

Asymmetry of productive & receptive sentence processing deficits in post-stroke aphasia

Jeremy Yeaton¹, Danielle Fahey², William Matchin³, Gregory Hickok¹

¹University of California, Irvine, ²University of Montana, ³University of South Carolina

Introduction. Despite decades of research on the relationship between expressive and receptive agrammatism in people with aphasia (PWA), very little recent work has been done on the relationship between expressive paragrammatism and syntactic comprehension deficits (Eling et al., 1987). Here we compare behavioral patterns of sentence production with measures of syntactic comprehension.

Background. By contrast to expressive **agrammatism** which is characterized by the reduction or omission of syntactic structures leading to “telegraphic speech”, **paragrammatism** is characterized by long utterances with more-than-necessary morpho-syntactic structure, and deficits in the hierarchical organization of sentences (Kleist, 1914). The two syndromes also have distinct lesion correlates, with expressive agrammatic participants having lesions in the left middle and inferior frontal gyri, and paragrammatic participants having lesions in the left posterior superior and middle temporal gyri (Matchin et al., 2020). PWA displaying expressive agrammatism tend to have relatively spared syntactic knowledge and comprehension (Linebarger et al., 1983), however to date, no work has investigated the relationship between paragrammatic output and syntactic comprehension. As such, it remains to be seen whether a) paragrammatism is constrained to the production domain, b) a paragrammatic production deficit entails a corresponding comprehension deficit, or c) depending on lesion location, paragrammatism can dissociate or co-occur with a comprehension deficit. These questions play a crucial role in distinguishing cortical models of syntax which rely on partially distinct circuits for production and comprehension (e.g.: Matchin and Hickok, 2020) from those that don’t (e.g.: Hagoort, 2016), or those which argue for a distributed rather than localized syntactic system (e.g.: Fedorenko et al., 2020).

Methods. Using an utterance-level error coding scheme (Fahey et al., 2023b), we coded the speech of 86 PWA retelling the story of Cinderella in English. For each participant, we calculated the proportion of agrammatic (missing functional morphemes), paragrammatic (containing insertions & substitu-

tions), or grammatical utterances they produced. We then carried out voxel-based lesion-symptom mapping (VLSM) to estimate the neural correlates of these discourse measures (DeMarco and Turkeltaub, 2018). In a partially overlapping sample ($n = 132$), and a separate sample ($n = 48$), we estimated the lesion correlates of impaired syntax comprehension using available scores from non-canonical sentence comprehension with sequential commands (Kertesz, 2007), sentence-picture matching (Love and Oster, 2002), semantic plausibility judgments (Rogalsky et al., 2018), and acceptability judgments (Fahey et al., 2023a).

Results. The VLSM results for the production measures revealed a large frontal region corresponded to agrammatic errors, while smaller regions in the mid-to posterior superior temporal sulcus (STS) and posterior parietal lobe corresponded to paragrammatic errors (Fig. 1A). We did not find any significant correlations between the production metrics and non-canonical sentence comprehension scores, after controlling for canonical sentence comprehension (Fig. 1B). The lesions corresponding to overall comprehension deficits covered large portions of the posterior temporal lobe, with maximum overlap in the posterior STS, adjacent to the production lesion (Fig. 1A).

Discussion. Corroborating recent work in Matchin et al. (2023), we did not find a relationship between agrammatic production and syntactic comprehension at the behavioral or neural level. Furthermore, our results point to a behavioral and neural dissociation between paragrammatic production and syntactic comprehension deficits. It is important to note that the data used in the analysis does not have 100% overlap between the production and comprehension data, so it remains possible that the dissociation observed here is an artefact, and further work is needed. Nonetheless these lesion correlates are consistent with previous work on syntactic production (Matchin et al., 2020) and comprehension (Yu et al., 2022; Matchin et al., 2023) in aphasia. The syntactic locus in the posterior STS would be a reasonable candidate for the lemma system posited by Matchin and

Hickok (2020) or correspond to different aspects of the message-structure interface proposed by Krauska and Lau (2023)’s non-lexicalist framework.

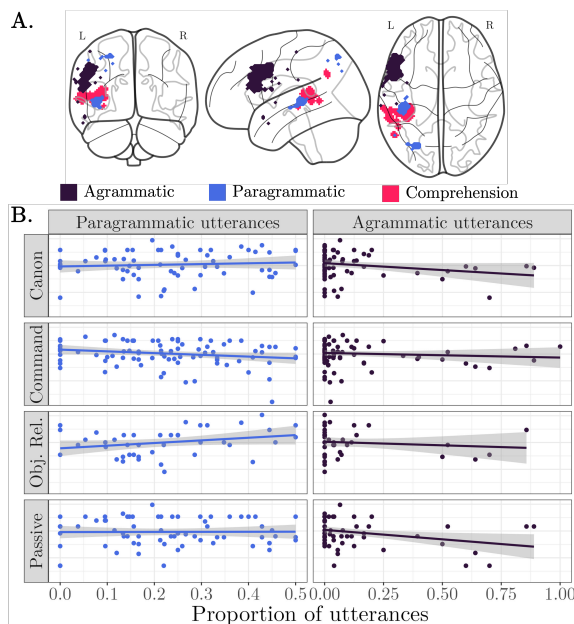


Figure 1. **A:** Lesion correlates of sentence production & comprehension deficits. **B:** Residual performance on non-canonical sentence comprehension (after controlling for canonical sentence comprehension) vs. proportion of agrammatic and paragrammatic utterances.

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