisiach, Bulgarelli, Sterzi, & Vallar, 1983; Bisiach, Capitani, Colombo, & Spinnler, 1976; Daini, Angelelli, Antonucci, Cappa, & Vallar, 2002). In manual line bisection, participants are required to mark the subjective mid-point of the line stimulus, placed horizontally in front of them, typically using the right dominant hand, which is unaffected by motor deficits in right brain-damaged

patients. The magnitude of the patients' rightward bias is influenced by stimulus length, typically with a disproportionately greater rightward error with longer lines, as compared to patients without neglect and control participants (Bisiach et al., 1983; Halligan & Marshall, 1989; Vallar, Daini, & Antonucci, 2000). This length effect may reflect a rightward attentional bias, whereby the right end of the line may disproportionately attract the patients' spatial attention.

In recent years, the bisection task has been considered a useful paradigm for investigating the spatial representation of written words. Fischer (1996) found that neurologically unimpaired participants exhibit a leftward bias (i.e., "pseudoneglect"), when setting the subjective mid-point of orthographic material, including words, pseudowords (i.e., legal, pronounceable non-words), letter strings, and symbols (Fischer, 2000b). Automatic lexical access may involve an attentional focusing on the beginning of words (Fischer, 1996, 2000a, 2000b, 2004), in order to establish a cohort of potential entries in the mental lexicon (Paap, Newsome, McDonald, & Schvaneveldt, 1982). Consequently, in participants who read from left to right, the extent of the initial part of a word would be over-represented, yielding a systematic leftward error in word bisection. According to this *Attentional Scaling Hypothesis*

<sup>☆</sup> This study was performed in partial fulfillment of the PhD program of L.V. G.V. was supported in part by FAR Grants from the University of Milano-Bicocca, and by Ricerca Corrente Grants from the IRCCS Istituto Auxologico Italiano.

\* Corresponding author at: Department of Neurorehabilitation Sciences, Casa Cura Policlinico, via Dezza 48, 20144 Milan, Italy. Fax: +39 0248593413.

E-mail address: [laura.veronelli@gmail.com](mailto:laura.veronelli@gmail.com) (L. Veronelli).

(Fischer, 1996) the greater leftward bias in bisecting English words showed by Hebrew-English bilinguals with right-to-left reading habits in their first language, as compared with native English participants, would be due to the higher cognitive load during lexical access in their second language (English). This spatial distortion could be also responsible, at least partially, for the leftward bias in oculomotor behavior during reading tasks, as it could reduce gaze duration, lexical decision and naming latencies (O'Regan & Jacobs, 1992; O'Regan, Lévy-Schoen, Pynte, & Brugailière, 1984). In a manual bisection task, Italian healthy participants show leftward biases for long words, pseudowords, consonant, and symbol strings, as well as for short and long lines; however, for orthographic and symbolic short sequences the bisection bias is rightwards (Arduino, Previtali, & Girelli, 2010). This result indicates that the general leftward bias in bisection ("pseudoneglect": Jewell & McCourt, 2000) may be modulated by linguistic factors, suggesting that the bisection of lines and of linguistic material involves processes that do not completely overlap (Fischer, 1996). In line with this view, right brain-damaged patients with left spatial neglect may show different patterns of impaired vs. preserved bisection performance for words and lines, further supporting the view that at least two types of processes (visuo-perceptual, for all types of stimuli; linguistic for letter and symbol strings) are involved, and may be differentially affected by left neglect (Veronelli et al., 2014).

The modulation by linguistic factors of the bisection bias of both unimpaired participants, and right-brain-damaged patients with left neglect is revealed also by the influence of ortho-phonological information contained in the final part of a word. Specifically, both right-brain-damaged patients with left neglect and neurologically unimpaired participants set the midpoint of Italian words stressed on the penultimate syllable more rightward than for words stressed on the antepenultimate syllable, in accord with the lexical information provided by stress position (more rightward for penultimate than for antepenultimate). Ortho-phonological information contained in the final part (right) of a word, which is likely to be comparatively more attended by patients with left neglect, may act as a cue during bisection (Veronelli et al., 2014).

In this study we aimed at extending the investigation of the role of linguistic and visuo-spatial factors from single written words (Veronelli et al., 2014) to written sentences, again using the bisection paradigm in right-brain-damaged patients and in neurologically unimpaired participants.

Experiment #1 assessed the role of linguistic information contained in the rightward final position of the sentence. There is evidence that the syntactic structure can reduce left-sided reading omission errors made by right-brain-damaged patients with left neglect dyslexia, namely: fewer word omission errors in sentences in which the final word is required by syntax, than in sentences that remain grammatical also without the final word (Friedmann, Tzailer-Gross, & Gvion, 2011).

In the present study we used Wh- interrogative sentences in both versions: where the subject is questioned, and thus with the object in final position in the sentence, and where the object is questioned. In the latter case, the object appears in an initial position in the sentence, rather than after the verb, where typically objects are found in Italian. Yes/No interrogative sentences and declarative sentences were also used. We predicted that when the object of a sentence was placed in the initial position (as in Wh- interrogative sentences where the object is questioned), patients could not find it on the right after the verb, and thus could be prompted to shift attention leftwards. This cue would reduce the rightward bisection bias, as compared to sentences with the object placed in final position. Furthermore, in written Italian the only difference between Yes/No interrogative sentences and

the corresponding declarative sentences is the presence of a question mark at the right end of the interrogative sentence. A difference in bisecting declarative vs. Yes/No interrogative sentences would suggest that the allocation of spatial attention is modulated by the status of the sentence (declarative vs. interrogative).

The control condition included unreadable letter strings, mimicking the visuo-perceptual structure of a sentence, in terms of spaces between words. Furthermore, a set of continuous lines was introduced as a baseline condition. Even if this point was not directly addressed by the present study, there could be a difference in bisecting sentences vs. letter strings, but also discrete letter strings vs. continuous lines (Arduino et al., 2010; Veronelli et al., 2014). Very few studies addressed this point in the literature. Lee et al. (2004) reported a systematic rightward error in the bisection of character and symbol strings in neurologically unimpaired participants, and a greater rightward displacement in right-brain-damaged patients with left neglect, as compared with solid lines. Mohr and Leonards (2007) replicated in healthy participants this rightward displacement using long letter strings in which words were inserted. The greater rightward bias when words are included was accounted for in terms of a greater contribution by left hemispheric processes (Bowers & Heilman, 1980), normally devoted to language processing, or by a greater demand on "local" attentional processes, also mainly supported by the left hemisphere (Martin, 1979). Furthermore, there is some evidence that patients with left spatial neglect may be more impaired at more "global", rather than "local", levels of information processing (Delis, Robertson, & Efron, 1986; Gallace, Imbornone, & Vallar, 2008). The activation of local processes may give leeway to right-brain-damaged patients with left neglect to perform a more extensive leftward exploration of letter strings, in comparison to standard line bisection.

## 2. Experiment #1. Materials and methods

### 2.1. Participants

Participants were recruited from the inpatient population of the Department of Neurorehabilitation Sciences of Casa Cura Policlinico, Milan, Italy. Eight right-brain-damaged patients with left unilateral spatial neglect (N+), eight right-brain-damaged patients without neglect (N-), and eight matched control participants (C) took part in the study. The 16 right-brain-damaged patients had suffered a ischemic cerebrovascular attack (two N+ patients an ischemic stroke with hemorrhagic infarction): eight N+ patients (six females; mean age 77.4 years, SD  $\pm$  5.95, range 68–86; mean years of schooling 8.0 years, SD  $\pm$  4.14, range 5–13; mean duration of disease 1.5 months, SD  $\pm$  0.76, range 1–3), and eight N- patients (two females; mean age 74.6 years, SD  $\pm$  7.33, range 61–87; mean years of schooling 9.6 years, SD  $\pm$  4.75, range 2–13; mean duration of disease 1.9 months, SD  $\pm$  2.10, range 1–7). The eight C participants (five females) had a mean age of 77.9 years (SD  $\pm$  5.46, range 70–85), and 8.8 mean years of schooling (SD  $\pm$  3.73, range 5–13). One-way analyses of variance (ANOVAs) showed that age ( $F_{2,23} = .62$ ;  $p = .55$ ;  $\eta^2 = .06$ ), and educational level ( $F_{2,23} = .30$ ;  $p = .77$ ;  $\eta^2 = .03$ ) did not differ among groups (N+, N- and C). Duration of the disease of N+ and N- patients was comparable (unpaired  $t$ -test:  $t_{14} = -.47$ ;  $p = .64$ ). Lesion site was assessed for each right-brain-damaged patient by CT or MRI scan, and drawn manually by LV, supervised by GV, using the MRIcro software (Rorden & Brett, 2000) onto selected horizontal slices of a standard template brain. The overlap lesion maps of the eight N+ right-brain-damaged patients, and of six out of the eight N- patients are shown in Fig. 1 (Experiment #1). In N+ patients lesions superimposed in the right putamen and in the white matter underneath the insula, the rolandic operculum and the precentral gyrus (four

Download English Version:

<https://daneshyari.com/en/article/7284656>

Download Persian Version:

<https://daneshyari.com/article/7284656>

[Daneshyari.com](https://daneshyari.com)