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Comprehension of sentences with reversible semantic roles is sensitive to phonological STM capacity.

Introduction

Comprehension of sentences with reversible semantic roles (e.g., The *boy* is kissing the *girl*.) is difficult for many individuals with agrammatic aphasia (e.g., Schwartz, Saffran & Marin, 1980), especially in the context of non-canonical sentence structures (e.g., passive). Early accounts attributed this difficulty to a specific deficit in syntactic processing that affected both comprehension and production Caramazza & Zurif, 1976; Caramazza & Berndt, 1981). This account was challenged in subsequent studies reporting that impaired comprehension of 'semantically reversible sentences was not present in all people with agrammatic aphasia (e.g., Miceli, Mazzucchi, Menn, & Goodglass 1983) and that it was present in some people with other aphasic syndromes (e.g., Caplan & Hildebrandt, 1988). Even in their seminal paper, Caramazza & Zurif (1976) reported the difficulty in comprehending semantically reversible sentences in conduction aphasia, but attributed this to an impairment of short-term memory (STM). In another seminal study, Linebarger, Saffran & Schwartz (1983) who demonstrated that impairment in comprehending sentences with reversible roles did not preclude the ability to judge grammaticality of sentences. From this, they proposed the "Mapping Hypothesis": Difficulty with comprehending semantically reversible sentences lies in the mapping of grammatical roles specified in the syntactic representation onto the underlying thematic roles in the semantic representation of that utterance. These and other similar findings (see R. Martin,

2006 for review) led to an increased interest in the role of verbal STM (semantic and phonological) in sentence comprehension. In the context of the mapping hypothesis, that role would be related to a reduction in processing capacity needed to assign grammatical roles of a sentence's surface structure onto the underlying thematic roles.

In this study, we provide evidence that is consistent with this hypothesis. We examined the comprehension of five sentence structures with and without reversible semantic roles by people with aphasia under two response conditions. We compared performance on the two semantic role conditions (reversible vs. not reversible) and examined the contributions of aphasia severity and verbal STM deficits (WAB-R score, semantic STM and phonological STM) to detriments in performance on the reversible semantic role condition.

Methods

Participants. Thirty-nine individuals with aphasia took part in this study: 19 cases with anomic aphasia, 8 with Broca's aphasia, 6 with conduction aphasia, 4 with Wernicke's aphasia and 2 with transcortical motor aphasia. Ages ranged from 32 to 72 years and time post-onset ranged from1 to 25 years. Data for this study comes from the Temple Assessment of Language and Short-term memory in Aphasia (TALSA; Martin, Kohen & Kalinyak-Fliszar, 2010).

Sentence Comprehension Test. This TALSA subtest includes 20 sentences, ten with reversible semantic roles (agent- patient) and10 with semantic roles that cannot be reversed. In each of these sets, there are two exemplars of each of the following transitive structures: active, passive, locative, object relative, subject relative. The sentences are randomized and presented auditorily one at time. After the participant listens to the sentence, two pictures appear on the screen, one depicting the scene described by the spoken sentence and the other picturing a

distracter scene. Distracters are either the same scene with reversed semantic roles (e.g., The *policeman* shoots the *robber* → The *robber* shoots the *policeman*.) or the same scene with a different agent or patient (The policeman shoots the *dog*). The task is to point to the picture that matches the sentence.

The 20 sentences were presented three times under three response conditions, after a 1-second unfilled interval (immediate response), after a 5-second unfilled response interval and after a 5-second filled interval (participant counting aloud single digits that appear on the computer screen). Data from the first two conditions are reported in this paper.

Dependent measures. (1) Proportion correct in each response condition for reversible and nonreversible semantic role sentence conditions (Table 1). Accuracy of the two sentence conditions was compared by dependent t-test for each interval condition.

(2) Difference in proportion correct between reversible and nonreversible sentences (Table 2). This measure reflects the degree of detriment that could be attributed to the presence of semantically reversible thematic roles. We used this measure as well as proportion correct as dependent measures in separate multiple regression analyses. The predictor variables were Aphasia severity (WAB-R Aphasia Quotient (AQ; , Kertesz, 2006), semantic STM and phonological STM (based on two TALSA subtests: Category Probe Span (Semantic STM) and Rhyme Probe Span (Phonological STM).Results.

Comparison of performances on reversible and nonreversible sentence comprehension conditions. Dependent t-tests showed that for both the 1-second unfilled and 5-second unfilled response conditions, proportions correct on the reversible sentences were significantly lower than proportions correct on the nonreversible sentences (1-second response: $t(38) = 7.32$, $p = .000$

two-tailed, 5-second response condition: $t(38) = 5.78$, p = .000 two-tailed). Importantly, decline in performance on the reversible conditions was not limited to individuals with Broca's aphasia. The decline in performance on the reversible sentences was as high as .56 in the 1-second response condition and .67 in the 5-second response condition. In the 1-second response condition, performance declined greater than .20 for 14 of 19 participants with Anomic aphasia, 5 of 8 with Broca's aphasia, 3 of 6 with Conduction aphasia 1 of 2 with transcortical motor aphasia and 3 of 4 with Wernicke's aphasia. Declines of greater than .20 in performance were similarly distributed in the 5-second response condition: Anomic aphasia, 10 of 19, Broca's aphasia, 7 of 8, Conduction aphasia, 4 of 6, Transcortical Motor Aphasia, 1 of 2 and Wernicke's aphasia, 1 of 4.

Factors influencing impaired comprehension of semantically reversible sentences in aphasia. Multiple regression analyses were conducted to determine whether the difference in performance on sentences with reversible semantic arguments (compared to nonreversible semantic arguments) could be predicted by any of three variables: aphasia severity semantic STM and phonological STM. Results revealed that for the 1-second response condition, only phonological STM predicted performance (proportion correct) on sentences with reversible semantic arguments (Multiple $R = .54$, $R^2 = .29$, F (3, 35) = 4.78, $p = .01$, $t = 2.37$, $p = .02$). When the difference score was the dependent variable, the model was not significant, but phonological STM showed a trend in predicting the decline in performance (Multiple $R = .36$, $R^2 = .13$, F (3, 35) = 1.68, $p = .19$, $t = 1.83$, $p = .08$). For the 5-second response condition, the WAB AQ emerged as the strongest predictor variable of proportion correct on sentences with reversible arguments (Multiple $R = .65$, $R^2 = .43$, F (3, 35) = 8.65, $p = .0002$, $t = 2.06$, p = .05). When the difference score was the dependent variable, only Phonological STM emerged as a trend

predictor (Multiple R = .40, R^2 = .16, F (3, 35) = 4.78, p = .10, t = 1.83, p =.08).

Discussion

The results indicate that comprehension of transitive sentences with reversible semantic arguments can be difficult for many people with aphasia regardless of the type of aphasia. The most consistent predictor of sensitivity to the presence of reversible semantic arguments in sentence comprehension was phonological STM. This finding is consistent with other studies indicating a role of verbal STM capacity in comprehension of sentences with reversible semantic roles, specifically that mapping syntactic roles onto underlying thematic arguments depends on adequate support from phonological STM.

References

Caplan, D., & Hildebrandt, N. (1988). Disorders of syntactic comprehension. Cambridge, MA: MIT Press.

Caramazza, A., & Zurif, E. B. (1976). Dissociation of algorithmic and heuristic processes in language comprehension: Evidence from aphasia. *Brain and Language, 3,* 572–582.

Kertesz, A. (2006). *Western Aphasia Battery-Revised*. San Antonio: Pearson.

Kolk, H., Van Grunsven, M., & Keyser, A. (1985). On parallelism between production and comprehension in agrammatism. In M. L. Kean (Ed.), *Agrammatism*. New York: Academic Press.

Linebarger, M. C., Schwartz, M.F., & Saffran, E. M. (1983). Sensitivity to grammatical structure in so-called agrammatic aphasics. *Cognition, 13,* 361-392.

Martin, R.C. (2006). The neuropsychology of sentence processing: Where do we stand? *Cognitive Neuropsychology,* 23, 74-95.

Miceli, G., Mazzucchi, A., Menn, L., & Goodglass, H. (1983). Contrasting cases of Italian agrammatic aphasia without comprehension disorder. *Brain and Language, 19,* 65–97.

Schwartz, M. F., Saffran, E. M. & Marin, O.S. M. (1980). The word order problem in agrammatism. I. Comprehension, *Brain and Language, 10 (2)* 249-262.

Table 1. Mean proportion correct (with standard deviation, SD) on the Sentence Comprehension subtest of the TALSA Battery, as a functino of distracter type (reversible, nonreversible) and response condition (1-second interval, 5-second interval).

Distracter Type		Response Condition	
		1-second interval	5-second interval
Reversible	Mean	0.67	0.66
	SD	0.21	0.20
Nonreversible	Mean	0.90	0.89
	SD	0.12	0.14

Table 2. Difference score between proportion correct on reversible and nonreversible conditions

	Response condition	
	1-second interval	5-second interval
Mean	0.23	0.23
SD	0.21	0.20