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Do individuals with aphasia show adaptation in online sentence processing? A self-paced listening experiment in German

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Introduction

What is syntactic adaptation?

- Implicit improvement in sentence comprehension performance following repeated exposure to sentences [1]
- Implicit = No feedback on performance or cues about structure are given
- Improved performance = E.g., higher accuracy following repeated exposure
  - Should be large in structurally complex sentences, which are difficult to process and thus have a high potential for improvement

Why is it interesting to study syntactic adaptation in aphasia?

- Provides insights into whether repetition alone can improve sentence comprehension in individuals with aphasia (IWA)

Previous results on syntactic adaptation:

- Neurotypical adults: Interaction between test session and syntactic complexity → difficulty processing complex sentences decreases over time [e.g., 1, 5, but see 2 for a replication failure]
- IWA: Hardly any findings
  - Mack et al. (2016): no changes in comprehension accuracy for active and passive sentences between two sessions
  - Schuchard et al. (2017): 4/9 IWA slight improvements in comprehension accuracy for passive sentences after 5 sessions of exposure

Aim

Investigate whether individuals with and without aphasia show syntactic adaptation during online sentence processing in the self-paced-listening paradigm.

Methods

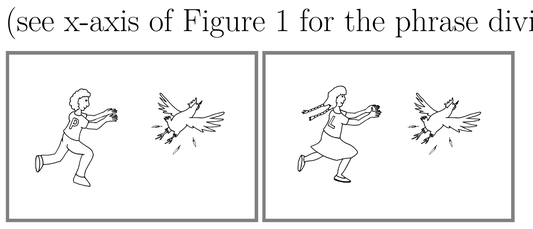
Participants: 71 German-speaking adults

- 50 neurotypical adults (18 male, 32 female, M_{age}: 48 years, range: 19–83 years)
- 21 IWA (12 male, 9 female, M_{age}: 60 years, range: 38–78 years, p.o. > 1 year)

Items: n = 120 sentences (60 structurally simple, 60 structurally complex)

- SO/OS Declaratives: *Here the$_{nom}$ tiger comforts the$_{acc}$ donkey / Here the$_{acc}$ tiger comforts the$_{nom}$ donkey*
- SRC/ORC: *Here is the tiger that$_{nom}$ comforts the$_{acc}$* donkey / *that$_{acc}$ the$_{nom}$ donkey comforts*
- Control structures with an overt pronoun (gender mismatch / match of main clause nouns):
  Peter promises Lisa that he will catch the chicken / Peter promises Thomas that he will catch the chicken
- Object/subject control structures with a covert pronoun (PRO):
  Peter allows Lisa to catch the chicken / Peter promises Lisa to catch the chicken

Procedure: auditory sentence-picture matching with self-paced phrase-by-phrase presentation (see x-axis of Figure 1 for the phrase division)



Heard sentence: *Peter promises Lisa to catch the chicken*
Task: Select the picture that matches the sentence best.

- Syntactic adaptation was assessed by comparing the performance in two test phases spaced ≈ 2 months apart; in total, participants were exposed 6 times to all sentences

Outcome measures & statistical analyses:

- Listening times (in ms) per phrase (see x-axis of Figure 1 for the phrase division)
- Bayesian linear model, predictors: sentence structure, structural complexity, test phase, participant group; random effects: participants and items;
  analysis focuses on the critical sentence region (marked in bold in Figure 1)

References:

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3. Mack, J. E., Wei, A. Z. S., Gutierrez, S., & Thompson, C. K. (2016). *Journal of Neurolinguistics, 40*, 98-111.
4. Schuchard, J., Nerantzini, M., & Thompson, C. K. (2017). *Aphasiology, 31*, 25-48.
5. Wells, J. B., Christiansen, M. H., Race, D. S., Acheson, D. J., & MacDonald, M. C. (2009). *Cognitive Psychology, 58*, 250-271.

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Results

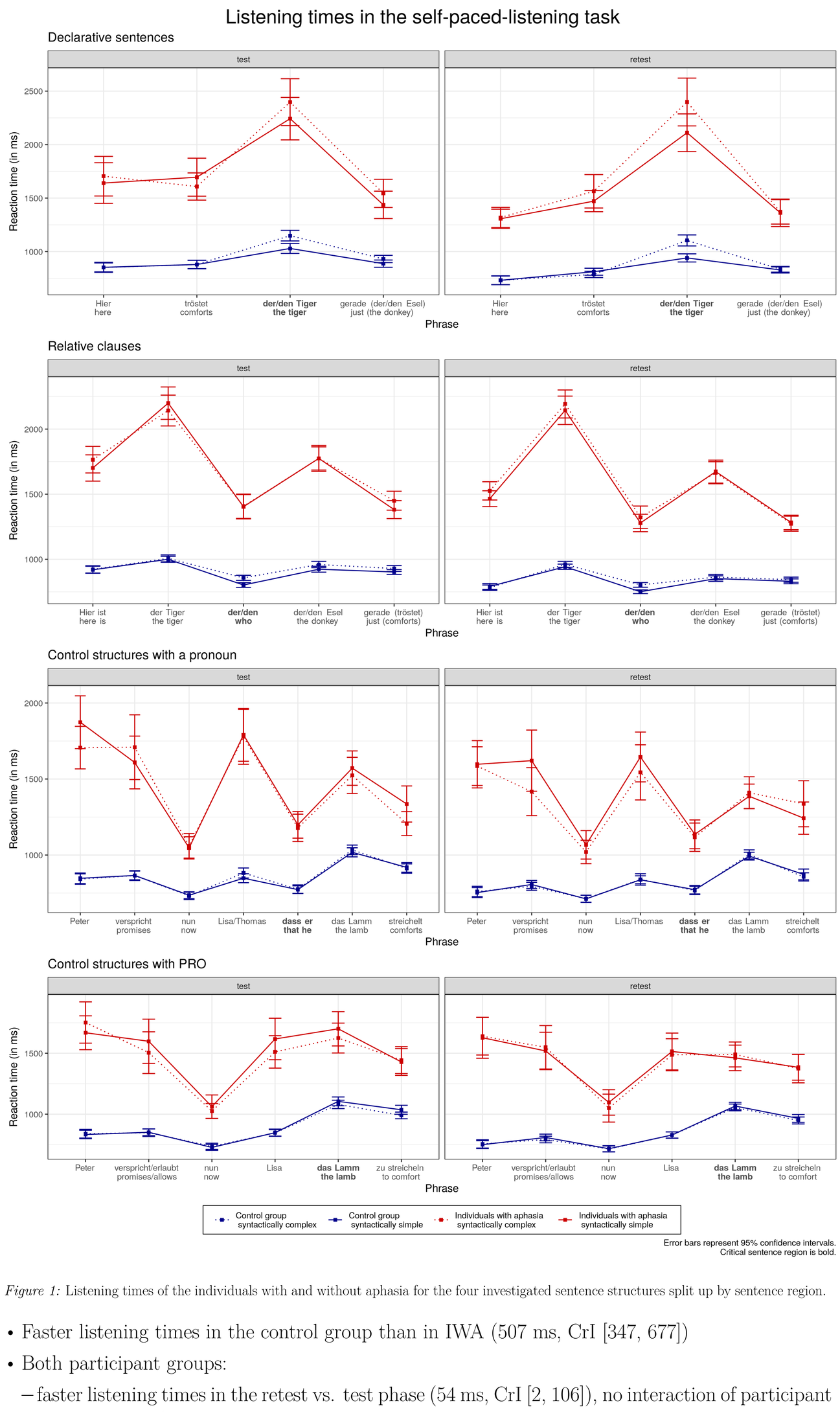

Figure 1: Listening times of the individuals with and without aphasia for the four investigated sentence structures split up by sentence region.

- Faster listening times in the control group than in IWA (507 ms, CrI [347, 677])
- Both participant groups:
  - faster listening times in the retest vs. test phase (54 ms, CrI [2, 106]), no interaction of participant group × test phase
  - longer listening times in complex vs. simple declaratives (IWA: 263 ms, CrI [-37, 588], controls: 116 ms, CrI [73, 162]) and RCs (IWA: 64 ms, CrI [-12, 143], controls: 42 ms, CrI [27, 60])
- IWA: interaction of syntactic complexity × test phase in relative clauses: difference between subject and object relative clauses increased by 50ms in the retest phase (52 ms, CrI [11, 94])

Discussion

- Speedup in listening times in the retest speaks for adaptation in both participant groups
- But possibly participants adapted to the task (higher familiarity with the method) and not to syntactic complexity, since there is no decrease in differences between complex and simple sentences
- IWA: increased difference between complex and simple sentences for relative clauses → speaks against syntactic adaptation in IWA, consistent with Mack et al. [3] and Schuchard et al. [4]
- Our findings suggest that repetition of sentences only (i.e. without any feedback) will not lead to an implicit improvement in sentences processing of IWA (at least not with 6 repetitions) → intervention based on sole repetition of sentences is unlikely to lead to improved sentence processing