

Noun–verb dissociation in aphasia: The role of imageability and functional locus of the lesion[☆]

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Abstract

Aphasic patients occasionally manifest a dissociated naming ability between objects and actions: this phenomenon has been interpreted as evidence of a separate organization for nouns and verbs in the mental lexicon. Nevertheless Bird et al. [Bird, H., Howard, D., Franklin, S. (2000). Why is a verb like an inanimate object? Grammatical category and semantic category deficits. *Brain and Language*, 72, 246–309], suggested that the damage underlying noun–verb dissociation affects the corresponding *semantic* concepts and not the *lexical* representation of words; moreover, they claimed that many dissociations reported in literature are caused merely by a strong imageability effect. In fact, most authors used a picture-naming task to assess patients' naming ability, and due to the fact that this test involves the use of pictures to represent actions and objects, nouns were frequently more imageable than verbs [Luzzatti, C., & Chierchia, G. (2002). On the nature of selective deficit involving nouns and verbs. *Rivista di Linguistica*, 14, 43–71]. In order to overcome this drawback, we devised a new task – nouns and verbs retrieval in a sentence context (NVR-SC) – in which nouns and verbs have the same imageability rate. Patients' performance on this task is compared with that obtained by the same patients on a standard picture-naming task. Of the 16 aphasic patients with a selective verb deficit, as revealed by the picture-naming task, two continued to show dissociation in the NVR-SC task, while 14 did not. The data indicate that at least some patients have an imageability-independent lexical deficit for verbs. The functional locus/i of the damage is also considered, with particular reference to the *lemma/lexeme* dichotomy suggested by Levelt et al. [Levelt, W. J. M., Roelofs, A., & Meyer, A. S. (1999). A theory of lexical access in speech production. *Behavioral and Brain Sciences*, 22, 1–75].

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1. Introduction

Since the late 1960s, it has been widely accepted that cognitive models must explain pathological behaviour, as the latter is thought to reflect a normal cognitive system with specific modules partially or totally injured by cerebral damage.

[☆] This study was carried out at the Department of Psychology of the University of Milano Bicocca in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

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In this perspective, neuropsychological evidence is a crucial test for models based on data from normal subjects and is an important source of information about the human cognitive system; remarkable progress in understanding the mental organization of language has been made thanks to this methodology.

Specific deficits of single linguistic processing abilities (e.g. phonological, lexical or syntactic) have been observed, revealing the functional independence of the mental linguistic modules.

Lexical deficits may be even more selective: in particular, patients have been observed who suffered from a dissociated noun or verb impairment in tasks eliciting lexical retrieval (Caramazza & Hillis, 1991; McCarthy & Warrington, 1985; Miceli, Silveri, Villa, & Caramazza, 1984; Thompson, Shapiro, Li, & Schendel, 1994; Zingeser & Berndt, 1988).

According to Caramazza and coworkers (Caramazza & Hillis, 1991; Hillis & Caramazza, 1995; Rapp & Caramazza, 2002), dissociated impairments may be caused by damage, which selectively affects verbs or nouns at a late lexical stage (phonological or orthographical output lexicons). This conclusion is drawn from the fact that a noun–verb dissociation may appear in some linguistic tasks, but not in others: for instance, patient SJD suffered from verb impairment only in written naming and spelling to dictation, but not in oral naming and in reading; on the contrary, patient HW suffered from verb impairment in a spoken naming task, but not in the written version of the same task (Caramazza & Hillis, 1991). An even more striking pattern emerged in patient EBA (Hillis & Caramazza, 1995): this patient performed better on verbs than nouns in spoken production, and on nouns than verbs in written comprehension. This dissociation between written and spoken output and between production and comprehension has been accounted for by hypothesizing a multiple representation of grammatical classes (i.e. noun versus verb) in all four lexicons (orthographic and phonological input and output lexicons).

The interpretation of these findings offered by Caramazza and coworkers is arguably uneconomic. Why does the cognitive system need to represent information four times that might just as effectively be represented once? After all, we always use the same knowledge when we carry out syntactic processing, irrespective of whether we are speaking, understanding, reading or writing. In fact, several models of lexical access hypothesize unitary lexical–syntactic storage. Levelt and coworkers (Levelt, 1989; Levelt, Roelofs, & Meyer, 1999) proposed a lexicon model based on a first layer of representations storing/activating grammatical and conceptual information (*the lemma level*) and on a second more peripheral level where the phonological word form is represented (*the lexeme level*).

Shapiro and coworkers (Shapiro & Caramazza, 2003; Shapiro, Shelton, & Caramazza, 2000; Shapiro, Pascual-Leone, Mottaghy, Gangitano, & Caramazza, 2001) have suggested that selective damage of word forms is not the only cause of noun–verb dissociation. They observed some

patients who were selectively impaired either in producing the third person of a verb (and of non-words used as verbs) or the plural form of a noun (and of non-words used as nouns). They concluded that these patients had a selective “deficit in retrieving or manipulating syntactic features” of nouns or verbs (Shapiro et al., 2000). However, while these findings are per se very interesting, they do not directly account for noun–verb dissociation. The selective impairment of number features (which are generally held to be significant on nouns) versus person features (significant on verbs) or possibly of the corresponding rule (“inflect for number” versus “inflect for person”) might in principle leave the corresponding lexical categories unaffected. It is conceivable, in other words that a deficit might affect a morpheme (or a morphological rule) without impacting the lexical–syntactic category typically associated with that morpheme. It is also unclear how the deficit identified by Shapiro et al. could explain the difficulty encountered on the picture-naming task, in which the relevant morphemes are apparently not called upon.

The existence of a lexical–syntactic representation of grammatical class has been claimed by Berndt and coworkers (Berndt, Mitchum, Haendiges, & Sandson, 1997a, 1997b; Berndt, Haendiges, Burton, & Mitchum, 2002). They tested 10 aphasic patients using several tasks involving isolated words or sentences and deduced that the deficit causing noun–verb dissociation would concern a lexical device, either at an orthographic–phonological modality-specific level (i.e. the lexeme level in Levelt’s model) or at a unitary lexical–syntactic device (i.e. the lemma level in Levelt’s model). This claim is based on three major outcomes of the study. A qualitative error analysis brought to light a great number of semantic errors in some patients and an absence of such errors in others; some patients showed an important word frequency effect, while the imageability effect was significant in others; some patients had considerable deficits both in the production of well-structured sentences and in the comprehension of reversible sentences (two deficits typically related to lemma damage), while others did not. Taken as a whole, these results seem to indicate two different breakdown loci, with some patients having a lemma deficit, and others a lexeme deficit.

Bird and coworkers (Bird, Howard, & Franklin, 2000a, 2001, 2002; Bird, Lambon Ralph, Patterson, & Hodges, 2000b), on the other hand, argued that noun–verb dissociation might be a semantic, rather than lexical phenomenon. Moreover, they suggested that many dissociations might be generated by an increased level of sensibility in aphasic patients to a number of semantic differences and imageability in particular. In fact, since nouns refer to concrete objects, they usually have a higher imageability rate than verbs and tests used to assess noun–verb dissociation were frequently not matched for this variable. Furthermore, many studies showed imageability to be an important predictor of patients’ ability to retrieve words (e.g. Bates, Burani, D’Amico, & Barca, 2001; Berndt et al., 2002; Luzzatti, Raggi, et al., 2002).

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