Verb Inflection and the Hierarchy of Functional Categories in Agrammatic Anterior Aphasia

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Impairments of inflectional morphology and of syntactic ''function words'' are associated in agrammatic aphasia, as revealed by patterns of omissions and substitutions (see Goodglass, 1993). A unified account of this deficit from the perspectives of both grammatical theory and neuropsychol-

ogy has been elusive. We posit that a grammatical dysfunction of concatenation and/or of movement in agrammatic anterior aphasia impairs the computation of the syntactic hierarchy of functional categories and that this impairment can explain observed patterns of errors.

The class of syntactic theories known as the Principles and Parameters Framework (including recent extensions such as Minimalism) (e.g., Chomsky, 1995) posits that sentence computation involves the manipulation not only of lexical categories such as nouns and verbs, but also of functional categories. These largely correspond to function words and, crucially, can also license inflection (e.g., tense, agreement). Therefore a deficit in the syntactic manipulation of functional categories should impair not only function words, but also inflectional affixes (e.g., *-ed*) and nonaffixal inflection (e.g., past-tense irregulars). Most importantly for our purposes, functional categories are concatenated stepwise into hierarchical structures, from subordinate (lower) to superordinate (higher) categories. Likewise, they trigger verb movement stepwise from subordinate to superordinate categories (Chomsky, 1995). An impairment of the operations of concatenation and/or movement should lower the likelihood of success of each such operation. Because fewer such operations are necessary to compute lower than higher categories, the lower the category, the easier it should be to compute.

In English, the bottom-up order of categories in the syntactic hierarchy proceeds from the lexical category of verb (V^0) to the functional categories of (present and past) participial inflection (Asp^0), tense (T^0), and then agreement (Agr^0). We therefore predict that agrammatic anterior aphasia should be associated with greater success at the computation of unmarked forms (e.g., walk, drive) than of participial forms (walking, driven), than of tensed forms (walked, drove), than of 3sg forms (walks, drives).

Method. We investigated verb inflection errors of nonfluent (agrammatic) anterior aphasics and fluent posterior aphasics in (1) the elicited past-tense production of 20 regular and 16 irregular verbs in sentence contexts (''Every day I dig a hole. Just like every day, yesterday I ____ a hole.'') and (2) the isolated word reading of 17 irregular and 17 regular past-tense forms (see Ullman et al., 1997). The reading task examined whether syntactic categories underlie the processing of isolated inflected words. We examined errors of both affixal and nonaffixal (irregular) inflection. The production task was completed by two anterior and six posterior aphasics and the reading task by nine anterior and five posterior aphasics.

Results. For the anterior aphasics as a group, both the production and the reading tasks yielded the predicted error pattern of unmarked $>$ participial $>$ *-s*-suffixed. This pattern held for individual subjects as well; the only exceptions were two subjects with an unmarked $<$ participial pattern and one with a participial $<$ *-s*-suffixed pattern. The posterior aphasics did not show the same pattern as the anterior aphasics. They had a much lower rate of unmarked responses, there was no consistent relation between their re-

TABLE 10
Error Rates as Percentages of Items over Regular and Irregular Verbs

	Non-fluent anterior aphasics		Fluent posterior aphasics	
	Production	Reading	Production	Reading
Unmarked	29%	22%	7%	3%
Participle	20%	4%	0%	4%
-ing-suffixed	17%	3%	0%	4%
-en-suffixed	3%	1%	0%	0%
-s-suffixed	0%	1%	0%	0%

Note. Error rates for *-en*-suffixed forms were calculated over irregular verbs.

sponse rates for unmarked and *-ing*-suffixed forms, and they produced no *-en-* or *-s*-suffixed forms (see Table 10).

Discussion. Whereas the anterior aphasics' high rate of unmarked errors in the production task may be attributed in part to the fact that stems were provided, this cannot explain their similarly high rate of unmarked forms in the isolated-word reading task. Importantly, a third of their unmarked errors in both tasks were produced on irregular items. This shows that not all of the unmarked errors can be attributed to an impairment of morphological affixation. Furthermore, the high rate of unmarked errors on irregular items in the reading task shows that the unmarked forms cannot be fully explained by a tendency for the aphasics to stop reading once a well-formed word is encountered (e.g., *walked*). Finally, the inflectional errors on irregular verbs argue against a purely phonological explanation of the anterior aphasics' deficit (Kean, 1977). The distinct response pattern of the posterior aphasics suggests that they are not afflicted with the hypothesized impairment of concatenation and/or movement.

Conclusion. We have offered evidence that the pattern of inflectional errors in agrammatic anterior aphasia (but not posterior aphasia) reflects the hierarchical order of functional categories in syntactic structure, both in sentence contexts and, somewhat surprisingly, in isolated-word reading. These results are predicted by our proposal of an impairment of concatenation and/or movement in anterior (but not posterior) aphasia. They are also consistent with the hypothesis that higher projections are particularly impaired in agrammatism (Friedmann & Grodzinsky, 1997; Hagiwara, 1995) and with the view that agrammatic deficits are due to working memory or processing limitations (e.g., Just & Carpenter, 1992). However, the fact that the anterior (but not posterior) aphasics reported in this study also had greater difficulty producing and reading regular than irregular past tenses (Ullman et al., 1997) seems to suggest an impairment of concatenation, both in morphology and

in syntax. Finally, the contrasting patterns found for the anterior and posterior aphasics support the view that left anterior brain structures play a particularly important role in concatenation.

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