

From theory to practice: treatment of agrammatic production in Hebrew based on the Tree Pruning Hypothesis

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Individuals with agrammatic aphasia show a variety of deficits in syntactic abilities. They fail to inflect verbs correctly, their speech lacks well-formed complex sentences such as relative clauses and sentential complements, and they avoid Wh questions or produce them incorrectly [1-3]. In the current study we examined which of these abilities should be treated first, based on a syntactic account for the agrammatic production, the Tree Pruning Hypothesis (TPH), as well as on new data regarding the syntactic characterization of degrees of agrammatic severity.

According to the TPH [4,5], the underlying deficit in agrammatism is the inability to build the syntactic tree up to its highest node, which renders the agrammatic tree pruned from a certain node and up. This causes an impairment in tense inflection, sentence embedding and Wh questions that all rely on high nodes of the tree, while abilities that rely on lower nodes such as subject-verb agreement and object case marking remain intact. Crucially, the impaired syntactic abilities rely on two different high nodes in the tree. Tense inflection resides in the tense phrase node (TP), and embedding and Wh questions reside in a higher node, the complementizer node (CP).

According to linguistic theories [6], when a syntactic node is present and well-formed, all nodes below it should be present too, whereas the existence of a low node does not guarantee the existence of higher nodes. This can be seen clinically in the patterns of impairment of mild and severe agrammatic patients. Severe agrammatic patients show a profound deficit that implicates both lower and higher nodes (tense inflection as well as subordination and questions are impaired), so their tree is pruned in a low node, while milder patients are impaired only in the highest node (deficit in embedding and question production, with relatively intact verb inflection). However, no agrammatic patient shows an intact high node with impaired lower node [5].

If the projection of the highest node indeed entails the projection of lower nodes, an interesting direction for agrammatic therapy follows. It suggests that treating structures that rely on the highest nodes will result not only in better access to the highest nodes themselves but it might also result in better access to lower nodes, even without direct treatment of these lower nodes. On the other hand, treatment of low nodes would not necessarily have an effect on higher nodes.

This study examined the efficiency of treating the higher ability first. We provided treatment for the highest node by Wh-question production therapy, and tested syntactic abilities that are related to lower nodes of the tree, such as sentence embedding and tense inflection.

Method

Question production was assessed before and after treatment using an elicitation test.

In addition, verb inflection, verb retrieval and sentence embedding were tested before and after treatment using a set of structured tests that included completion, elicitation and repetition tasks, as well as picture description.

The Wh-question production treatment focused on 4 types of questions (who, what, when, and where). The treatment procedure began with Wh morpheme selection training (“who” is used for a person, “what” for a thing etc.). The next stage was based on an adaptation to Hebrew of the syntactic treatment method developed by Thompson, Shapiro and their group [3,7,8], and included thematic role identification, followed by training of insertion and movement of the Wh morpheme. During the 3 months of treatment only question production treatment was given, and no other syntactic ability was treated.

Patient

RN was a 30 years old Hebrew-speaking male who suffered left frontal CVA with infarct in the area of the left middle cerebral artery 5 years prior to treatment. During these years he was constantly treated, but never before treated for question production. His speech was non-fluent with short, mainly ungrammatical phrases, limited use of verbs, and almost no correct use of Wh-questions and embedded structures. RN was diagnosed as Broca’s aphasic with agrammatism by the Hebrew diagnostic batteries ILAT (Israeli Loewenstein Aphasia Test, [9]) and BAFLA [10].

Results

Question elicitation Following the treatment period, the patient's question production improved considerably. From the low baseline of 24% (15/62) correct Wh questions in the question elicitation test before treatment, the patient improved to 89% correct (57/64) after treatment. This difference was significant $\chi^2=54.11$, $p<<0.0001$.

Verb inflection Not only question production improved following the question production treatment. Crucially, syntactic abilities that relate to lower nodes in the syntactic tree improved as well. The correct production of tense inflection increased from 76% (96/126) on verb completion task prior to treatment, to 91% correct (151/166) following treatment. This difference was significant ($\chi^2=12$, $p=0.0005$).

Verb retrieval Verb retrieval has improved as well. Performance in a verb completion test which was only 69% (44/64) before treatment has improved to the level of 92% (59/64) after treatment (significant difference $\chi^2=11.18$, $p<0.001$). In picture description, the number of verbs retrieved increased from 12 to 23 verbs. This might indicate that verb retrieval is modulated, among other factors, by the ability to project the syntactic tree, specifically the inflection nodes. (A similar improvement in verb retrieval following improvement in verb inflection was reported by Weinrich et al. [11].)

Embedded sentences Sentence embedding relates to a node in the syntactic tree which is part of the highest maximal projection of the tree but is located lower than the Wh-question node. In this ability too a significant improvement was found. Before treatment, the patient could not produce a single relative clause in a relative clause elicitation task (0/24 correct). However, after treatment he improved significantly, producing 22/24 relative clauses (13 full relatives and 9 semi-relatives). This improvement was significant: $\chi^2=40.6$, $p<<0.0001$. In embedded clause repetition, no significant improvement was detected.

Although these are only preliminary data from one patient, these data suggest that treatment of a higher structure can improve the production of lower structures, possibly by enhancing the projection of the syntactic tree up to the highest node. These findings are in line with a recent study by Thompson, Ballard, and Shapiro, [12] who report a generalization from treatment of a more complex structure to a less complex structure.

To conclude, a fruitful interaction between syntactic theory for agrammatic production, a syntactic characterization for degrees of severity and clinical therapy considerations yielded a promising direction for treatment which is somewhat counterintuitive: start treatment with the more complex structures, and an improvement in less complex structures will follow.

References

- [1] Menn L, Obler L. In: L Menn, & L Obler, editors. Agrammatic aphasia: A cross -language narrative sourcebook. Philadelphia, John Benjamin's Publishing Company, 1990.
- [2] Goodglass H., Christiansen JA, Gallagher R. Comparison of morphology and syntax in free narrative and structured tests: fluent vs. nonfluent aphasics. *Cortex* 1993;29:377 -407.
- [3] Thompson CK, Shapiro LP, Tait ME, Jacobs BJ, & Schneider SL. Training Wh-question production in agrammatic aphasia: analysis of argument and adjunct movement. *Brain and Language* 1996;52:175-228.
- [4] Friedmann N, Grodzinsky Y. Tense and agreement in agrammatic production: pruning the syntactic tree. *Brain and Language* 1997;56:397-425.
- [5] Friedmann N. Functional categories in agrammatic production: a cross-linguistic study. Doctoral dissertation, Tel Aviv University, 1998.
- [6] Rizzi L. Some notes on linguistic theory and language development: The case of Root Infinitives. *Language acquisition* 1994;3:371-393.
- [7] Thompson CK, Shapiro LP, Roberts M. Treatment of sentence production deficits in aphasia: A linguistic – specific approach to Wh-interrogative training and generalization. *Aphasiology* 1993;7:111-133.
- [8] Thompson CK, Shapiro LP, Ballard KJ, Jacobs BJ, Schneider SS, Tait ME. Training and generalized production of Wh- and NP-movement structures in agrammatic aphasia. *Journal of speech, language, and hearing research* 1997;40:228-244.
- [9] Schechter I. ILAT - Israeli Loewenstein Aphasia Test. Loewenstein Hospital, Rehabilitation Center, 1965.
- [10] Friedmann, N. BAFLA – Friedmann's Battery for Agrammatism. Ms. Tel Aviv University, 1998.
- [11] Weinrich M, Shelton JR, Cox DM, McCall D. Remediating production of tense morphology improves verb retrieval in chronic aphasia. *Brain and Language* 1997;58:23 -45.
- [12] Thompson CK, Ballard, KJ, & Shapiro, LP. The role of syntactic complexity in training Wh - movement structures in agrammatic aphasia: optimal order for promoting generalization. *Journal of the international neuropsychological society*, 1998;4:661-674.