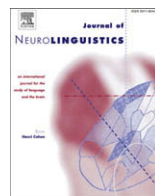




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Words and number words transcoding: A retrospective study on 57 aphasic subjects

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ABSTRACT

Alphabetically written numbers are of particular interest because they stand at the boundary between the domain of words and the domain of numbers whose dissociation has been repeatedly reported in single case studies.

In this retrospective study we analyze the performance of a series of left-brain-damaged aphasic subjects in reading aloud, repetition and writing to dictation of words and number words in order to explore in an unselected group of aphasic subjects the effect of the type of stimulus.

57 Aphasic subjects underwent a language examination test and a calculation and number processing battery that included repetition, reading aloud, and writing to dictation of words and number words.

Performance for words was better than performance for number words in all tasks, while writing to dictation was the more difficult task for both types of stimuli. An analysis of error type showed that phonological paraphasias were the most frequent error in word reading and repetition, whereas lexical substitutions were the most frequent error in number words reading and repetition.

This result supports the hypothesis of a dissociation between transcoding of words and number words: the analysis units appear to be phonemes in words transcoding and single digit words in number words transcoding.

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1. Introduction

Since the seminal report of Anderson, Damasio, and Damasio (1990) that showed a sparing of number reading and writing in comparison to letters and words in an aphasic patient, the notion that language and Arabic number knowledge represent distinct cognitive domains, requires specific processing resources and can be independently damaged by brain lesions slowly emerged and was firmly established.

Selective loss or preservation of the semantic domain of numbers has been repeatedly reported (Butterworth, Cappelletti, & Kopelman, 2001; Cipolloti, Butterworth, & Denes, 1991; Thioux et al., 1998).

Analogously, the experimental evidence that, even at the lexical level, numerals require specific processing mechanisms, different from those required for word processing, results from a number of recent case studies. Marangolo, Nasti, and Zorzi (2004) assumed that their patient, ZA, with impaired oral production of number words and relatively spared production of words had difficulty in accessing number words in the phonological output lexicon. Domahs, Bartha, Lochy, Benke, and Delazer (2006) described a case of primary progressive aphasia with spared semantic knowledge for numerals and concepts related to nouns and massive impairment in comprehension and naming of words but not of number words. This pattern of results was taken as evidence of damage to an amodal lexical layer between the semantic system and the four modality-specific word stores, with a selective preservation of numerals. DPI (Bachoud-Lévi & Dupoux, 2003), despite very good word reading and repetition, made a substantial number of phonological errors in object naming, while naming of number words, days and months was spared. The authors assumed that this pattern was a consequence of deficit at the level of phonological word form retrieval.

Reading aloud of number words has also attracted much attention and different mechanisms have been hypothesized for reading of words and number words. Cohen, Verstichel, and Dehaene (1997) suggested that, beyond the stage of lexical processing, the units of speech may differ between number words and words; as they put it “while phonemes are the building blocks of most words, one may say that ... individual number words are the building blocks of complex numerals” (p. 1058), whose phonemic or orthographic sequence is retrieved as distinct units, with segmental information already spelled out. This concept was recently reinforced by the report of a Wernicke’s patient described by Semenza et al. (2007), who showed a selective deficit in production of spoken word (naming and mostly reading) affecting vowels more than consonants, while production of number words was free from phonological errors.

Marangolo, Piras, and Fias (2005) described the case of an amonic patient who showed a selective deficit in the spoken production of numbers, while number writing and comprehension were spared, suggesting the existence of different modality-specific output lexicons for the written and spoken production of numerals. Denes and Signorini (2001) reported the case of a patient who showed a specific deficit in reading numbers, number words and nonwords: they assumed that “a common mechanism underlies the process of transcoding numbers (words) and nonwords: actually most numbers (words) are devoid of any meaning and are likely to be processed similarly to nonwords through a non semantic transcoding mechanism” (for a similar view, see also Mondini, Girelli, & Semenza, 1998).

Dissociations in the written output production are rare. Subject GC (Basso & Beschin, 2000) made very few errors in writing even long words to dictation but made frequent spelling errors in writing number words, as “due” (2) written “que” or “nove” (9) written “rove”.

So far, evidence that number words can be selectively impaired or spared at lexical and post-lexical stages of processing comes from single case studies, most of whom had reading impairments.

In this retrospective study we analyze the performance of a series of left-brain-damaged aphasic subjects in reading aloud, repetition and writing to dictation of words and number words. Aim of the study was to explore in a group of aphasic subjects the effect of the type of stimulus (words and numerals) in the three tasks.

2. Materials and methods

2.1. Subjects

Between 1991 and 1995, 165 left-brain-damaged subjects with at least 5 years of formal education were evaluated at the Aphasia Unit of the Department of Neurological Sciences of Milan University

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