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Automatic Syntactic Processing in Agrammatic Aphasia: the Effects of Grammatical Violations

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Introduction

There are two symptoms in aphasia that indicate impaired syntactic abilities: agrammatic production and asyntactic comprehension (Bastiaanse & Thompson, 2012; Goodglass, Menn &, Kean, 1976). While it seems intuitive that persons with agrammatic production would also have asyntactic comprehension due to a core or central syntactic impairment, evidence so far is mixed. Agrammatic productions and asyntactic processing do not necessarily co-occur in aphasia (Caplan et al., 2007; Caramazza & Zurif, 1976). The findings of prior research on asyntactic comprehension vary depending on the experimental task and syntactic contrasts used in the study. Additionally, when performance of persons with agrammatic aphasia is compared to neurotypical adults, as has been done in several studies, it does not tease apart a general effect of aphasia from syntactic deficits. Thus, it is unclear if syntactic deficits in aphasia result from a central, amodal breakdown that affects both comprehension and production. Recent theoretical views suggest distinct neural correlates for agrammatic production (left frontal) and asyntactic comprehension (left temporal) (Matchin & Hickok, 2020). The main goal of this research is to delineate the nature of asyntactic comprehension deficits, if any, in individuals with agrammatic production. We examined performance in offline and online comprehension tasks and compared this with a group of aphasic participants who did not have agrammatic production.

Methods

The study recruited three groups of participants: agrammatic production (N=9), severity-matched non-agrammatic individuals with aphasia (N=7), and age and education matched neurotypical adults (N=9). Persons with agrammatic production were identified through narrative language analysis. Participants engaged in two computer-based tasks in which sentences with and without syntactic violations were presented (modeled after Faroqi-Shah et al., 2020): word monitoring, which is sensitive to online detection of syntactic violations, and auditory sentence judgment, which measured offline decisions about sentence well-formedness. The stimuli consisted of sentences with and without morphosyntactic (tense and word category) violations and semantic violations. Reaction time differences to word monitoring in sentences with and without syntactic violations gave a word monitoring effect. Sensitivity to offline judgments was computed using D-prime (Macmillan & Creelman, 1991). Group (Kruskal-Wallis test) and single-subject (Crawford & Garthwaite, 2002) analyses were conducted.

Results

Group analyses showed impaired sentence judgment in agrammatic aphasia and no word monitoring deficit for both tasks in aphasia (Table 1). Single subject statistics showed deficits in a subset of both agrammatic and non-agrammatic participants.

Conclusions

Although off-line sentence judgment was impaired in agrammatic aphasia, on-line sentence processing was preserved in both agrammatic and non-agrammatic aphasia, consistent with Faroqi-Shah et al.(2020). The findings show that individuals with agrammatic production are preserved in automatic syntactic processing, as measured by the word monitoring task. Their breakdown in off-line sentence judgments could arise from challenges in post-syntactic analysis or working memory limitations. This finding is consistent with distinct neural resources for sentence production and syntactic analysis (Matchin & Hickok, 2020). The current study does not support an "amodal" syntactic deficit in individuals with agrammatic production.

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Table 1.
Performance of neurotypical and aphasic groups on the sentence judgment and word monitoring tasks.

	Violation	**NT, M (SD)**	**Non-Agr, M (SD), N**	**Agr, M (SD), N**	**KWT χ^2, p**	**Significant pairwise comparisons, MWU, p<.05**
Word Monitoring (Effect/Mean RT in msecs)	Semantic	19 (154)	24 (115), 0	-57 (161), 0	.037, .98	-
	Tense	56 (103)	-20 (163), 2	-133 (429), 1	.032, .85	-
	Word Category	290 (130)	279 (223), 0	-106 (480), 2	2.34, .31	-
	Overall	468 (92)	439 (110), 0	-47 (1024), 2		
Auditory Sentence Judgment (D')	Semantic	4.23 (2.06)	2.94 (1.74), 0	2.17 (1.19), 0	7.26, .03*	NT vs Agr (p=.008)
	Tense	3.88 (1.67)	3.15 (2.23), 0	2.04 (1.89), 1	3.64, .16	-
	Word Category	4.73 (1.38)	2.82 (1.48), 2	2.08 (1.57), 3	10.32, .005**	NT vs Agr (p=.003)
	Overall	4.28 (1.06)	2.97 (1.61), 2	2.10 (1.32), 5		

Agr = Agrammatic Aphasia, KWT=Kruskal-Wallis test, M=Mean, msecs=milliseconds, MWU=Mann-Whitney U test, N=Number of participants showing a deficit (Crawford & Garthwaite, 2002), Non-Agr = Non-agrammatic Aphasia, NT = Neurotypical, RT= Response Time, SD=Standard Deviation, **p* <.05, ***p* <.01