The impact of resolved filler-gap dependencies on later dependency completion

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Background

How is syntactic context organized in memory?

Filler-gap dependencies provide a useful case for investigating this question, as their resolution requires the retrieval and integration of a stored representation with particular structural properties:

I wondered [WH] which dachshund [WH] Tom wanted [WH] to pet...

Recent research indicates that fillers are accessed directly during comprehension [1]. Direct access is argued to be not mediated by a distinct memory architecture dedicated to such processes, but rather by a cue-based retrieval in a content-addressable memory [2,3].

Interference due to cue overload is a property of such associative models of memory, and its role in language processing has received renewed attention. Studies demonstrating interference in language comprehension must clearly indicate a role for interference stemming from shared information in the input sequence [4,5]. However, it is also well understood to the extent to which configurational cues are implicated in the same retrieval system, though there is suggestive evidence [6].

In two self-paced reading studies, we present evidence that suggests that syntactic fillers can induce interference directly during comprehension.

The studies

We considered cases where two filler-gap dependencies with similar properties co-occurred within the same sentence. We then examined reading times where the second dependency was resolved.

PREDICTION: If the structural configuration of constituents can induce interference in retrieval, then we predict greater difficulty in resolving filler-gap dependencies when two constituents with similar structural properties are available as potential candidates, compared to cases where similar structural candidates are not available.

We identify the following potential interference scenarios:

Study 1: Nested dependencies

Target measure: Difficulty of resolving an embedded wh-question at its verb

Potential interferer: Filler of relative clause, attached to the embedded subject

Design: Embedded Clause Type x Subject-attached Clause

What motivates interference?

The heads of both dependencies occupy the same or similar clause-edge position: [Spec[C]]

<table>
<thead>
<tr>
<th>Critique Word</th>
<th>Relative clause</th>
<th>Noun-complement clause</th>
</tr>
</thead>
<tbody>
<tr>
<td>The woman considered [WH] the secret [WH] that her son often told to his friends</td>
<td>possibly suggested [WH] anything for his future.</td>
<td></td>
</tr>
<tr>
<td>The woman considered [WH] the secret [WH] that her son often lied to his friends</td>
<td>possibly suggested [WH] anything for his future.</td>
<td></td>
</tr>
</tbody>
</table>

Study 1: Results

Comprehension Accuracy

<table>
<thead>
<tr>
<th></th>
<th>WH</th>
<th>RC</th>
<th>Subtotal</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTROL</td>
<td>85</td>
<td>85</td>
<td>85</td>
</tr>
<tr>
<td>Subtotal</td>
<td>80</td>
<td>87</td>
<td>83</td>
</tr>
</tbody>
</table>

All effects are reliable by subject nested effects analysis (p < 0.05)

Summary

- Processing the verb that resolves a filler-gap dependency is not more difficult when a relative clause intervenes rather than a noun complement clause. Noun complement clauses lead to greater difficulty on the critical verb [WH](1,2), [WH]-[WH], [WH]-[WH], [WH]-[WH].
- However, when there is no filler-gap dependency, processing a relative clause v. a noun complement clause does not lead to differential difficulty on the critical verb [WH](1,2), [WH]-[WH], [WH]-[WH], [WH]-[WH].
- When the embedded question filler-gap dependency is open, subject-attached clauses that could be resolved as relative clauses can be processed with considerably more difficulty than those that cannot be resolved as relative clauses [WH](1,2).
- Comprehension accuracy is impacted most strongly in the +WH + RC condition. This measure could reflect interference at the resolution of the outermost dependency, or the difficulty experienced in processing the most deeply embedded one.

Study 2: Sequential Dependencies

Target measure: Difficulty of resolving an object relative at its verb, processed in object position

Potential interferer: Filler of a full relative clause, processed in subject position

Design: Subject Relative Clause Type x Subsequent Clause Type

What motivates interference?

Full RCs have identical structural positions that head the dependency: [Spec[CP]]. Infinitival RCs are argued not to mediate the dependency via the projection [WH].

<table>
<thead>
<tr>
<th>Critique Word</th>
<th>WH/RC</th>
<th>WH/Inf</th>
<th>WH/Conj</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full RC</td>
<td>The last singer [WH] that joined the band</td>
<td>hated the guitarist</td>
<td>possibly suggested [WH] anything for his new album.</td>
</tr>
<tr>
<td>Infinitival RC</td>
<td>The last singer [WH] to join the band</td>
<td>hated the guitarist</td>
<td>possibly suggested [WH] anything for his new album.</td>
</tr>
</tbody>
</table>

Study 2: Results

Comprehension Accuracy

<table>
<thead>
<tr>
<th></th>
<th>RC</th>
<th>SubRC</th>
<th>Subtotal</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTROL</td>
<td>92</td>
<td>92</td>
<td>92</td>
</tr>
<tr>
<td>Subtotal</td>
<td>92</td>
<td>92</td>
<td>92</td>
</tr>
</tbody>
</table>

No effects are reliable by logitastic cross-effects analysis.

Summary

- Resolution of a filler-gap dependency in a relative clause was not more difficult when there was a previous subject/relative clause present.
- Reading time trends followed (non-significantly) in the opposite direction: resolving the dependency was more difficult at the point where the subject contained an infinitival RC. [WH](1,2), [WH]-[WH], [WH]-[WH], [WH]-[WH]; p < 0.05
- Processing the full relative clause attached to the subject was more difficult than the infinitival relative, though difficulty cannot be clearly localized in this dataset: [WH](1,2), [WH]-[WH], [WH]-[WH].
- The interference condition RC/RC did not lead to lower accuracy on comprehension question, as in Study 1.

Discussion

- We find no evidence of difficulty in resolving filler-gap dependencies in the presence of multiple potential candidate fillers with similar structural properties.
- Both studies produced consistent results:
  - In both experimental comparisons, the data show potential evidence that resolution of a wh-dependency may be facilitated when a similar resolution has just occurred earlier in the sentence.
  - One confounding factor with looking for structural interference may be an opposing force of structural priming in comprehension.
- There are several possible interpretations:
  1. Configurational information is not used to cue retrieval of previously processed constituents during sentence reading.
  2. Configurational information is used during retrieval, but in cooperation with information that is sensitive to dependency status (open v. resolved) [cf. 9].
  3. Configurational information accesses syntactic context separately from the cue-based retrieval systems argued to operate on the basis of similarity-based interference results.
- The second interpretation finds support in the increased reading times observed during the resolution of the internal nested dependency in Experiment 1: +WH/WH/RC, in contrast to +WH/RC.
- Further research is necessary that finds and compares very close structural variants, and assesses the impact of such variation on processing.

References


Acknowledgments

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