

# Grammatical category ambiguity in aphasia

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## Abstract

This study asked whether aphasic adults show different noun/verb retrieval patterns based upon their clinical categorization as fluent or nonfluent. Participants selected either the noun or the verb meaning of target words, as presented in three contexts. The framework was that nouns (associated with temporal lobe function) are processed, stored, and retrieved separately from verbs (associated with frontal lobe function), implying separate status in the mental lexicon. Stimuli were homophonic homographs, words that are spelled and pronounced the same but which have different meanings (in this case, noun and verb meanings). Another contrast was the putative difference between systematic pairs (e.g., “kiss” and “farm”), in which noun and verb meanings are transparently related, and may be stored as a unit, and unsystematic pairs (e.g., “squash” and “sink”), in which noun and verb meanings are apparently unrelated, implying discrete storage. Results demonstrated significant interactions between fluent and nonfluent participants, suggesting that, as expected, fluent aphasic adults have more difficulty with nouns, nonfluent aphasic adults have more difficulty with verbs. There was no effect of systematicity. Contrary to expectations, verbs proved less vulnerable, rather than more vulnerable, to aphasic impairment.

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## 1. Introduction

The distinction between nouns and verbs is a fundamental property of human language, beginning with acquisition, demonstrated in normal usage, and often revealed in language breakdown (Koenig & Lehmann, 1996). Verbs have relational meaning, while nouns have meanings as referents or objects (Gentner, 1978; Reyna, 1987). Berndt, Mitchum, Haendiges, and Sandson (1997a) found that verbs are acquired later, are more difficult to process, have a greater range of meanings and are more difficult to comprehend than nouns. Nouns are processed more quickly (Gomes, Ritter, Tartter, Vaughan, & Rosen, 1997). Verbs are more complex syn-

tactically and morphologically (Bates, Chen, Tzeng, Li, & Opie, 1991).

Neurological studies indicate that there are different anatomical substrates for nouns and for verbs (Daniele, Guistolisi, Silveri, Colosimo, & Gainotti, 1994; Gomes et al., 1997; Kersten, 1998; Koenig & Lehmann, 1996; Pulvermuller, 1996; Silveri, Perri, & Cappa, 2003). Daniele et al. (1994) claimed that there are separate neural systems for the different categories, the temporal lobe for nouns, the frontal lobe for verbs. Warrington and McCarthy (1987) suggested that action verbs are processed in the motor channel. Damasio and Tranel (1993) proposed an interactive network rather than a fixed neural site for word forms. Experiments using event-related potentials (ERPs) suggested that different neural populations represent different word classes (Koenig & Lehmann, 1996). Pulvermuller, Preissi, Lutzenberger, and Birbaumer (1996) found stronger 30 Hz activity

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elicited by verbs over the motor cortices, while stronger responses were elicited by nouns at sites in the occipital lobes over visual cortices. Other studies, however (Hernandez, Dapretto, Mazziotta, & Bookheimer, 2001; Soros, Cornelissen, Laine, & Salmelen, 2003; Tyler, Ruszel, Fadili, & Moss, 2001) did not report an effect of word-class in healthy volunteers using functional neuroimaging.

Focal brain damage has produced selective deficits in either nouns (Wernicke's aphasia, anomia) or verbs (Broca's aphasia) (Bates et al., 1991; Berndt et al., 1997a, Berndt, Mitchum, Haendiges, & Sandson, 1997b; Lapointe, 1985; Miceli, Silveri, Villa, & Caramazza, 1984; Miceli, Silveri, Noncentini, & Caramazza, 1988; Silveri et al., 2003; Zingeser & Berndt, 1988, 1990). Bates et al. (1991) found a double-dissociation between object and action naming in Chinese Broca's versus Wernicke's patients. In Daniele et al. (1994), nonfluent patients had virtually no errors in noun production, while fluent noun-impaired patients had trouble with both nouns and verbs. Damasio and Tranel (1993) found that verb-impaired patients had left premotor cortex lesions; noun-impaired patients had damage to the left anterior and middle temporal lobe. Pulvermuller (1996) suggested that lesions in the frontal lobe produce problems with verbs whereas lesions in the inferior temporal lobe produce problems with nouns. In Caramazza and Hillis' (1991) patients, errors were not uniformly distributed across nouns and verbs, and reflected modality (writing versus speaking) as well as grammatical class. In that and other accounts by the same authors (Hillis & Caramazza, 1991, 1995), a patient retrieved the noun but not the verb meanings in written form, and showed the reverse impairment in speech, suggesting "that grammatical category information is represented separately and redundantly in each modality-specific lexical system." (Caramazza & Hillis, 1991, p. 789.)

The disparity between the two grammatical classes is clearly displayed in English homonyms, where the same word can serve as both noun and verb, depending on context. A subset of homonyms are homographs, words whose written form is the same, but whose pronunciation and meanings may vary. In the present study, we are looking at homographs which function as both verb and noun. These homographs are also homophonic, i.e., pronounced the same. In this subset is yet another dichotomy, systematic versus unsystematic homographs. In systematic homographs, the noun/verb connection is transparent: kiss/kiss (coupling henceforth to be understood as "to kiss" [verb]/"the kiss" [noun]), plow/plow; unsystematic homographs have no apparent connection between noun and verb forms: squash/squash (action and vegetable) or steer/steer (action and animal). Rubenstein, Garfield, and Millikan (1970) and Rubenstein, Lewis, and Rubenstein (1971), suggested that with systematic homographs, both forms, noun and verb, are

stored as a unit. In contrast, Forster and Bednall (1976) and Hagoort (1990) propose a model in which the verb meaning and the noun meaning of a homograph are stored separately.

Homographs are ubiquitous in the English language; Twilley, Dixon, Taylor, and Clark (1994) reported that as many as 44% of a random sampling of English words, and 85% of a sample of high-frequency English words had more than a single meaning. Homographs are typically responded to more rapidly than are words with a single meaning (Kellas, Ferraro, & Simpson, 1988; Nelson, McEvoy, Walling, & Wheeler, 1980; Rubenstein et al., 1970, 1971). With respect to frequency of occurrence, surveys by Twilley et al. (1994); Kruez (1987), and the present authors suggest that primary associations favor the noun meaning, and that noun meanings are of higher frequency than verb meanings in 75% of the cases. Analysis reveals that systematic homographs outnumber unsystematic homographs by a ratio of approximately four to one. Consulting Francis and Kucera (1982) as to overall representation of nouns and verbs, we find that nouns comprise 60% of the sum of nouns and verbs, verbs 40%.

In Rubenstein et al. (1971), frequency of meanings was significant in recognition of unsystematic homographs only; systematic homographs do not differ from nonhomographs. One implication of this finding is that with systematic homographs, both forms, noun and verb, are stored as a unit. In contrast, Forster and Bednall (1976) and Hagoort (1990) claimed that the two meanings of a homograph are accessed independently. This conclusion would accord with a model in which the verb meaning and the noun meaning of an unsystematic homograph are stored separately. With respect to aphasia, it has been shown that aphasic subjects were less able than normal subjects to retrieve the various meanings of homographs (Pierce, 1984; Sherman & Schweickert, 1989). A basic question is whether the effects of aphasic damage are so potent that they override frequency of occurrence, the most robust factor in word retrieval, in determining the choice of grammatical class by a given subject. This robustness has been demonstrated in studies with nonimpaired populations (Bradley, 1980; Rubenstein et al., 1970) as well as in studies of subjects with aphasia (Berndt et al., 1997a, 1997b; Zingeser & Berndt, 1988, 1990).

The purpose of this study was to investigate the effects of grammatical class, using noun/verb homographs framed in three syntactic contexts, asking whether differential aphasic damage results in a difference in the retrieval of nouns and verbs, using systematic versus unsystematic homographs as variables. The hypotheses were that fluent aphasic adults would tend to select verb meaning over noun meaning, whereas nonfluent aphasic adults would do the opposite; that the effect of frequency would prevail; that systematicity would

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