Semantic Working Memory Predicts Relative Clause Sentence Comprehension: A Case-series Approach

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Sentence Comprehension and Working Memory
- Comprehension includes maintaining, processing and integrating linguistic information actively.
- By studying people with aphasia who have varying degrees of WM deficits, we can look at the mechanisms relating relative clause sentence comprehension and verbal WM.
- Domain specific model of WM proposes separate buffers to hold different information, specifically semantic and phonological buffers.
- Previous research has found a link between semantic WM capacity and sentence comprehension.

Hypothesis
- Patients’ Semantic WM capacity will have an independent contribution to sentence comprehension and verbal WM capacity will not.

Sentence type (see methods)
- We used relative clause sentences because they have a working memory component of who did what to whom.
- Object relative (5) is harder to integrate in comparison to subject relative (4) sentences.
- Passive sentences (3 & 4) are harder to comprehend than active (1 & 2) because of the assumption we make of the first noun of the sentence is usually the agent.
- Passive embedded (4) has more of a WM demand than active main clause (3) because you have to process the difficult passive embedded clause while maintaining the subject in WM to integrate with the descriptive clause.

Methods
- Participants: (N=54) chronic aphasic patients.
- Mean age = 67 years old
- Mean years of education = 15 years, Range = [11-22]
- Multiple regression
- Regress accuracy for the harder sentence type on semantic and phonological processing measures, semantic and phonological WM measures and accuracy on a baseline sentence type that is easier to comprehend.
- Semantic processing measures – Peabody picture vocabulary test, Pyramids and Palm Trees, Single word single picture matching task
- Phonological processing measures – Consonant Discrimination, Auditory Lexical Decision, Single word single picture match
- Phonological WM:
  - Digit matching task
  - 14365… 13465
  - Same or different?
  - Digit span
  - 18650
  - Repeat numbers in order
- Semantic WM:
  - Category probe
    - List: Rose, hurricane, table, hair
    - The problem word in the same category as any of the words in the original list?

Results

<table>
<thead>
<tr>
<th>Target sentence regressed on baseline</th>
<th>Beta</th>
<th>t ratio</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Object relative on active embedded</td>
<td>0.004</td>
<td>0.19</td>
<td>0.848</td>
</tr>
<tr>
<td>phonological WM composite score</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2) Passive composite (3-4) on active composite (1-2)</td>
<td>0.007</td>
<td>0.46</td>
<td>0.668</td>
</tr>
<tr>
<td>phonological WM composite score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3) Embedded passive on main clause passive</td>
<td>0.023</td>
<td>1.57</td>
<td>0.122</td>
</tr>
<tr>
<td>phonological WM composite score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4) Relative clause average on lexical distractors</td>
<td>0.036</td>
<td>2.12</td>
<td>0.040*</td>
</tr>
<tr>
<td>phonological WM composite score</td>
<td></td>
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</tr>
</tbody>
</table>

*Significant Correlation

1. Object relative (5) on active embedded (2)
4. Relative clause average on lexical distractors

Discussion
- Category probe (semantic WM) had a significant independent contribution (p=0.006) to the comprehension of object relative sentences.
- Our Phonological WM composite score (Phonological WM) had a significant contribution (p=0.0401) to the average comprehension of the relative clause sentences when regressed on lexical distractors.

Limitations and Implications
- Should develop an experimental paradigm to test online sentence comprehension of aphasic patients.
- Need to also look at the relationship between language production and the domain specific WM model in healthy individuals.

References

Acknowledgement
This material is based upon work supported by the National Science Foundation under Grant No. (SMA-1853936 and SMA-1559393).

This project is a part of the NSF REU: Translational Research in Psychological Sciences- Human Factors at Rice University Program.