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Research report

The role of noun syntax in spoken word production: Evidence from aphasia

Ruth Herbert^{a,*} and Wendy Best^b

^aDepartment of Human Communication Sciences, University of Sheffield, UK

^bDepartment of Human Communication Science, University College London, Chandler House, London, UK

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ABSTRACT

We describe MH who presents with agrammatic aphasia and anomia, and who produces semantic errors in the absence of a central semantic impairment. This pattern of performance implies damage to syntactic processes operating between semantics and phonological output. Damage here may lead to lexical selection errors and a deficit in combining words to form phrases.

We investigated MH's knowledge and processing of noun syntax in mass and count nouns. She produced more count nouns than mass nouns. She showed impaired knowledge of noun syntax in judgement tasks and production tasks, with mass noun syntax being more impaired than count.

We interpret these results in terms of a two-stage model of lexical retrieval. We propose that syntactic information represented at the lemma level is activated even in bare noun production, and can be differentially impaired across noun categories. That same damage can lead to semantic errors in production. For MH limited syntactic options are available to support production, and these favour count noun production. The data provide a new account of output semantic errors.

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1. Introduction

Theories of spoken word production need to account for the patterns of impaired and intact linguistic processes found in people with aphasia. One account of spoken word production which has been very influential in this regard holds that a direct mapping is achieved from a semantic level, incorporating the meaning of the word, to a phonological level, where the word's sounds are stored (e.g., Morton, 1985; Caramazza, 1997). This model has dominated research and clinical work in aphasia, defining our understanding of aphasia and

influencing the way in which people with aphasia are assessed and treated.

There are many published case studies of people with anomia who present with a purely semantic deficit (e.g., JCU: Howard and Orchard-Lisle, 1984), those who present with a deficit in the phonological output lexicon (e.g., EE: Howard, 1995), those with a deficit in mapping between the two levels (e.g., GM and JS: Lambon Ralph et al., 2000; Cuetos et al., 2005), and those with a post-lexical deficit (e.g., NC: Martin and Saffran, 1992; Martin et al., 1994). This model has influenced the selection of therapy methods for both adults and children

* Corresponding author. Department of Human Communication Sciences, University of Sheffield, 31, Claremont Crescent, Sheffield S10 2TA, UK.

E-mail addresses: r.herbert@sheffield.ac.uk (R. Herbert), w.best@ucl.ac.uk (W. Best).

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(e.g., Nickels, 2002; Best, 2005). In addition the model accounts for error production in aphasia by postulating that semantic paraphasias arise due to damage at the semantic processing level and phonological paraphasias arise at a phonological processing level.

The deficit in mapping between the two levels of processing is of interest here. Patients with pure anomia, such as those described by Lambon Ralph et al. (2000) make very few semantic errors, readily reject the small number they do make, and, when they cannot name an item, they produce no response, or they attempt to describe the item. In other words, the deficit in mapping between the two levels does not result in significant numbers of semantic errors in such cases.

The same hypothetical level of deficit has also been claimed however, as the source of output semantic errors. Caramazza and Hillis (1990) described RGB and HW, who made semantic errors in oral naming, while showing no impairment on input tests of semantics. Their breakdown in spoken word production is thus located in the same functional site as that of people with pure anomia, i.e., between semantic and phonological processing, and yet results in a different pattern of output. Caramazza and Hillis (1990) explained such errors in terms of a response blocking mechanism, which prohibits access to the target phonological form, but allows access to a near semantic neighbour. If this is the case the question arises as to why such errors do not occur in pure anomia. The data from RGB and HW and from the similar cases reported since then (e.g., PH and NK: Hickin et al., 2002; Herbert et al., 2003) have placed a strain on the descriptive power of such models.

Two influential groups of researchers claim that an intermediate stage exists between semantic and phonological representations (Dell et al., 1997; Levelt et al., 1999). This has been labelled the lemma level (Kempen and Huijbers, 1983). According to the fullest articulation of their theory (Levelt et al., 1999; Indefrey and Levelt, 2004) the lemma node provides access to information about a word's syntax. In this account access to phonology from semantics is dependent upon prior access to the syntactic level. The importance of this intermediate lexical level for understanding aphasic word retrieval deficits is as follows: if there is obligatory access to this level in normal spoken word production, and this level can be damaged in aphasia, it follows that a specific pattern of deficit will result from the damage.¹

Incorporation of the lemma level into explanations of aphasic speech production offers three further possible deficit patterns: a deficit in access to the lemma, a deficit within the lemma level itself, and a deficit in accessing phonology from an intact lemma level. According to the theory a particular pattern of performance is associated with each level of deficit. There are published reports of the third functional lesion in processing nouns (e.g., Badecker et al., 1995), and verbs (Lee and Thompson, 2004), but few investigations have looked directly at lemma processing in aphasia. At the lemma level

lexical selection takes place, bound by semantic constraints from input processes and by syntactic constraints operating within the level. It is possible that the pattern of semantic output errors without a semantic processing deficit, seen in patients such as RGB and HW (Caramazza and Hillis, 1990), results from damage to the lemma level.

The lemma information for nouns includes the following: the syntactic class (noun, verb, adjective and so on); whether it is a count noun such as 'cat' or a mass noun such as 'rice'; and in certain languages the grammatical gender of the noun (see e.g., Bock and Griffin, 2000). This information allows a noun to be combined correctly with other word classes in a noun phrase. The lemma node thus provides access to syntactic features, which specify the combinatorial information necessary for the word's appropriate syntactic use, including access to noun phrase structures in syntax (see Cleland and Pickering, 2003, for an account of the interface between the lemma and syntactic structures).

Investigations into lemma level knowledge involve the experimental manipulation of these syntactic features. Two aspects of noun lemma information have been exploited in previous studies: grammatical gender, and the mass/count status of nouns. English no longer marks nouns for grammatical gender, however, there is a distinction between mass and count nouns, which is reflected in noun syntax. Syntactic rules govern the ways in which the two types of nouns combine with other words to make phrases. Count nouns can take a plural form (cat, cats), can be combined with both definite and indefinite articles (the cat, a cat), with denumerable quantifiers such as *many* and *few*, and with numerals (three cats), but not with non-denumerable quantifiers (such as *much*). Mass nouns cannot be pluralized (*rices), cannot take indefinite articles (*a rice), cannot be used with certain quantifiers such as *many*, or with numerals (*three rices), but can be combined with quantifiers such as *much*.² These differences can be exploited to investigate participants' access to lemma information.

There is evidence from normal speakers and from those with aphasia, of retained access to syntactic information, when phonology is not available. Normal subjects in tip of the tongue states are frequently able to report the grammatical gender of items they cannot name, knowledge of the words' phonological form being available partially or not at all (Caramazza and Miozzo, 1997; Vigliocco et al., 1997). Furthermore Vigliocco et al. (1999) report that normal participants have knowledge of the count-mass status of items for which they are in a tip of the tongue state. A small number of neuropsychological studies support the ToT findings. GM (Henaff Gonon et al., 1989), Dante (Badecker et al., 1995), and BA (Macoir and Béland, 2004) had marked word finding problems, but were able to correctly identify the grammatical gender of items they could not name. Vigliocco et al. (1999) describe the performance of MS who was able to identify whether an item

¹ There is also a debate on the nature of semantic representations and whether 'lexical semantics' and 'conceptual semantics' are separate (e.g., Best, 2000). This issue is not discussed here as it is beyond the scope of this paper which focuses on noun syntax in language production.

² There are contexts where use of numerals and a plural form of mass nouns may arise, such as ordering 'three coffees' (see Semenza et al., 1997 for a discussion of this). Such instances relate to particular usage to convey a different sense of the word. In the experiments conducted here the context was unambiguous and such usage was therefore inappropriate.

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