Production of non-canonical sentences in agrammatic aphasia: Limits in representation or rule application?

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Abstract

The study reported here compares two linguistically informed hypotheses on agrammatic sentence production, the TPH [Friedmann, N., & Grodzinsky, Y. (1997). Tense and agreement in agrammatic production: Pruning the syntactic tree. *Brain and Language, 56*, 397–425.] and the DOP [Bastiaanse, R., & van Zonneveld, R. (2005). Sentence production with verbs of alternating transitivity in agrammatic Broca's aphasia. *Journal of Neurolinguistics, 18*, 59–66]. To explain impaired production of non-canonical sentences in agrammatism, the TPH basically relies on deleted or pruned clause structure positions in the left periphery, whereas the DOP appeals to limitations in the application of movement rules. Certain non-canonical sentences such as object-questions and object-relative clauses require the availability of nodes in the left periphery as well as movement to these nodes. In languages with relatively fixed word order such as English, the relevant test cases generally involve a coincidence of left periphery and movement, such that the predictions of the TPH and the DOP are identical although for different reasons. In languages with relatively free word order such as German, on the other hand, it is possible to devise specific tests of the different predictions due to the availability of scrambling. Scrambled object sentences, for example, do not involve the left periphery but do require application of movement in a domain below the left periphery. A study was conducted with German agrammatic subjects which elicited canonical sentences without object movement and non-canonical scrambled sentences with object movement. The results show that agrammatic speakers have a particular problem with the production of scrambled sentences. Further evidence reported in the study from spontaneous speech, elicitation of object relatives, questions and passives and with different agrammatic subjects confirms that non-canonical sentences are generally harder to produce for agrammatics. These findings provide evidence in favor of the DOP and it will be argued that a cross-modal explanation of agrammatic deficits is possible if two factors—movement and canonicity—are taken into consideration.
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1. Introduction

Classically, agrammatic aphasia is defined as a predominant production disorder. The spontaneous speech is non-fluent and syntactically simplified in the sense that the length of a sentence is reduced (in terms of number of words which are produced) and/or that more complex structures such as embedded clauses are more or less absent in the agrammatic speech. Furthermore, agrammatic pro-

duction is characterized by specific problems with grammatical words (or functional elements). These problems are particularly apparent with inflectional endings, which are often omitted if the omission of the suffix leads to a root which can serve as a legal word. This type of speech is typically referred to as "telegraphic style", a label that has been extended to the agrammatic production in general, including agrammatism in morphologically richer languages such as Russian or German, where roots are often not legal words and inflectional endings are substituted by the citation form rather than omitted (e.g. Goodglass & Berko, 1960; Goodglass, 1976; Grodzinsky, 1984; Leuninger, 1989).

Besides the deficits in production, impairments in comprehension are also part of the definition of agrammatic aphasia. Furthermore, these deficits may be highly selective. Whereas comprehension at the word level is generally uncompromised, deficits have frequently been observed at the sentence level (Caramazza & Zurif, 1976). Impairments at this level do not seem to be total but are often restricted to a specific type of sentence, namely, non-canonical semantically reversible sentences (i.e. clauses in which both NPs are potential agents and in which the subject, the object and the verb do not follow a basic language-specific order).

Are similar specific problems with non-canonical sentences also observable in production? Evidence that this is the case has recently been provided in a study by Burchert, Swoboda-Moll, and De Bleser (2005), where spontaneous speech samples of eight German speaking agrammatic patients (MP, AF, WR, JK, JR, RK, WE and RG) were analyzed with respect to the production of canonical (SVO) and non-canonical (XVS) main clauses. The samples were gathered in interviews each lasting between 7 and 10 min. The results demonstrated that the agrammatic group produced significantly more canonical than non-canonical classifiable main clauses (SVO: mean 68%, XVS: mean 32%; Wilcoxon, $Z = -2.197$, $p = .028$). A comparison with a control group of two native German speakers from the Menn and Obler corpus (Menn & Obler, 1990), on the other hand, showed that such a dissociating pattern could not be observed in normal speech. Unimpaired subjects used a comparable amount of canonical (mean 52%) and non-canonical (mean 48%) sentences. On an individual basis, 5/8 agrammatic patients showed a significant difference (χ^2) in favor of canonical SVO sentences (AF, WR, JK: $p < .001$; JR: $p = .03$; RK: $p = .01$) whereas none of the control subjects showed this pattern. A similar result was obtained in an elicitation task (Schröder et al., 2005; Stadie et al., in press) with 15 German control subjects and seven agrammatic patients (six of these were identical to the spontaneous speech population mentioned above). The production of three types of non-canonical sentences (object-relative clauses, object-questions and passives) in seven agrammatic subjects was tested in a baseline assessment prior to a syntactic treatment study of non-canonical sentences. The results of the baseline assessment are summarized in Table 1.

Table 1 shows that the seven agrammatic subjects as a group performed very low on all of the non-canonical sentence types as reflected by the mean values of correct responses (obj-questions: 2.7/40; obj-relatives: 6.6/40; passives: 9.6/40). A generally low performance could also be observed on an individual basis. However, the performance of one patient (AF) was relatively high on passives (75% correct responses) compared to the other non-canonical sentences. Interestingly, a reverse picture was found in another patient (JR), who scored relatively high on obj-relatives (70% correct responses) and was low on passives and obj-questions. The individual results are summarized in Fig. 1. Control subjects, on the other hand, performed relatively high on each of the sentence types as reflected by the mean values of correct responses (obj-questions: 39.3/40; obj-relatives: 34.3/40; passives: 39.2/40).

How can these specific impairments for the production of non-canonical sentences be explained? There are basically two groups of linguistically informed theories which offer explanations for agrammatic production deficits at the sentence level. A first set of linguistic theories links production impairments to syntactic structures and the hierarchical organization of syntactic nodes within these structures (Friedmann & Grodzinsky, 1997; Grodzinsky, 2000; Hagiwara, 1995). The basic assumption of Hagiwara's hypothesis and Friedmann and Grodzinsky's Tree-Pruning Hypothesis (TPH) is that elements which rely on higher syntactic nodes (i.e. positions in the left periphery of sentences such as *wh*-words or complementizers) are more prone to impairments than those requiring lower nodes (such as VP). The TPH was originally designed to explain highly selective impairments in the production of inflectional morphemes in a hierarchical configuration. It was proposed that, since Tense morphemes are higher up in the syntactic tree than Agreement morphemes, they may be specifically impaired. Later on, the TPH was extended to explain the agrammatic production pattern of different sentence types as well. Its prediction, then, was that agrammatic speakers would either be completely unable or find it harder to produce structures such as relative clauses and *wh*-questions compared to canonical Subject–Verb–Object (SVO-) sentences (and not vice-versa), as only the former but not the latter require higher nodes in the syntactic tree. This prediction was, in fact, supported by several studies (Burchert et al., 2005; Friedmann, 2002; Stadie et al., in press).

It should be stressed that the TPH does not make any prediction in terms of a contrast exclusively between canonical and non-canonical sentences in production comparable to comprehension but solely in terms of structure. For example, subject-relative clauses, which are canonical structures, are predicted to cause similar problems as object-relative clauses, the non-canonical counterpart, since both require the highest CP-node in the tree. Similarly, the TPH predicts an asymmetrical dissociation between the production of passives (non-canonical sentences), which are located lower in the tree and relative clauses (either canonical or non-canonical) in the upper part. Therefore, dissociating patterns are predicted even within non-canonical sentences. Non-canonical passives should be easier to produce than non-canonical relatives due to their location in the tree. A pattern in which passives are more affected than relatives is not predicted (Friedmann, 2006) but was in fact reported for at least one patient in Stadie et al. (in press), as shown in Fig. 1.

In conclusion, syntactic impairments according to the TPH are defined in terms of non-existing (pruned) or underspecified nodes in the left periphery of syntactic trees, basically the complementizer phrase CP or even