

# Semantic, lexical, and phonological influences on the production of verb inflections in agrammatic aphasia

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## Abstract

Verb inflection errors, often seen in agrammatic aphasic speech, have been attributed to either impaired encoding of diacritical features that specify tense and aspect, or to impaired affixation during phonological encoding. In this study we examined the effect of semantic markedness, word form frequency and affix frequency, as well as accuracy and error patterns, in an attempt to evaluate whether diacritical or affixation operations are impaired. Verb inflections (*V + ing*, *V + ed*, *V + s*, and *V stem* in present progressive, past, present 3rd person singular, and future tense contexts, respectively) were elicited in eight mild-moderate agrammatic aphasic individuals in a sentence context using a picture description task. Results revealed that the majority of verbs produced were affixed (75%) although accuracy was low (36%). Word form frequency was found to be a significant predictor of the accuracy with which verb inflections were produced; while affix frequency and semantic markedness were not found to influence accuracy. These results suggest that a diacritical deficit is more likely to undermine the production of verb inflections than a affixation deficit, and indicate that when diacritical processes are compromised, word form frequency is likely to influence production of verb inflections in agrammatic aphasia.

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## 1. Introduction

An impairment in the production of inflectional morphology is one of the characteristic features of agrammatic Broca's aphasia and this has been the focus of much research in the past two decades. In English speaking individuals with agrammatic aphasia, a deficit in producing inflectional morphology is manifested as verb inflection errors, frequently in the form of omissions of inflectional affixes and overuse of the *ing* form of the verb (*V + ing* as in *kicking* and *smiling*) (De Villiers, 1974; Goodglass, 1976). Across most languages studied, difficulty with verb inflections is largely restricted to features of tense and

aspect with relative sparing of subject verb agreement (Benedet, Christiansen, & Goodglass, 1998; Friedmann & Grodzinsky, 1997; Goodglass, Christiansen, & Gallagher, 1993). However, the underlying source of tense/aspect errors is unclear.

The mental operations involved in the production of inflected verbs are generally believed to include two crucial processes: selection of diacritical features and concatenation of verb stems with affixes (Levelt, 1989; Levelt, Roelofs, & Meyer, 1999). The term *diacritics* was used by Levelt (1989) to refer to segments of the speaker's message that are typically conveyed by inflectional affixes (e.g., tense, aspect, mood, person, and number). For the production of inflected verbs in English, conceptual and semantic information is used to specify diacritical features that indicate tense and aspect, such as +PAST or +PROGRESSIVE. According to Levelt, selection of diacritical features determines which verbal affix is retrieved from the mental lexicon (*ed* for +PAST and *ing* for

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+PROGRESSIVE and so on).<sup>1</sup> Thus, production of regular verbs is believed to proceed by locating the lexical entries of the verb stem and the appropriate inflectional affix. This is followed by concatenation of the verb stem and the inflectional affix(es), which then receive a phonological form (Janssen, Roelofs, & Levelt, 2002; Levelt et al., 1999). As per Levelt and colleagues, selection of diacritical features and relevant verbal affixes is considered a pre-phonological process, while affixation occurs during phonological encoding.

The process of selecting the exact tense/aspect diacritic necessitates a degree of precision that may be problematic for individuals with agrammatic aphasia. Retrieval of the exact inflectional affix on the basis of the selected diacritical feature(s) also demands specificity and is a potential locus of breakdown for individuals with verb inflection errors. Indeed, a number of investigations of verb inflections have implicated such pre-phonological morphosyntactic operations (Badecker, 1997; Bastiaanse, 1995; Luzzatti & Blesser, 1996; Miceli & Caramazza, 1988). Support for difficulty in relating tense/aspect features to specific verb forms comes from more constrained tasks such as reading, where aphasic individuals have been reported to produce verb stems for both regular (e.g., *talk-talked*) and irregular (e.g., *take-took*) inflections (Badecker, 1997). Conversely, the phonological process of affixation of a verb stem with an inflectional affix(es) could be a source of difficulty. Past research has implicated such a morphophonological deficit (Badecker & Caramazza, 1991; Kean, 1977; Nadeau & Rothi, 1992; Ullman et al., 1997). The frequent occurrence of verb stems in agrammatic narrative speech (De Villiers, 1974; Goodglass, 1976) has been taken as evidence for a failure of affixation. In other words, verb inflection errors observed in agrammatic aphasia could potentially arise from a deficit of either diacritical (i.e., pre-phonological), or affixation (i.e., phonological) operations. This study attempts to elucidate whether verb inflection errors denoting tense in English speaking agrammatic aphasic individuals are due to a diacritical deficit or due to a difficulty with affixation.

Different predictions can be made about error patterns resulting from diacritical and affixation deficits. In the case of a diacritical deficit, there is a failure to select semantically and syntactically appropriate diacritic features, and/or failure to utilize diacritical feature infor-

mation to retrieve the exact affixes. Hence verb inflection errors are most likely to result in inflectional substitutions. Production of verb inflections may be determined by ease of lexical access, rather than semantic and syntactic appropriateness since the process of specifying diacritical features is either ineffective or erroneous. Two factors that could influence 'ease of lexical access' are semantic markedness (Lapointe, 1985; LaPointe & Dell, 1989; Wunderlich, 1995), and frequency of occurrence.

Lapointe (1985) suggested that the mental lexicon may be organized along a semantic dimension and proposed a hierarchy of verb groups. The hierarchy was based on the complexity of semantic notions expressed by verb forms (attitude, voice, aspect, tense, and agreement) and the complexity of derivational properties of verb forms. Thus, for example, passive voice is more marked (i.e., complex) than active voice, and past tense is more marked than present tense. Lapointe proposed that accessing more marked inflections placed greater processing demands on mental mechanisms than accessing less marked inflections. According to this hierarchy, verb stems are the least marked and hence engage in a minimal processing load, followed by present progressive tense (expressed by the affix *ing*), present third person singular tense (expressed by the affix *s*), and past tense (the affix *ed*) in that order. Lapointe assigned numerical values to represent the amount of processing resources required to access each verb form (see Table 1). The central claim of this proposal is that verb inflection errors in agrammatic aphasia result from a reduction in available processing resources which limit the ability to perform an extensive search through the mental lexicon. This results in verb form substitutions that abide by the proposed semantic markedness hierarchy. Therefore less marked verb forms are produced in the place of more marked verb forms since the former require fewer processing resources. Hence verb stems are produced more often than inflected verbs.

Lapointe's (1985) semantic markedness hierarchy predicts that verb stems,  $V + ing$ , and  $V + s$  verb forms will be substituted for a past tense ( $V + ed$ ) target, but  $V + ed$  forms will not be substituted for verb stem,  $V + ing$ , and  $V + s$  targets since  $V + ed$  is the most marked verb form. Similarly, verb stems and  $V + ing$  will be substituted for  $V + s$  targets and only verb stems will be substituted for  $V + ing$  targets. Lapointe (1985) analyzed the narrative speech of two Italian agrammatic

<sup>1</sup> According to some authors, the mental lexicon consists of both inflected verbs as well as verb stems (Joanisse & Seidenberg, 1999; Stemmer, 1985). Production of inflected verbs therefore involves retrieval of a single lexical unit. In this view, a single lexical entry representing the whole inflected word is retrieved. Pinker and Ullman (2002) point out that regular verbs might be stored since human memory can store verbal material such as idioms. However, even if inflected verbs are represented in the mental lexicon, there needs to be a stage during production where diacritical features are used to select and retrieve the appropriate inflected verb.

Table 1  
Numerical values of "energy units" involved in the production of each verb form assigned by Lapointe (1985), and the frequencies (per million words) of the different verbal affixes from the Francis and Kucera (1982) database

	V stem	ing	s	ed
Energy units	1	2	2.5	3.5
Frequency	—	18,210	7649	26,199

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