Comprehending Anaphoric Presuppositions Involves Memory Retrieval *too*

Sherry Yong Chen[1] & E. Matthew Husband[2]

1 Massachusetts Institute of Technology **2** Language and Brain Laboratory, University of Oxford

Memory in Processing Presuppositions?

Anaphoric presupposition triggers such as *again* and *too* are thought to establish a dependency relation between the trigger and its presupposed content.

- e.g. Beck (2007), Heim (1992), Kripke (1990/2009), van der Sandt (1992), among others.

Like other anaphoric dependencies, establishing presuppositional dependencies likely relies on memory processes. There are three possibilities:

1. Discourse content may be *actively maintained* in working memory.
2. Previous experimental work suggests that the processing of presuppositions exhibits a locality bias (Kim 2015), suggesting a *serial search retrieval* mechanism.
3. However, presupposition triggers like *again* have been reported to be rapidly sensitive to presupposition violations (Tiemann et al, 2011), suggesting a *direct access retrieval* mechanism.

Hypotheses & Predictions

These three possibilities may be distinguished by differences in the *availability* and *retrieval speed* of the presupposed content.

- If actively maintained → there should be no difference in either *availability* or *retrieval speed* as dependency length increases.
- If retrieved → *availability* should be reduced as dependency length increases.
  - If not via direct access → *retrieval speed* should be slowed as dependency length increases, indicating serial search (McElree, 2000).

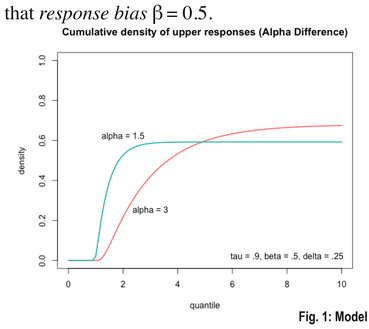
Drift Diffusion Model

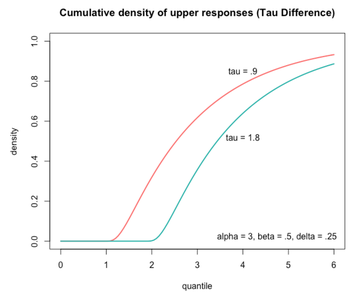
Drift Diffusion Modelling (DDM) has been used to analyse two alternative forced choice experimental designs.

- We use DDM as an alternative to Multiple Response SAT, a methodology that disassociates memory access from retrieval speed and availability
- Advantage of DDM: it provides convergent evidence to SAT, and has advantages in requiring fewer response time measurements to recover meaningful parameters.

DDM jointly models accuracy and response time distributions with parameters that reflect distinct underlying memory retrieval processes.

- We focus on three parameters:
  - τ, *nondecision time*, the time required for memory access (similar to the SAT intercept);
  - α, *boundary separation*, the retrieval speed (similar to the SAT rate);
  - δ, *drift rate*, the asymptotic accuracy reflecting the quality of the memory trace (similar to the SAT asymptote).
- Because we are modelling accuracy, we assume that *response bias* $\beta = 0.5$.





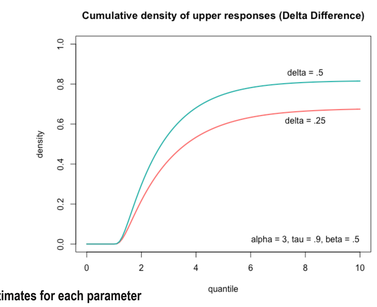


Fig. 1: Model estimates for each parameter

Pilot Study

Replication of Martin & McElree (2011)

- Martin & McElree (2011) reported that distance had *no effect* on the time for memory access in the processing of sluicing constructions.
- They suggested that antecedents are retrieved via a *cue-based direct-access* mechanism that is susceptible to general memory variables.
- Using DDM, we replicated their findings for sluicing, manipulating Distance and Acceptability:
  - Near-Grammatical — Michael slept and studied, but he didn't tell me what.
  - Far-Grammatical — Michael studied and slept, but he didn't tell me what.
  - Near-Ungrammatical — * Michael slept and studied, but he didn't tell me which.
  - Far-Ungrammatical — * Michael studied and slept, but he didn't tell me which.

Speeded acceptability judgement (N = 64) on MTurk

- An experimenter-paced, phrase-by-phrase sentence reading task RSVP presentation.
- Followed by an end of sentence acceptability judgment with binary choices.

Results:

- DDM revealed no effect on τ or α, suggesting that memory access during the processing of sluicing constructions is not a serial search mechanism.
- This is in line with Martin & McElree's (2011) report of needing only a single intercept parameter (and multiple asymptote parameters, similar to our findings for significantly different δs).

		τ (Nondecision Time)	α (Boundary Separation)	δ (Drift Rate)
Sluicing	Distance	1.150	1.051	-0.266
	Grammaticality	-0.700	0.521	3.361**
	Interaction	-1.338	1.097	3.509***

Table 1: *t*-values for model estimates of effects on DDM parameters in Experiment 1

The Current Study: *too*

The pilot study suggests that DDM can be used to model speed-accuracy tradeoffs during memory retrieval in sentence processing.

- Specifically, a difference in τ or α can be used to infer whether a serial search or a direct access retrieval process is at play.

We now investigate the memory retrieval mechanism for the anaphoric trigger *too* (N=64).

- Using the paradigm above, we manipulated Distance and Acceptability of the presupposed content:
  - Near-Acceptable — If the editor resigned, then the critics resigned too.
  - Far-Acceptable — If the editor resigned, then everyone at the publishing house would be shocked to hear that the critics resigned too.
  - Near-Unacceptable — * If the editor plagiarized, then the critics resigned too.
  - Far-Unacceptable — * If the editor plagiarized, then everyone at the publishing house would be shocked to hear that the critics resigned too.
- The presuppositions of *too* is embedded within the conditional "*if ... then …*" to avoid strategic processing due to the trigger being obligatory in the discourse (*Maximize Presupposition,* Heim 1991)

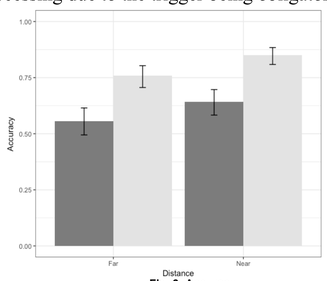


Fig. 2: Accuracy

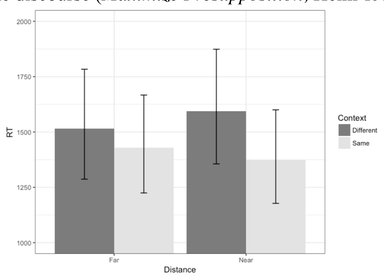


Fig. 3: Reaction times

Results & Analyses

Accuracy data:

- Participants were more accurate at resolving the presupposition dependency in the **Near** condition, suggesting *availability* differences.
  - There was a main effect of Distance ($t = 4.769$, $p < .001$) and Context ($t = 3.604$, $p < .001$).
  - Their interaction was non-significant ($t = 0.671$, $p = .502$).

Reaction time data:

- There was a main effect of Context ($t = -2.755$, $p = .007$) with only a marginally significant interaction between Distance and Context types ($t = 1.799$, $p = .079$).
- However, planned comparison revealed *no effects* of Distance within the Context types.

DDM Analysis:

- DDM revealed an effect of Context on τ, but not Distance, and no effect on α.
- We found no significant effects of Distance in terms of speed of retrieval.
- This is consistent with a *cue-based direct access* model of memory retrieval.

		τ (Nondecision Time)	α (Boundary Separation)	δ (Drift Rate)
Anaphoric Presuppositions	Distance	1.691	0.863	-1.725
	Context	2.100*	0.821	4.261***
	Interaction	0.941	-0.051	-0.310

Table 2: *t*-values for model estimates of effects on DDM parameters in Experiment 2

General Discussion

Key findings:

- Our results support the idea that the processing of the anaphoric trigger *too* involves memory retrieval processes.
- More specifically, the comprehension of the presupposition of *too* favors a local antecedent in terms of accuracy but not retrieval speed, supporting a content-addressable, direct access mechanism.
- Comprehenders are able to directly access the representation of a presupposed content that has been established in the discourse, without searching through irrelevant intermediate material before finding the desired representation in memory.

Implications:

- Retrieval of the presupposed content of *too* by a direct access mechanism fits well with evidence for other types of linguistic dependencies, such as pronoun resolution (Foraker & McElree, 2007), VP ellipsis (Martin & McElree, 2008), and sluicing (Martin & McElree, 2011).
- These findings contribute to a growing body of empirical evidence suggesting that the memory representations of discourse dependencies formed during comprehension are content-addressable and retrieved with a direct-access process.
- It has been proposed that triggers may be "hard" or "soft" depending of the possibility of accommodation (Abusch, 2010), raising the question of whether different triggers behave differently with regards to memory retrieval.
  - The answer may be directly related to memory retrieval mechanisms.
  - For instance, a direct-access retrieval mechanism may be best suited for "hard" triggers during the processing of presuppositions, since these require exhaustive search of context which would be burdensome for a search-based mechanism.

Remaining questions:

- What "cues" are being exploited to retrieve the memory representations of presupposed content?
  - Certainly not morph-syntactic cues, e.g. person/number/gender for pronoun resolutions.
  - Discourse cues? How are they represented?
- How should distance be represented when the antecedent that satisfies the presupposition is not in the same sentence as the trigger?
  - A theory of the hierarchy of discourse content (e.g. QUD) may provide a solution to this question
- What are the processing costs for memory retrieval and context update? How are these related to presupposition accommodation, where memory retrieval fails but the context can still be updated?

Contact

Email: sychen@mit.edu
Website: sherrychen.org
Twitter: @linguistsherry

Email: matthew.husband@ling-phil.ox.ac.uk
Website: https://sites.google.com/site/emhusband/
Twitter: @emhusband

Selected References

Beck, S. (2007). Quantifier dependent readings of anaphoric presuppositions. • Foraker, S., & McElree, B. (2007) The role of prominence in pronoun resolution: Active versus passive representation • Heim, I. (1992). Presupposition projection and the semantics of attitude verbs. • Kim, C. S. (2015). Presupposition satisfaction, locality and discourse constituency. • Kripke, S. (1990/2009). Presupposition and anaphora: Remarks on the formulation of the projection problem. • van der Sandt, R. (1992). Presupposition projection as anaphora resolution. • Tiemann, S. et al. (2015). Presupposition Processing and Accommodation: An Experiment on *wieder* ('again') and Consequences for other triggers. • Martin, A. E., & McElree, B. (2008). A content-addressable pointer mechanism underlies comprehension of verb-phrase ellipsis. • Martin, A. E., & McElree, B. (2011). Direct-access retrieval during sentence comprehension: evidence from sluicing. • Martin, A. E., & McElree, B. (2011). Direct-access retrieval during sentence comprehension: evidence from sluicing. • McElree, B. (2000). Sentence comprehension is mediated by content-addressable memory structures. • Tiemann, S., Schmid, M., Bade, N., Rolke, B., Hertrich, I., Ackermann, H., & Beck, S. (2011). Psycholinguistic evidence for presuppositions: On-line and off-line data.

Acknowledgement: We thank Brian Dillon and Alex Göbel (UMass Amherst) for many helpful discussions.

QR Code