Auditory comprehension and repetition in persons with aphasia

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Introduction

When investigating language processing and linguistic representations, it is often difficult to separate these skills from other cognitive processes. One such cognitive process that appears to be linked with language is short-term memory (STM), or the ability to maintain a piece of information in one's mind for a short period of time (Martin & Reilly, 2012). A subtype of STM is working memory (WM), in which a person has to both maintain a piece of information in cognitive storage and manipulate it. Various models of WM have been used to explain how people process linguistic information. One model includes a phonological loop, in which auditory information is stored and rehearsed in order to be remembered and manipulated (Wright & Fergadiotis, 2012). Following this mental rehearsal, the information can be encoded, which is a necessary step for comprehension. Some argue that auditory comprehension deficits in aphasia are influenced by the person's STM or WM deficits (Martin & Saffran, 1997).

Auditory comprehension and repetition abilities are two skills that are often are impaired in persons with aphasia (PWAs), but limited research has been conducted investigating the relation between these two language skills. Wright et al. (2007) investigated ways to measure WM in PWAs for different types of linguistic information (phonological, semantic, and syntactic), as well as examining the relation between performance on WM tasks and auditory comprehension. They found that different n-back tasks could be used to measure different types of WM. Results also indicated that there was a connection between different types of WM and different types of linguistic processing.

Eom and Sung (2016) examined the effect of WM intervention on sentence comprehension in PWAs. Intervention consisted of treating repetition of sentences. Results indicated that there were improvements in sentence repetition and WM, as well as generalization to other language tasks, including auditory comprehension tasks. No studies were found in the literature investigating a correlation between auditory comprehension and repetition abilities except in the context of intervention. If there is a correlation between these two, there are clinical implications regarding the potential use of STM and WM models to guide intervention in PWAs.

Research Question

Is there a strong positive correlation between auditory comprehension and repetition abilities in PWAs?

Subjects

Data from 110 participants were selected from the AphasiaBank online database (www.talkbank.org). Aphasia types were based on Western Aphasia Battery – Revised (WAB-R) scores.

Participation Inclusion/Exclusion Criteria:

- Diagnosis of aphasia
- Left hemisphere damage due to stroke
- Aphasia duration of at least 6 months
- Adequate vision and hearing
- No history of other neurological conditions
- English-speaking monolinguals
- Completed all relevant assessment tasks
- No missing data scores

Anomic	Broca's	Conduction	Wernicke's	Transcortical Motor	TOTAL
36	37	24	12	1	110

Time Post-Onset M = 5.4 years (SD= 5.11)

Years of Education M = 15.1 years (SD = 2.6)

Age M = 61.8 years (SD = 11.4)

Gender 47 Female, 63 Male

Ethnicity 95 Caucasian; 14 African American; 1 Asian

Handedness 101 Right, 8 Left, 1 Ambidextrous

Procedure

AphasiaBank participants completed a variety of standardized and non-standardized tests. For this study, scores from two sentence-length auditory comprehension subtests of the WAB-R were extracted for analysis:

- Yes/No Questions (max. score of 60)
- Sequential Commands (max. score of 80)

In addition, four AphasiaBank Repetition Test sub-scores were extracted for analysis:

- 1.B. Open Word Lists – Increasing Length, Serial Order (word span; max. score of 7)
- 1.B. Open Word Lists – Increasing Length, Any Order (word span; max. score of 7)
- 2.A. Sentences - Increasing Length (repetition of sentences of increasing length; max score of 65 (total # of words correct))
- 2.B. Sentences – No Errors, Semantic Errors, Interference Effect (repetition of sentences of varying linguistic complexity; max. score of 88 (total # of words correct))

Sample Stimuli from the WAB-R and the AphasiaBank Repetition Test

WAB-R Yes/No Questions subtest

- Is this a hotel?
- Will paper burn in fire?

WAB-R Sequential Commands subtest

- Point to the comb with the pen.
- Put the pen on top of the book, then give it to me.

AphasiaBank Repetition Test 1.B. Open Word Lists - Increasing Length

- 1. Train 2. Can, globe 3. Spool, belt, flower 4. Shoe, girl, ball, camel 5. Geese, jelly, fork, hammer, rock 6. Turtle, square, forest, blood, window, bird 7. Table, world, boy, camp, lemon, baby, nest

AphasiaBank Repetition Test 2.A. Sentences - Increasing Length

- 1. The bus is coming. 2. The tour bus is coming. 3. The tour bus is coming into the town. 4. The tour bus is coming into the town to pick up the people. 5. The tour bus is coming into the town to pick up the people from the hotel. 6. The tour bus is coming into the town to pick up the people from the hotel to go swimming.

AphasiaBank Repetition Test 2.B. Sentences – No Errors, Semantic Errors, Interference Effect

- The dog chased the cat up the tree. (NE)
- The bird was caught by the worm. (SE)
- Would you like to star in a movie? (IE)

Results

There were significant positive correlations between each WAB-R subtest and the four sub-scores of the AphasiaBank Repetition Test. The percentage of variability in the AphasiaBank Repetition Test scores that could be accounted for by the variability in the WAB-R sentence-length auditory comprehension test scores ranged from 14% to 28% (r^2 data); the correlations were weak to moderate, so variables other than sentence-length auditory comprehension are accounting for additional variability in repetition ability. Post-hoc, we chose to explore fluency as another potential contributor to variability in repetition ability. When WAB-R Fluency scores were correlated with the four aforementioned AphasiaBank Repetition Test sub-scores, the resulting Pearson correlation coefficients ranged from .46 to .54.

Correlations Between WAB-R Scores and Sub-scores from the AphasiaBank Repetition Test

	WAB-R Yes/No Questions	WAB-R Sequential Commands	WAB-R Fluency
Span Score – Serial Order	.398*	.456*	.461*
Span Score – Any Order	.385*	.458*	.466*
Sentence Repetition – Increasing Length	.416*	.529*	.535*
Sentence Repetition – Varying Complexity	.381*	.450*	.447*

A bivariate correlation function in SPSS revealed positive and significant correlations between all variables at $p<0.01$.

Discussion

Sentence-length auditory comprehension is weakly to moderately correlated with repetition span and sentence repetition in PWAs; thus, other variables also must be accounting for the variability in repetition ability. Our post-hoc analysis of the relation between fluency and repetition revealed that fluency also was weakly to moderately correlated with repetition ability. The fluency of a person's speech often has a large impact on scores on various tasks, even if other underlying linguistic or cognitive skill remains intact. In other words, PWAs may have some of the skills necessary to repeat a sentence (e.g., good short-term memory), but nonfluent oral expression may prevent the person from being able to verbalize the utterance to be repeated. It is clear that auditory comprehension bears some relation to repetition in PWAs; however, auditory comprehension is not the only factor that should be considered when treating repetition deficits. Results of this study imply the need for further research to determine the relation between various impairments and abilities in PWAs in order to assess and treat speech and language skills.

References

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Disclosure

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