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Journal of Neurolinguistics 19 (2006) 1–37

Journal of NEUROLINGUISTICS

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Number words are special: Evidence from a case of primary progressive aphasia

Frank Domahs[a,b,*], Lisa Bartha[c], Aliette Lochy[c,d], Thomas Benke[c], Margarete Delazer[c]

[a]*Lehr- und Forschungsgebiet Neuropsychologie, Universitätsklinikum der RWTH Aachen, Pauwelsstr. 30, D-52074 Aachen, Germany*

[b]*Kognitive Neurolinguistik, Universität Potsdam, Germany*

[c]*Universitätsklinik für Neurologie, Medizinische Universität Innsbruck, Austria*

[d]*F. C. Donders Centre for Cognitive Neuroimaging, Nijmegen, The Netherlands*

Received 4 February 2005; received in revised form 15 June 2005; accepted 12 July 2005

Abstract

We present a patient with primary progressive aphasia who showed no problems dealing with a variety of semantic tasks for simple nouns and numerical material. However, massive impairments became apparent in all lexical input and output tasks for non-number words, whereas peripheral processing was demonstrated to be intact. Interestingly, no parallel impairment was observed for numerals. This is the first case study reporting an isolated sparing of number words at the level of lexical processing in all four modalities.

Keywords: Primary progressive aphasia; Transcoding; Lexical impairment; Numerals

1. Introduction

Selective loss or preservation of certain classes of words or concepts in neurological patients has attracted a considerable amount of interest during the last few decades. From the thorough examination of such dissociations in patients important insights can be gained about the normal representation and processing of language related information.

* Corresponding author. Tel.: +49 241 80 89909.
E-mail address: domahs@neuropsych.rwth-aachen.de (F. Domahs).

0911-6044/$ - see front matter © 2005 Published by Elsevier Ltd.
doi:10.1016/j.jneuroling.2005.07.001

Concerning the semantic knowledge a huge body of evidence has been accumulated that several categories can be selectively impaired or spared (for reviews see Gainotti, 2002; Vinson, Vigliocco, Cappa & Siri, 2003). Furthermore, there are also reports about certain classes of words being selectively impaired or spared at lexical[1] or even peripheral processing stages without a parallel semantic deficit. As such cases provide important evidence about the organization of the lexical system, we will dedicate the first section of the introduction to shortly present current models of lexical processing. Afterwards, we will review cases which demonstrate the separation of numerical concepts within the semantic system. Finally, we will discuss relevant cases of category-specific deficits in the lexicons and beyond concerning numerical material.

1.1. Models of lexical processing

One of the most influential approaches to lexical processing, the 'lemma model' (Levelt et al., 1999), assumes two stages of lexical processing - an amodal 'lemma' level and modality specific 'lexemes' (see Fig. 1a)[2]. At the lemma level, word-specific morpho-syntactic information is stored and assigned. In German this would include, e.g., the gender of inanimate nouns or the plural formation of nouns. The independent network theory (IN; Caramazza and Miozzo, 1997; Rapp & Caramazza, 2002) does not include any amodal level of lexical processing but assumes modality-specific lexeme-levels only (see Fig. 1b). Recently, Lambon Ralph et al. (2001)proposed a more radical model of naming which does completely without any lexical level of processing (see Fig. 1 c)[3].

Crucially, the model of Lambon Ralph et al. (2001) and the IN model can easily account for category-and modality-specific impairments while they exclude amodal impairments exclusively caused by lexical deficits. According to the lemma model, however, amodal lexical impairments can be expected, leading to similar patterns of performance in all four modalities.

We will follow proposals on language processing which assume the existence of both lexical and sublexical routes of processing (Fig. 1 a and b; sublexical routes not depicted). While in the lexical route word-specific knowledge is processed, the sublexical route applies general rules to process unknown words or pseudowords.

1.2. Selective damage and preservation of numerical concepts

There is converging evidence that numerical knowledge can dissociate from non-numerical knowledge at the level of semantic processing. However, not all cases were reported in full detail (e.g., Diesfeldt, 1993). In some cases the dissociation between

[1] The term 'lexicon' refers to components storing ideosyncratic (especially morphosyntactic and phonological) knowledge about words. These modules can be thought to be distinct from the semantic system (s. Fig. 1 a and b).

[2] Actually, this model is only proposed to account for oral output. It can, however, be extended with some confidence into a multimodal model as depicted in Fig.1a. (For an extension in this sense to include writing see Caramazza and Miozzo, 1997.)

[3] These authors are actually silent about written language. However, following their logic, the model can be extended to include written modalities.