Memory Retrieval in the Processing of Anaphoric Presupposition Dependencies

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Joint work with E. Matthew Husband (Oxford)
Language comprehension involves successfully establishing linguistic dependencies.

To do this, the comprehender must successfully retrieve the memory representation of an antecedent.

- When is memory retrieval required?
- How is a desired memory representation retrieved?
- What happens in the case of mis-retrieval?
ROADMAP

- Presupposition and memory retrieval
- Exp 1: *When is memory retrieval required?*
- Retrieval mechanisms: direct access vs. serial search
- Exp 2-3: *What retrieval mechanism underlies the processing of anaphoric presuppositions?*
- Discussions
PRESUPPOSITION AS ANAPHORIC DEPENDENCY

- Treating presuppositions analogously to anaphoric expressions such as pronouns (Kripke, 1990/2009; van der Sandt, 1992; Beck, 2007; a.o.).

- “Anaphoric” is taken to mean “requiring a contextually provided antecedent”.

Presupposition & Memory | Exp 1 | Retrieval Mechanisms | Exp 2 | Exp 3 | Discussion
Too as an anaphoric trigger

- *Too*: a hard trigger

- Establishing an anaphoric dependency between the trigger (i.e. retrieval site) and the presupposed content (i.e. antecedent).

- Known to be focus sensitive: it can F-associate with the subject or the VP of the host sentence (but the latter use is not our concern here).
ANAPHRORIC DEPENDENCY OF TOO

- Dependency: *John went swimming. Mary went swimming too.*
- No dependency: *John went swimming. Mary went dancing.*
We expect to see that the processing of *too* would share the same processing signature as other anaphoric expressions.

- Pronoun resolution  (Foraker & McElree, 2007)
- VP ellipsis  (Martin & McElree, 2008)
- Sluicing  (Martin & McElree, 2011)
We investigate the memory retrieval process as a processing signature of the presuppositional dependency:

- A memory retrieval process is initiated — When?

- The memory retrieval process of many anaphoric dependencies may use either “direct access mechanism” or “serial search mechanism” — Which?
HYPOTHESIS FOR THE RETRIEVAL PROCESS

Trigger → Retrieving presupposed content

- Successful
  - Update context
    - Successful
    - Update context
    - Unsuccessful
    - Reject utterance

- Unsuccessful
  - Accommodate
    - Successful
    - Update context
    - Unsuccessful
    - Reject utterance
  - Ignore?
TODAY’S FOCUS:

- We first experimentally investigate this process of presupposition resolution.

Diagram:

Trigger ➔ Retrieving presupposed content

Successful

Update context
OUR QUESTIONS

- What is the memory retrieval mechanism that underlies the processing of too?

- Specifically:
  - When is memory retrieval required? (Exp 1)
  - When retrieval is required, does it show interference effects (a component of cue-based, direct access)? (Exp 2-3)
OUR QUESTIONS

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- Specifically:
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When is memory retrieval required?


- Outside focal attention, which is known to be a very limited span (Broadbent, 1958; McElree, 2006).
- Some information is shunted nearly immediately from the focal attention, necessitating its later retrieval.
EXPERIMENT 1: THE DISTANCE PARADIGM

- Speeded acceptability judgement (N = 36, 60 items)
  - An experimenter-paced sentence reading task
  - Word-by-word, RSVP presentation
  - Each trial ends with an acceptability judgment with binary choices.
EXPERIMENTAL DESIGN

- $3 \times 2$ design:
  - Distance was manipulated as **Short** or **Long**.
  - Antecedent (VP) was **Near**, **Far**, or **Failure**.
<table>
<thead>
<tr>
<th></th>
<th>Short</th>
<th>Long</th>
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<tbody>
<tr>
<td>Near</td>
<td>If the writer <em>complained</em> and the editor <em>resigned</em>, then the critics <em>resigned</em> too.</td>
<td>If the writer <em>complained</em> and the editor <em>resigned</em>, then <em>everyone at the publishing house would be shocked to hear that</em> the critics <em>resigned</em> too.</td>
</tr>
<tr>
<td>Far</td>
<td>If the editor <em>resigned</em> and the writer <em>complained</em>, then the critics <em>resigned</em> too.</td>
<td>If the editor <em>resigned</em> and the writer <em>complained</em>, then <em>everyone at the publishing house would be shocked to hear that</em> the critics <em>resigned</em> too.</td>
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<tr>
<td>Failure</td>
<td>#If the writer <em>complained</em> and the editor <em>plagiarized</em>, then the critics <em>resigned</em> too.</td>
<td>#If the writer <em>complained</em> and the editor <em>plagiarized</em>, then <em>everyone at the publishing house would be shocked to hear that</em> the critics <em>resigned</em> too.</td>
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RESULTS

Speeded Judgments, Responses

Proportion of YES Responses

Distance
- Long
- Short

Clauses:
- Failure
- Far
- Near

Presupposition & Memory | Exp 1 | Retrieval Mechanisms | Exp 2 | Exp 3 | Discussion
Helmert-coded contrasts revealed a significant effect of Distance on Near vs. Far (z = 2.046, p = .041), replicating previous results (Chen & Husband, 2018).

Distance worsened availability in the Near condition, but not in the Far condition.
Once outside focal attention, the quality of memory representation decays —> decreases availability.

Having a single clause between the presupposed content and the trigger is enough to push that content out of focal attention and thus requiring retrieval, consistent with Frazier & Clifton (2005).
The processing of *too* requires memory retrieval.

- This process is structure-sensitive.
What is the memory retrieval mechanism that underlies the processing of too?

Specifically:

- When is memory retrieval required? (Exp 1)
- When retrieval is required, does it show interference effects (a component of cue-based, direct access)? (Exp 2-3)
Direct access mechanism is cue-based, content-addressable (Foraker & McElree, 2007; Martin & McElree, 2008, 2011):

- When retrieving the memory representation of an antecedent, only the target representation is considered.

- Quality of the representation for remote antecedents decays, reducing availability (but not speed of retrieval).

- Liable to interference effects (Anderson & Neely, 1996)
Set of representations being inspected: {Mary}

Decayed quality

Presupposition & Memory

Retrieval Mechanisms

Exp 1

Exp 2

Exp 3

Discussion
Distance effects on VP Ellipses:

- **Near antecedent**: The editor/ admired the author’s writing,/ but the critics/ did not.

- **Distant antecedent**: The editor/ admired the author’s writing,/ but everyone/ at the publishing house/ was shocked to hear that/the critics/did not.
Distance effects on the asymptote (availability), but not on the speed of retrieval.

Consistent with a content-addressable, direct access process.
MEMORY RETRIEVAL MECHANISMS: TWO HYPOTHESES

- **Serial search** mechanism involves necessarily accessing irrelevant intermediate contents:
  - Multiple representations are inspected, resulting in a slowdown in terms of retrieval speed.

- Temporal/Spatial order information, and unstructured lists are recovered with a serial search mechanism (Gronlund, Edwards, & Ohrt, 1997; McElree, 2001, 2006; McElree & Dosher, 1993)
Intermediate content might be unsuitable as an antecedent, but relevant for determining whether the dependency is legitimate.

- e.g. c-commanding relations can be easily checked via a serial walk through the structure.
Distance effects on Mandarin *ziji*, a morpho-syntactically impoverished long-distance reflexive:

- **Near antecedent**: AUTO-BIOGRAPHY SAY Zhangsan UNDERESTIMATE-PERF ziji.

- **Distant antecedent**: Zhangsan SAY REPORT UNDERESTIMATE-PERF ziji.
Distance effects on the asymptote (availability), as well as the speed of retrieval.

A time-course advantage for near antecedents, consistent with a serial search process.
RETRIEVAL BEHAVIORS: A RECAP

- The two retrieval mechanisms make different predictions about the retrieval behaviors:
  - A **direct access** process is **insensitive to the distance** of licensed antecedents, but suffer **interference** from structurally inaccessible antecedents.
  - A **serial search** process is **sensitive to the distance** of licensed antecedents, but avoids **interference** from structurally inaccessible antecedents.
Instead of SAT, we primarily use the speeded acceptability judgement paradigm, which requires the participants to:

- (a) rely on memory (since the sentence is not on the screen),
- (b) respond relatively quickly (but may still be trading off speed and accuracy)

As such, the data might fall anywhere along the SAT curves.

In previous work, we’ve also used Drift Diffusion Modelling to get at the issue of retrieval speed (Chen & Husband, 2018).
EXPERIMENT 2: THE MODAL PARADIGM

- Speeded acceptability judgement (N = 64, 64 items)
  - An experimenter-paced sentence reading task
  - Word-by-word, RSVP presentation
  - Each trial ends with an acceptability judgment with binary choices.
EXPERIMENTAL DESIGN

- 2 × 2 design:
  - Accessibility was either Inaccessible or Accessible.
  - Antecedent (VP) was Satisfaction or Failure.
WHAT IS AN INACCESSIBLE ANTECEDENT?

- Embedding the antecedent under an *epidemic possibility modal* makes it structurally inaccessible.
  - Mary ate an apple. John ate an apple *too*.
  - Mary might have eaten an apple. John ate an apple *#too*.
- If mis-retrieved, interference effects arise:
  - Given time, speakers can recognise the infelicity.
  - Under time pressure, speakers judge incorrectly.
<table>
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RESULTS

Speeded Judgments, Responses

Inaccessible                                            Accessible

Antecedent

Presupposition & Memory

Exp 1      Retrieval Mechanisms      Exp 2      Exp 3      Discussion
### Results

- No interaction ($t = 1.042, p = .302$)

- A significant main effect of Satisfaction vs. Failure ($t = 5.867, p < .001$), but no significant main effects of Inaccessible vs. Accessible ($t = -1.048, p = .299$)

- Crucially, no evidence for difference between Inaccessible Satisfaction and Accessible Satisfaction, but Inaccessible Satisfaction is distinct from Inaccessible Failure.
This suggests interference effects from inaccessible content, which is expected if a direct access retrieval process is at play.

Consistent with the lack of distance effects on retrieval speed as reported in our previous study using Drift Diffusion Models (Chen & Husband, 2018).
MORE INTERFERENCE

- Another way to induce interference effects: Negation
  - Mary ate an apple. John ate an apple too.
  - Mary did not eat an apple. John ate an apple too.
EXPERIMENT 3: THE NEGATION PARADIGM

- Speeded acceptability judgement (N = 36, 64 items)
- An experimenter-paced sentence reading task
- Word-by-word, RSVP presentation
- Each trial ends with an acceptability judgment with binary choices.
EXPERIMENTAL DESIGN

- 2 × 2 design (same as Exp 2)
  - Accessibility was either Inaccessible or Accessible.
  - Antecedent (the VP) was Satisfaction or Failure.
### Material

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Proportion of YES Responses

Inaccessible

Accessible

Antecedent

Presupposition & Memory | Exp 1 | Retrieval Mechanisms | Exp 2 | Exp 3 | Discussion
COMPARISON: EXP 2 VS. EXP 3

Exp 2: the Modal paradigm

Exp 3: the Negation paradigm
RESULTS

- Sum-coded contrasts revealed a significant interaction of Antecedent and Accessibility ($z = 3.772, p < .001$)
- Accessible Satisfaction is distinct from Failure ($26.2\%, z = 4.621, p < .001$)
- No evidence for difference between Inaccessible Satisfaction and Inaccessible Failure ($4.9\%, z = 1.599, p = .117$).
This seems to run counter to the predicted interference effects in a direct access account.

However, we may also take it to be suggestive of the size of the retrieved antecedent:

- Phrasal negation is still part of the antecedent content, unlikely to be mis-retrieved.
- Prediction: Higher negation may still induce inference.
CONCLUSIONS

- Our results suggest that the processing of the presuppositional dependency of *too* shows signatures of content addressable, direct-access memory retrieval:

  - This retrieval of the presupposed content is insensitive to the distance of licensed antecedents;

  - But it is also interference-prone, suffering interference from structurally inaccessible antecedents.
IMPLICATIONS

- Retrieval of the presupposed content of *too* via a direct access mechanism fits well with evidence for other types of anaphoric dependencies.

- The current findings contribute to a growing body of empirical evidence suggesting that the memory representations of *linguistic dependencies* formed during comprehension are *content-addressable* and retrieved in a *direct-access* manner.
FURTHER DISCUSSION: DEPENDENCY & RETRIEVAL

- Three relevant dimensions for considering which memory retrieval mechanism is at play:
  - What is a suitable antecedent in which dependency?
  - How much information is required for identifying a target antecedent in direct access?
  - What are the structural properties of a dependency that need to be taken into account?
SELECTED REFERENCES


Thank you!

Acknowledgements

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