Brain and Cognition 84 (2014) 69–75

Contents lists available at ScienceDirect

Brain and Cognition

journal homepage: www.elsevier.com/locate/b&c

Prose Reading in Neglect

Nicoletta Beschin [a,b,*], Carlo Cisari [b], Roberto Cubelli [c], Sergio Della Sala [d]

[a] Clinical Neuropsychology Unit, Rehabilitation Department, Hospital S. Antonio Abate Gallarate, Varese, Italy
[b] Physical and Rehabilitation Medicine, Azienda Universitaria Osped. "Maggiore della Carità", Piemonte Orientale University, Novara, Italy
[c] Department of Psychology and Cognitive Sciences, Università di Trento, Italy
[d] Human Cognitive Neuroscience, Psychology, University of Edinburgh, Edinburgh, UK

ARTICLE INFO

Article history:
Accepted 6 November 2013
Available online 8 December 2013

Keywords:
Prose reading
Unilateral Spatial Neglect
Dyslexia
Text neglect
Cerebral lesions

ABSTRACT

Prose reading has been shown to be a very sensitive measure of Unilateral Spatial Neglect. However, little is known about the relationship between prose reading and other measures of neglect and its severity, or between prose reading and single word reading. Thirty participants with a first stroke in the right hemisphere and clear symptoms of spatial neglect in everyday life were assessed with tests of prose reading (text in one column book-like, and in two columns magazine-like), single words reading, and a battery of 13 tests investigating neglect. Seventy percent of these participants omitted words at the beginning of the text (left end), showing Prose Reading Neglect (PRN). The participants showing PRN differed from those not showing PRN only for the overall severity of neglect, and had a lesion centred on the insula, putamen and superior temporal gyrus. Double dissociations emerged between PRN and single word reading neglect, suggesting different cognitive requirements between the two tests: parallel processing in single word reading vs. serial analysis in text reading. Notably, the pattern of neglected text varied dramatically across participants presenting with PRN, including dissociations between reading performance of one and two columns text. Prose reading proved a complex and unique task which should be directly investigated to predict the effects of unilateral neglect. The outcome of this study should also inform clinical assessment and advises given to patients and care-givers.

1. Introduction

Patients with Unilateral Spatial Neglect (USN) (Chica, 2012) may commit errors when reading single words, sentences or texts (Ellis, Flude, & Young, 1987; Riddoch, 1990). This deficit has been termed "Neglect Dyslexia" (ND – for a recent review see Vallar, Burani, & Arduino, 2010) and can be observed also in patients without other manifestations of USN (Haywood & Coltheart, 2000; Warrington, 1990).

In word reading, errors include letter deletions ("*brain*" is read "*rain*"), substitutions ("*pen*" is read "*ten*") and, more rarely, additions ("*rose*" is read "*prose*"), involving the side of the stimulus contralateral to the side of the brain lesion (Arduino, Burani, & Vallar, 2002; Kinsbourne & Warrington, 1962; Lee et al., 2009). Single word reading is affected by perceptual, spatial and lexical factors: the size of the letters and the space between them (Behrmann, Moscovitch, Black, & Mozer, 1990), the stimulus orientation (Nichelli, Venneri, Pentore, & Cubelli, 1993) and its spatial location (Cubelli, Pugliese, & Gabellini, 1994), the lexical status of the stimulus (words tend to be read better than nonwords) and its morphological structure (Behrmann et al., 1990; Hillis & Caramazza, 1991). Research on single word reading has identified different profiles and provided important information to derive theoretical models of word recognition (e.g., Caramazza & Hillis, 1990).

ND encompasses also errors committed in reading sentences or texts. However, information about reading complex text is scant and derives mainly from clinical reports or anecdotal observations. In sentence reading, the words at the beginning could be omitted and/or misread (Tegner & Levander, 1991). For instance, the sentence "*In primavera gli uccelli costruiscono il nido*" [In spring birds make their nest] is read as "*iscono* [nonword] *il nido*" (Berti, Ladavas, & Della Corte, 1996) and the sentence "*There is nothing unfair about it*" is read as "*how about it*" (Hillis, 2006). The sentence reading task is included in a widely used screening battery for USN (Pizzamiglio, Judica, Razzano, & Zoccolotti, 1989) and appears to be rather sensitive: right brain damaged patients showing left neglect on this task ranged from 39.5% (Massironi, Antonucci, Pizzamiglio, Vitale, & Zoccolotti, 1988) to 41.8% (Zoccolotti et al., 1989). Reading performance is better with meaningful sentences than with meaningless jumble of words (Kartsounis & Warrington, 1989).

* Corresponding author. Address: Servizio Neuropsicologia, Dipartimento Riabilitazione, Azienda Ospedaliera S. Antonio Abate, Presidio Somma Lombardo, Via Bellini 2, Somma Lombardo, Varese, Italy.
E-mail address: nicoletta.beschin@aogallarate.it (N. Beschin).

0278-2626/$ - see front matter © 2013 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.bandc.2013.11.002

Paragraph or text reading also has been included in standard diagnostic batteries, e.g. the Behavioural Inattention Test (BIT – Wilson, Cockburn, & Halligan, 1987) or the French Test Battery (Azouvi et al., 2006). Typically, on this task patients do not read more than three (Kartsounis & Warrington, 1989) or five (Làdavas, Paladini, & Cubelli, 1993) words from the extreme right of each line. Text reading has been reported as an extremely sensitive test for left USN (Azouvi et al., 2006; Caplan, 1987; Schwartz, Ojemann, & Dodrill, 1997; Stone et al., 1991): over 46% of right brain damaged patients show left neglect on this task (Azouvi et al., 2006). Different patterns of performance have been reported: some patients omit approximately the same number of words in each line of the text (Kartsounis & Warrington, 1989) whereas other patients tend to produce more omissions and paralexias when reading the last lines than when reading the first ones (Ellis et al., 1987; Vallar, Guariglia, Nico, & Tabossi, 1996). Patients with USN may fail in reading texts but could perform flawlessly in reading single words (Làdavas et al., 1993). Notwithstanding this possible dissociation, it is widely assumed that ND is a unitary disorder; it derives that by assessing single word reading the diagnosis of presence or absence of ND can be made. Indeed, ND is often equated to poor performance on single word processing (e.g., Ward, 2010, p. 268).

In particular, little is known about the relationship between prose reading and other measures of USN and its severity, or between prose reading and single word naming. To address these pending issues is the aim of the present study.

2. Materials and methods

2.1. Participants

Thirty participants (18 men and 12 women), all Italian speakers, with a first stroke in the right hemisphere were recruited for the study according to the following inclusion criteria: (i) clear symptoms of USN in everyday life (Vossel, Weiss, Eschenbeck, & Fink, 2013) ascertained by means of the Catherine Bergego Scale (CBS), a questionnaire administered to care-givers based on direct observations of the patient's functioning in 10 daily situations (Azouvi et al., 2002; Azouvi et al., 2006); (ii) availability of morphological neuroimaging to confirm that the brain damage was due to a single lesion and to document its nature and localisation. A total of 18 participants had a haemorrhagic stroke, 12 had an ischemic lesion. The visual field of the participants was assessed clinically by means of the Confrontation Test (Bisiach, Cappa, & Vallar, 1983) and when doubts persisted also by means of a Goldmann Visual Field Test (Siverstone & Hirsch, 1986). Twenty-one of the 30 participants presented with signs of anosognosia for the everyday behavioural effects of their USN ascertained by the difference between their score on the CBS compared to that obtained from the professional caregivers or relatives (Azouvi et al., 2002; Azouvi et al., 2006). None of the patients had any known history of pre-morbid psychiatric or neurological diseases. The participants' mean age was 63.1 years (sd = 12.7; range: 40–86), they had on average 8.9 years of formal education (sd = 4.2; range = 5–18), and where assessed on average 75 days (sd = 118; range: 15–663) post onset. All participants formally consented to enter the experiment.

2.2. Methods

2.2.1. General neuropsychological examination

All participants underwent a brief standardised neuropsychological battery to assess general intellectual and executive abilities by means of verbal tasks. This battery included the Mini-Mental State Examination (Magni, Binetti, Bianchetti, Rozzini, & Trabucchi, 1996), the Verbal Judgement Task (Spinnler & Tognoni, 1987) and the Cognitive Estimation Test (Della Sala, MacPhearson, Phillips, Sacco, & Spinnler, 2003).

2.2.2. Assessment of Unilateral Spatial Neglect

Thirteen tests assessing USN were administered to all participants according to the standard procedures. These included: four cancellation tasks, whereby the targets were respectively Stars (Wilson et al., 1987), Lines (Wilson et al., 1987), Letters (Diller, Gerstman, & Gordon, 1974), or Circles (Ota, Fujii, Suzuki, Fukatsu, & Yamadori, 2001); three further cancellation tasks with the stimuli (Lines, Letters or Circles) grouped in two blocks separated by a gap as proposed by Driver and Halligan (1991); four drawing tasks requiring to copy a Complex Scene (Gainotti, Messerli, & Tissot, 1972), a Vase and Two Flowers (Halligan & Marshall, 1993) or Geometrical Shapes (Spinnler & Tognoni, 1987); a Line Bisection test (Wilson et al., 1987); and the verbal Description of a Complex Scene (Cocchini, Cubelli, Della Sala, & Beschin, 1999).

The tests were administered in a random order, in one or two sessions depending on the availability of the participant. The cut off score for the diagnosis of USN in each test was taken from the relevant literature or the standardised test manuals. The total number of tests performed below cut-off was used as measure of USN severity; the score of which therefore ranged from zero (no psychometric evidence of USN) to 13 (very severe USN).

2.2.3. Reading tasks

2.2.3.1. Single word reading. Participants were asked to read aloud three blocks of Italian words, each of 35 stimuli (words 5–14 letters long, printed in font Times New Roman size 12). In one block the words were presented one by one in the centre of a single A4 sheet, in the other two blocks, individual words were presented respectively on the right hand side and on the left hand side, along midline of the sheet. Each participant therefore read 35 words in each of three positions. The three blocks were presented randomly. According to the criteria of Ellis et al. (1987), paralexias were classified as left neglect errors if the target and the response were identical to the right of an identifiable neglect point and there were no letters in common to the left of this point. These errors denote Single Word Neglect (SWN).

2.2.3.2. Prose reading. Passages of prose were presented in two formats, book-style, i.e. with the text running continuously on one column, and magazine style, i.e. with the text distributed in two columns separated by a gap. The text was in Times New Roman 12.

2.2.4. Text on one column

Participants were asked to read aloud a short prose passage comprising 130 words distributed in 11 lines, each 142 mm long. Caplan (1987) posited that reading with both the left and right margin irregularly indented, i.e. less predictable, might prove more sensitive to the effect of USN (see also Bachman, Fein, Davenport, & Price, 1993). However, this assumption did not hold when experimentally tested (Towle & Lincoln, 1991). Moreover, we wanted the text to be as close as possible to a real text as encountered in everyday life. Therefore, for the purpose of this study, we used a standard, fully justified format.

Following Caplan (1987), participants were diagnosed as having Prose Reading Neglect (PRN) when they omitted sequences of words or individual words at the beginning (on the left) of at least one of the rows. Even the omission of the first letter of the first word was considered as indicative of PRN, provided that was not the only error type occurring, otherwise it would have been difficult to disentangle it from the effect of SWN. The length of omission in mm, and the number of incomplete lines were taken as measures of severity. These two measures captured the two spatial