Treatment of sentence production in German agrammatism: a multiple single case study

Introduction

Individuals with agrammatism have specific problems with the production of movement-derived non-canonical sentence structures which, according to the *Tree Pruning Hypothesis* (TPH, Friedmann & Grodzinsky, 1997; Friedmann, 2001), are due to an inability to access hierarchically higher nodes of the syntactic tree. Thus, movement-derived structures relying on higher nodes in the syntactic tree cannot be produced correctly. With respect to treatment outcome, the TPH predicts that a specific remediation of structures relying on higher nodes should lead to an improvement of all syntactic abilities and across different sentence types, relying on lower node structures though no specific treatment has focussed on lower node structures. This has been observed by Friedmann et al. (2000) in a Hebrew-speaking agrammatic patient. Alternatively, the *complexity account of treatment efficacy* (CATE, Thompson et al., 2003) predicts that remediation of syntactically complex sentences results in an improvement of syntactically less complex sentences but not inversely. The authors reported generalization effects from production of sentences in which movement occurs within an embedded clause (syntactically complex sentences, i.e. object-relative-clauses) to sentences in which movement occurs in the matrix clause (simple sentences, i.e. object extracted who-questions). As syntactically complex sentences rely on higher node structures than less complex sentences, both accounts predict generalization effects in the same direction after treatment.
In sum TPH and CATE both, postulate that treatment of complex, respectively hierarchically higher represented structures result in improved production of syntactically simpler, respectively hierarchically lower represented sentences structures. Inversely, treating simple or lower represented sentences does not lead to an improvement in the production of complex, higher represented sentences. However, Thompson and colleagues postulate generalization effects only within structures that rely on the *same* movement operations (i.e. wh-movement or NP-movement) as the treated structures. After treatment of structures relying on wh-movement (i.e. object-relative-clauses), Thompson et al. (1997) observed an improvement only in the production of other wh-movement structures (i.e. wh-questions) but not of NP-movement structures (i.e. subject-raising, passive-sentences) and vice versa.

Objective

This study evaluates an intervention focussing on the production of non-canonical sentences in a multiple single case study with agrammatic participants. Each individual was trained in producing *object relative clauses* (orc) and *object derived who-questions* (whq) in order to establish (1) structure specific learning effects, (2) generalized learning effects across sentence structure of the (2a) same movement type and (2b) different movement type, e.g. *passive sentences*. Following Friedmann and collegues (2000), generalization effects should occur for untrained sentences relying on lower nodes than the treated sentences, irrespective of the movement type. Thompson et al., (1997) predict generalization effects only for sentences that are based on the same movement type.

Methods

Participants

Seven monolingual German speaking participants (4 men, 3 women; mean age: 53 years (range: 33-67) with a prototypical agrammatic speech output. All participants were chronic, mean time post-onset was 9 years (range: 3 -15).

Material

The basic material consisted of 80 semantically reversible active sentences and 80 corresponding pictures. The sentences were constructed from a set of 20 transitive verbs combined with animate nouns. Two sets of active sentences were constructed for counter-balancing across participants,

each set consisting of 20 trained and 20 untrained stimuli balanced for frequency (Baayen et al., 1993). *Orc*, *whq* and *passive sentences* (40 each) were derived in a controlled manner from this material.

Baseline

Individual baseline performance was measured four times: before, between and after intervention phases. A follow-up was investigated post intervention (8-10 weeks). During baseline, each participant was assessed in the production of *object relative clauses, object derived who-questions* and *passive sentences* (40 each). Stable performance (interval of seven days) was examined for each participant prior to intervention. In order to control for recovery mechanisms and charm effects, two impaired control tasks functionally unrelated to the treatment using the LEMO-Battery (De Bleser, et al., 2004) were applied before and after the study.

Intervention

Participants attended at two different intervention phases, training *orc* and *whq,* always emphasizing on the sentence specific underlying form (e.g. Thompson, 2001). Treatment of each sentence began and ended with a sentence elicitation task. In case of an incorrect response, a clearly detailed, hierarchically ordered protocol was applied in which the processing steps required to derive the target sentence were simulated via visual manipulation of the constituents using word cards.

Each treatment phase was administered in a maximum of 12 sessions (45 min.), twice a week. Cut-off for ending an intervention phase was reached if participants produced 90% correct of the trained item set without feedback in two subsequent sessions.

In a counter-balanced ABACA design, four participants received training of *orc* first; three participants received training of *whq* first. One participant was not trained with whq, as cut-off was achieved during the first two treatment sessions.

Analyses of treatment effects

For the evaluation of treatment effects, only *unique effects*, i.e. an effect being unambiguously attributable to the applied treatment phase were considered in the present study. Thus, any structure specific or generalized learning effects arising after treatment phase B were considered as unique effects. Effects arising after treatment phase C could only be unambiguously reduced to the prior treatment, if no improvement was observed after phase B, as increased performance occurring after phase C conflicts with additive or sustained learning effects of the previous treatment phase.

Results

All seven participants showed a significant *unique structure specific learning effect* (McNemar, all p-values <.001) after training of *orc*; five of six participants showed a *unique structure specific learning effect* (McNemar, all p-values <.05) after training of *whq* (see figure 1). With respect to *unique generalization effects across sentences with the same movement type,* two of four participants showed an increased performance on *whq* after treatment of *orc* (McNemar, all p-values <.05, see figure 2), whereas none of the three patients showed better performance on *orc* after treatment of *whq*. Considering *unique generalization effects across sentences with different movement types,* four of seven participants showed generalization to the production of passive sentences after training of *orc* (all McNemar p-values <.001; see figure 3), and one participant showed a unique generalization to the production of passive sentences after training *whq* (Mc Nemar, X^2 23.04, p=.001).

Discussion

The results of this multiple single case study evaluating *structure specific effects* for the remediation of *orc* and *whq* show remarkable improvements for all agrammatics, though all of them had chronic agrammatism. The obtained *generalized learning effects* after training of *orc* on the production of *whq* support the assumptions of TPH, e.g. generalization to structures relying on lower nodes of the syntactic tree and of CATE, e.g. generalization to syntactically less complex sentences. In contrast, the observed generalization effects after treatment of *orc* to the production of passive sentences, e.g. sentences with a different movement type is solely explicable within TPH.

Moreover, this study provides evidence that remediation procedures using a rather small amount of items and following a strict treatment protocol, do allow for significant outcomes. Finally, with respect to clinical applicability, it should be emphasized that all seven individuals participated with eagerness at the treatment study and were very impressed and aware about their individual improvement.

References

Baayen, R.H., Piepenbrock, R., & Rijn, H. (1993). *The CELEX Lexical Database* (Release 1) [CD-ROM]. Philadelphia, PA: Linguistic Data Consortium, University of Pennsylvania.

De Bleser, R., Cholewa, J., Stadie, N., & Tabatabaie, S., (2004). *LEMO – Lexikon Modellorientiert. Einzelfalldiagnostik bei Aphasie, Dyslexie und Dysgraphie.* München: Elsevier.

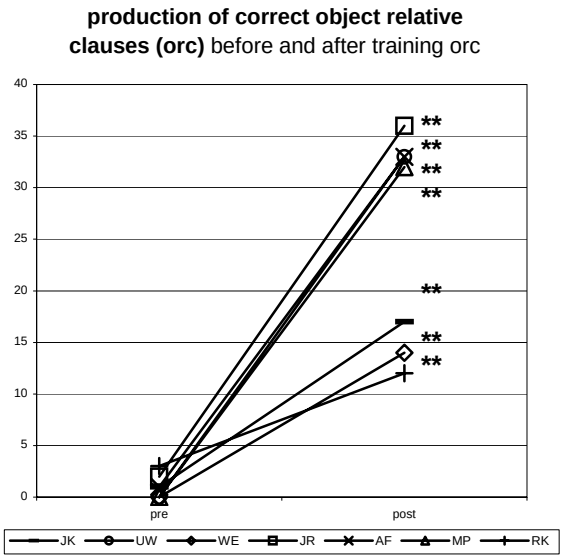
Friedmann, N. (2001). Agrammatism and the psychological reality of the syntactic tree. *Journal of Psycholinguistic Research, 30,* 71-90.

Friedmann, N., & Grodzinsky, Y. (1997). Tense and agreement in agrammatic production: pruning the syntactic tree. *Brain and Language,* 56, 397-425.

Friedmann, N., Wenkert-Olenik, D., & Mali, G. (2000). From theory to practice: treatment of agrammatic production in Hebrew based on the Tree Pruning Hypothesis. *Journal of Neurolinguistics,* 13, 250-253.

Thompson, C.K., Shapiro, L.P., Ballard, K.J., Jacobs, B.J., Schneider, S.S., & Tait, M.E. (1997). Training and generalized production of Wh- and NP-movement structures in agrammatic aphasia. *Journal of Speech and Hearing Research,* 40, 228-244.

Thompson, C.K., Shapiro, L.P., Kiran, S., & Sobecks, J. (2003). The role of syntactic complexity in treatment of sentence deficits in agrammatic aphasia: the complexity account of treatment efficacy (CATE). *Journal of Speech and Hearing Research,* 46, 591-607.



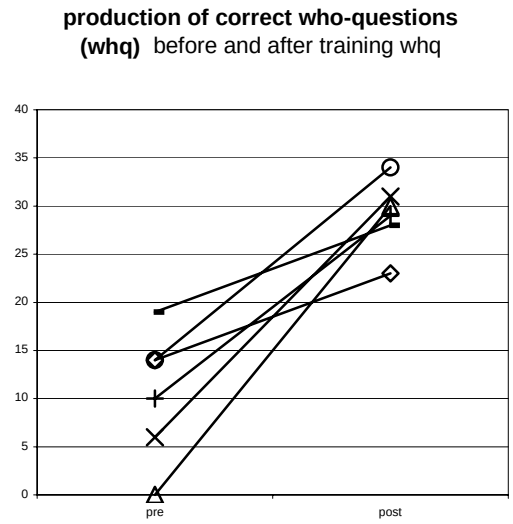


Figure 1: Unique structure specific learning effects for participants receiving *orc* training (n=7) and training of *whq* (n=6). Significance levels: p<.001= **, p<.05=*, McNemar.

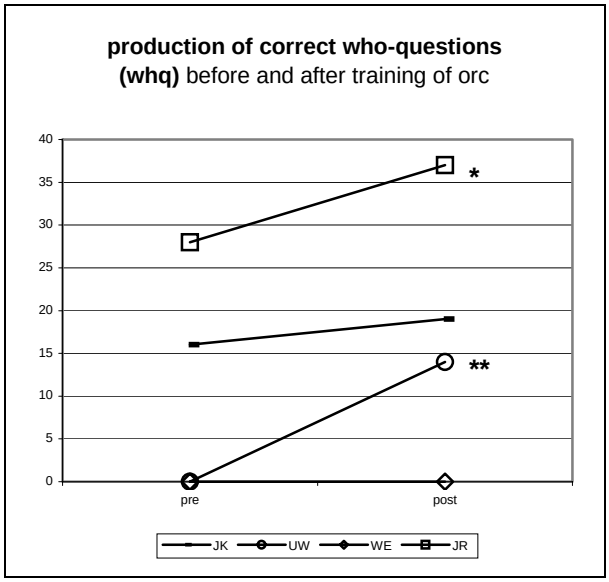


Figure 2: Unique generalization effects. Production of object dirived who quenstions (whq), pre- and post- training of object relative clauses (orc) for 4 participants. Significance levels: p<.001= **, p<.05=*, McNemar.

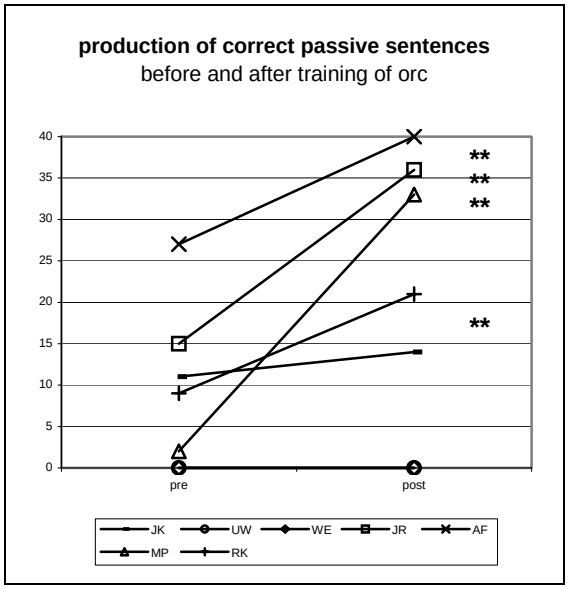


Figure 3: Unique generalization effects. Production of *passive sentences*, pre- and post-training of object relative clauses (orc) for 7 participants. Significance levels: p<.001=**, p<.05=*, McNemar.