An Assessment of the Resource Reduction Hypothesis for Sentence Processing in Aphasia: a Visual Word Study in German

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Introduction

Sentence comprehension performance in individuals with aphasia (IWA) is found to be variable but performance for structurally complex sentences is often reported to be systematically more impaired than for simpler sentences (e.g., Caplan et al., 2013). The Resource Reduction Hypothesis (RRH, Caplan, 2012) takes both the variability in performance and the effect of structural complexity into account. According to this hypothesis, performance depends on the resource capacities of a given individual and on the resources a sentence requires for processing. If the available resources meet the demands, sentences are processed in a normal-like fashion, otherwise sentence processing is impaired. Importantly, the resources in IWA randomly fluctuate leading to variability in performance. Based on the RRH, we derived predictions for the fixation behavior of IWA in the visual world paradigm. Specifically, we assessed structural complexity effects and variability in sentence comprehension in IWA.

Methods

We included 21 IWA (mean age = 60.2, range = 38–78 years, 1–26 years post onset) and 50 control participants (mean age = 48, range = 19–83 years), all native speakers of German. Sentence comprehension was assessed in a variant of the visual world eye-tracking paradigm by using an auditory sentence-picture matching task with two pictures (see Hanne et al., 2011). Sentence complexity effects were investigated in declarative sentences, relative clauses, and control structures with a pronoun or PRO. Variability in the performance was investigated by comparing results between a test and a retest phase separated by two months. Proportion of looks to the target were analyzed using Bayesian hierarchical generalized linear models with the predictors test phase, sentence complexity, and time bin.

Results

Figure 1 displays the fixation paths in each participant group in correct trials. Both groups showed increases in target fixations over 50%. However, the increase in target fixations was higher in the control group compared to IWA across sentence types and test phases. **Structural complexity effects**: In the control group, target fixations in simple sentences exceeded the target fixations in complex sentences in all sentence types with the exception of control structures with a pronoun. In IWA, target fixations between simple and complex sentences diverged only in declaratives. **Variability between test phases**: The control group showed earlier target fixations in the retest phase in declaratives and in non-

canonical relative clauses. The IWA showed later target fixations in the retest phase in non-canonical declaratives.

Conclusions

The finding that IWA showed increased target fixations in correct trials across all sentence types might suggest that sentence processing in correct trials is normal-like. This interpretation is supported by the RRH. However, three of our results speak against such a conclusion: 1) the increase in target fixations was lower in IWA than in controls, 2) IWA showed fewer structural complexity effects, and 3) IWA exhibited later increases in target fixations in the retest phase as compared to the test phase. We will consider how these differences between groups might be explained. Following Cope et al. (2017), we suggest that sentence processing in aphasia is guided by inflexible top-down predictions.

References

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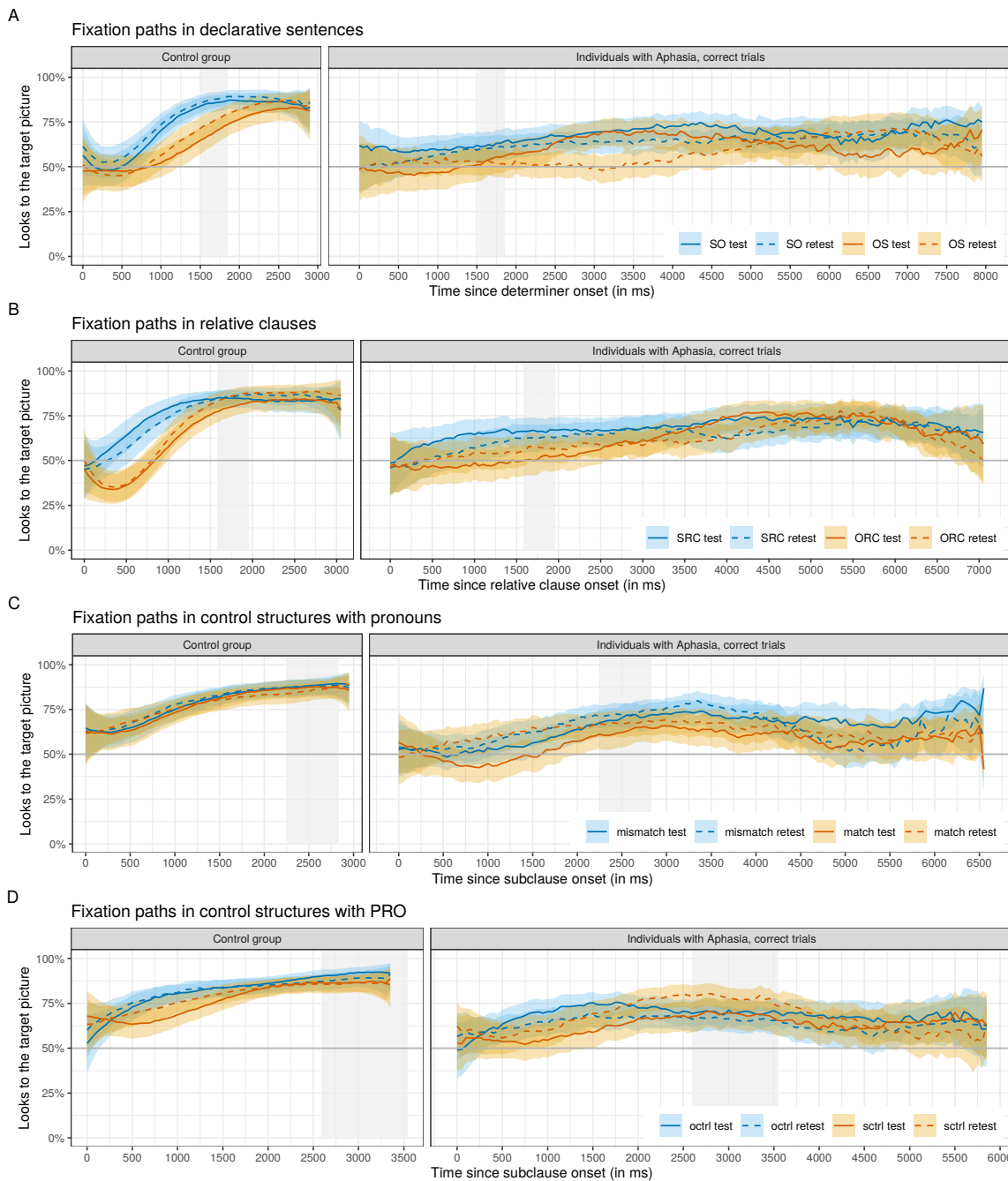
Figure 1. Estimated fixation curves of the control group and the individuals with aphasia in canonical and non-canonical declaratives (SO and OS, A), subject and object relative clauses (SRC and ORC, B), control structures with a pronoun with gender matching or mismatching nouns (match and mismatch, C), and subject and object control structures with PRO (sctrl and octrl, D). Solid and dashed lines represent the mean fixations and shaded areas represent the 95% credible intervals around the mean. Vertical bands shaded in grey mark the sentence end.