



A Lesion-Symptom Mapping Study of Syntactic Acceptability Judgments in Chronic Post-Stroke Aphasia

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A lesion-symptom mapping study of syntactic acceptability judgments in chronic post-stroke aphasia

Danielle Fahey^{1*}, Julia Igoe¹, Julius Fridriksson¹, Gregory Hickok², and William Matchin¹

¹ Department of Communication Sciences & Disorders, University of South Carolina, Columbia, SC, USA

² Department of Cognitive Sciences, University of California, Irvine, Irvine, CA, USA

*corresponding author, dfahey@email.sc.edu

Introduction

Prior lesion-symptom mapping studies have associated damage to posterior networks with syntactic comprehension deficits (Kristinsson et al., 2019; Pillay et al., 2017; Rogalsky et al., 2018) and paragrammatic speech (Matchin et al., 2020). By contrast, lesion-symptom mapping studies have associated damage to frontal networks with agrammatic production deficits (Den Ouden et al., 2019; Matchin et al., 2020; Wilson et al., 2010) and to some extent, deficits in comprehension of complex non-canonical structures (Amici et al., 2007; Magnúsdóttir et al., 2013; Mesulam et al., 2015), but with little implication in basic syntactic comprehension deficits. However, most studies assess syntactic comprehension indirectly through the use of noncanonical sentence comprehension. Syntactic acceptability judgments (SAJ), which ask participants to gauge sentences' well-formedness, provide a more direct assessment of syntactic comprehension. We predicted people with aphasia (PWA) would better detect word-order violation than agreement (Wulfeck & Bates, 1991) or subcategorization violations. We expected lesion-symptom mapping to show association between comprehension deficits and damage to posterior temporal regions, but no association with frontal damage, consistent with Wilson & Saygin (2004).

Methods

We adapted Wulfeck & Bates (1991)'s SAJ task into two experiments; in ours, we suggested that English was the speaker's second language. The experiment was presented in 2 tasks: each task presented 64 sentences, eight of each type (examples shown in *Table 1*). In both tasks, we manipulated sentences' grammaticality, $\frac{1}{2}$ being ungrammatical, counterbalanced for placement of the (single) error, on the verb or object. In task 1, agreement and word order grammaticality was manipulated. In task 2, we manipulated subcategorization selection (i.e., prepositional phrase or noun phrase, adding/deleting/substituting a preposition), and controlled whether verbal complements were obligatory or optional. From responses, we performed a repeated measures (RM) ANOVA to identify differential accuracy by error type and location, and regressed participants' lesions against error detection in both tasks using NiiStat, correlating lesion site to grammatical processing (Matchin et al., 2020).

Results

Fourteen PWA have participated, with one participant completing only task 2. RM ANOVA results showed a significant main effects of error type ($p < .001$, $F(1.622) = 3.195$, $\eta^2 = .176$). Main effect of error location ($p = .054$, $F(1.000) = 4.358$, $\eta^2 = .225$) and interaction between error type and location ($p = .068$, $F(1.264) = 16.345$, $\eta^2 = .521$) were approaching significance. Predictably, participants were more accurate on word-order violations ($M = 65\%$), but unexpectedly more accurate on subcategorization violations ($M = 52\%$) than agreement violations ($M = 46\%$). Lesion-symptom mapping showed significant association to the posterior temporal ROI (task1: $z = -2.097$, $p = .036$; task2: $z = -2.166$, $p = .030$) but not the inferior frontal ROI (task1: $z = -1.4509$, $p = .147$; task2: $z = -1.185$, $p = .236$).

Conclusions

Generally, word-order violations were easier to detect than agreement or subcategorization violations; all violations showed association to posterior temporal regions rather than inferior frontal regions, consistent with findings by Wilson & Saygin (2004), but contra suggestions that frontal regions primarily support grammatical comprehension processing (Friederici, 2017; Hagoort, 2005). Differential accuracy across violation types could be because word-order involves sentence constraint (Borovsky et al., 2010; Frishkoff et al., 2010), while agreement and subcategorization require processing hierarchical dependencies; further, agreement is an unbounded dependency.

Word count: 497

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Table 1. Exemplar Stimuli from Experimental Tasks.

		Task 1			Task 2	
		agreement			obligatory	
		on object	on verb		on object	on verb
		word order			optional	
		on object	on verb		on object	on verb
She is baking a cake/*a cakes.						
She is/*are baking a cake.						
They have listened to some teachers/*teachers some.						
They have listened/*listened have to some teachers.						
They are chasing a cat/*in a cat.						
They have signaled/*have signaling to a boat.						
He is answering a phone call/*to a phone call.						
They are hurrying/*have hurrying to a meeting.						