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 [$_{CP}$ **which dachshund** [$_{C'}$ Tom wanted [$_{TP}$ to **pet** …

Legal fillers occupy a position in the clause edge

Recent research indicates that fillers are accessed directly during comprehension [1]. Direct access is argued to be not mediated by a distinguished 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 most clearly indicate a role for interference stemming from shared inherent properties of items in memory [4,5]. Less well understood is 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 constituents that share similar structural properties within a sentence do not significantly interfere with retrieval. These data either constrain the kinds of cues used or restrict the scope of cued-based retrieval in structure-sensitive processes.

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**

An embedded *wh*-question must be resolved which contains a relative clause.

Study 2 **SEQUENTIAL DEPENDENCIES**

An object-attached relative clause must be resolved in a sentence which also contains a subject-attached relative clause.

Isolating experimental comparisons which vary one local configuration but are otherwise identical on all conceivably relevant dimensions is probably not possible. Structural changes are rarely vacuous. We rely therefore on qualitatively similar results across two studies to draw our conclusions

Discussion

- **We find no evidence of difficulty in resolving filler-gap dependencies, due to 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 comprehension.
  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/+RC**, in comparison 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

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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
{ **wh** | **if** } x { **relative clause** | **noun complement clause** }

What motivates interference?
The heads of both dependences occupy the same or similar clause-edge position: [Spec,CP]

CRITICAL VERB

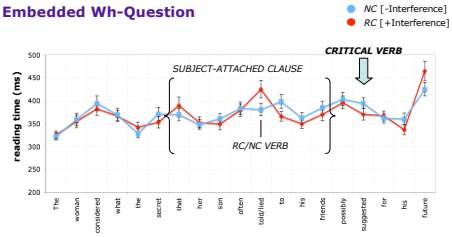
Relative clause
The woman considered **what**/if the secret [$_{RC}$ that her son often told to his friends] possibly **suggested** ____ / anything for his future.

Noun-complement clause
The woman considered **what**/if the secret [$_{NC}$ that her son often lied to his friends] possibly **suggested** ____ / anything for his future.

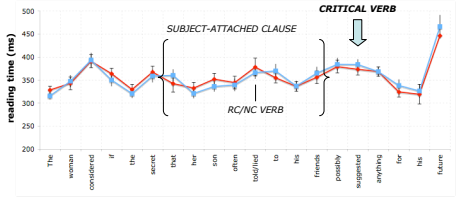
Study 1: Results

N = 31

Embedded Wh-Question



Control: Embedded If-Question



Comprehension Accuracy

%	RC	NC	*Subtotal*
WH	75	89	82
CONTROL	85	85	85
Subtotal	80	87	83

All effects are reliable by logistic mixed-effects model ($ps < 0.05$)

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 [$F_1(1,31)$: 7.4*; MSE: 63410].
- 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 [$F_1(1,31)$: ~0; MSE: 64].
- When the embedded question filler-gap dependency is open, subject-attached clauses that could be resolved as relative clauses are processed with considerably more difficulty than those that cannot be resolved as relative clauses [cf. 7].
- 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
{ **full RC** | **infinitival RC** } x { **full RC** | **conjoined clause** }

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 this projection [8].

CRITICAL VERB

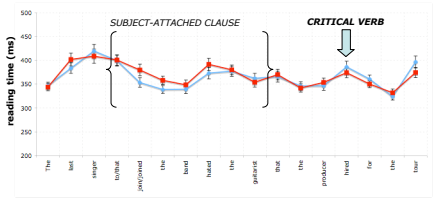
Full RC
The last singer [$_{RC}$ that joined the band] hated the guitarist [$_{RC}$ **that**/[$_{DP}$ **but** the producer **hired** ____ / **him** for the new album]

Infinitival RC
The last singer [$_{Inf\text{-}RC}$ to join the band] hated the guitarist [$_{RC}$ **that**/[$_{DP}$ **but** the producer **hired** ____ / **him** for the new album]

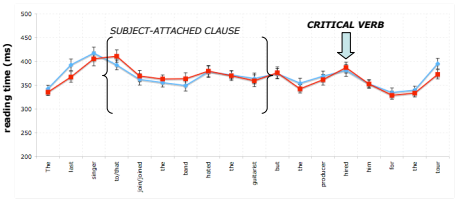
Study 2: Results

N = 22

Second Clause = Full Relative Clause



Control: Second Clause = Conjoined Clause



Comprehension Accuracy

%	RC	InfRC	*Subtotal*
2nd: RC	96	95	95
CONTROL	92	92	92
Subtotal	94	93	94

No effects are reliable (by logistic mixed-effects model).

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 results trended (non-significantly) in the opposite direction: resolving the dependency was more difficult at the critical verb when the subject contained an Infinitival RC. [$F_1(1,22)$: 2.3; MSE: 54952; $p < 0.15$]
- 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 [$F_1(1,22)$: 5.9; MSE: 93535].
- The interference condition **RC/RC** did not lead to lower accuracy on comprehension question, as in Study 1.