

Animacy & long-distance pronominal anaphora in discourse: evidence from the Maze

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Pronominal anaphora resolution in discourse

Pronominal anaphora resolution between adjacent clauses is modulated by factors including information structure [1,2], lexical semantics [3], and discourse structure [4]. Relatively little is known about long-distance anaphora processing [5,6].

How do the factors modulating short-distance pronominal anaphora resolution influence long-distance pronominal anaphora resolution?

Two views of long-distance anaphora resolution

- The accessibility of a potential antecedent is modulated by its prominence.
 - Factors that can facilitate short-distance anaphora resolution, like syntactic focus, may facilitate long-distance noun phrase anaphora resolution [4].
- The accessibility of a potential antecedent is fully structurally determined.
 - Rooted in formal pragmatic theories positing hierarchical discourse structure [7,8].
 - By the rules of discourse structure-building, only potential antecedents in certain positions are hierarchically accessible; the rest are inaccessible.

Hypotheses

Prominence: Antecedent prominence modulates long-distance anaphora resolution. The more prominent an antecedent, the easier to resolve to it.

- Any prominence-modulating factor can affect pronoun resolution

Grammatical Constraint: Discourse-structural accessibility of potential antecedents governs long-distance anaphora resolution [7,8].

- Doesn't straightforwardly allow for any (other) antecedent prominence effects.

Animacy and anaphora

- We operationalize prominence with animacy, viewed as a hierarchy (animate > inanimate) [9].
- Our previous finding: In final state interpretations, sentences containing pronouns with discourse-structurally inaccessible antecedents were rejected less frequently with animates than inanimates.
 - Consistent with Prominence, not Grammatical Constraint.
- Open question: How does animacy influence online long-distance pronominal anaphora processing?

Predictions

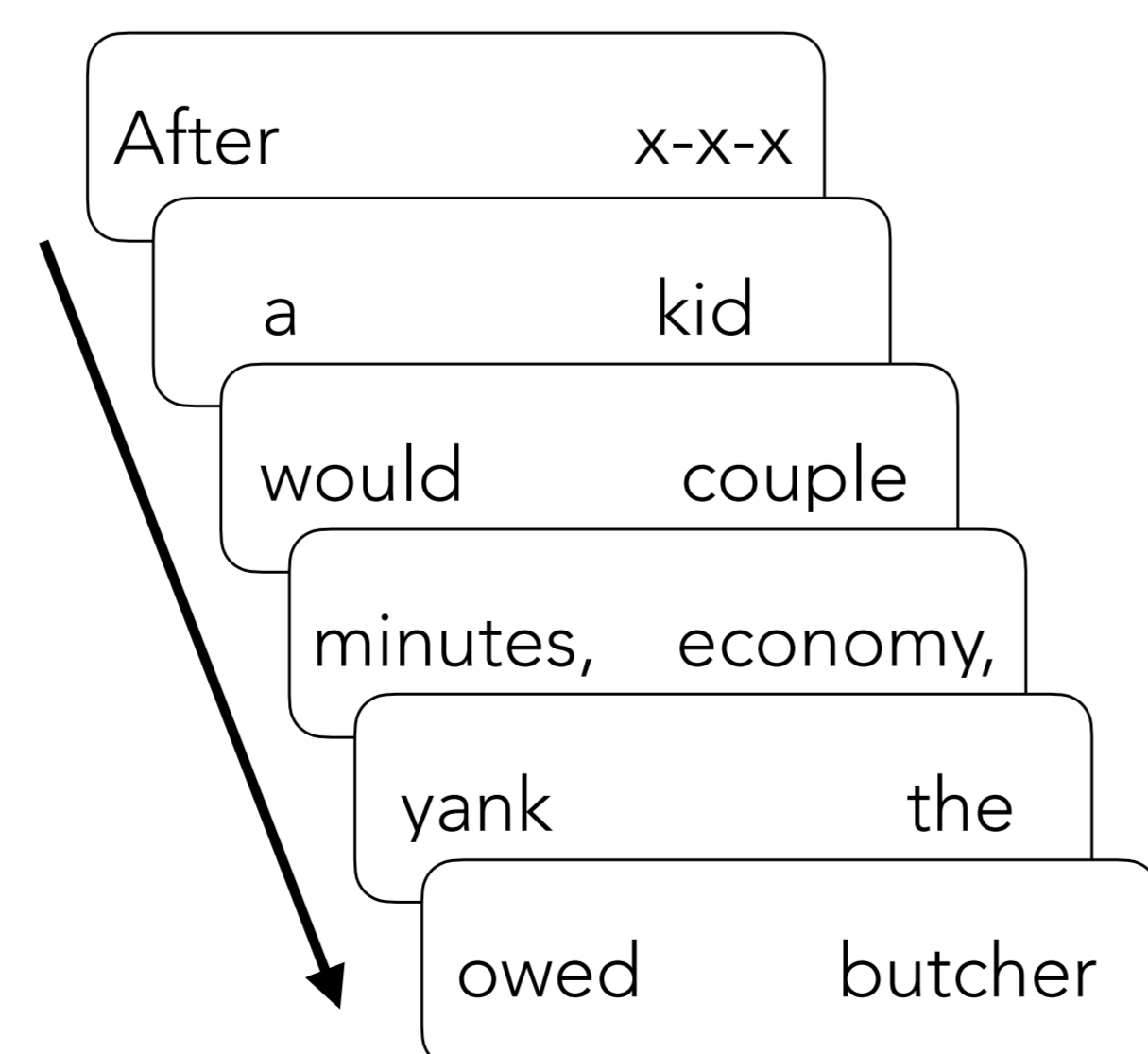
Prominence: Anaphora resolution should be easier with animates than inanimates.

Grammatical Constraint: Pronominal anaphora resolution should be harder than NP anaphora resolution when the antecedent is structurally inaccessible.

- Animacy should not modulate this effect.

The Maze Task [10]

- Advance by choosing valid continuation
- Choosing foil terminates trial
- Success requires fully incremental processing
- Foils auto-generated [11], then manually revised



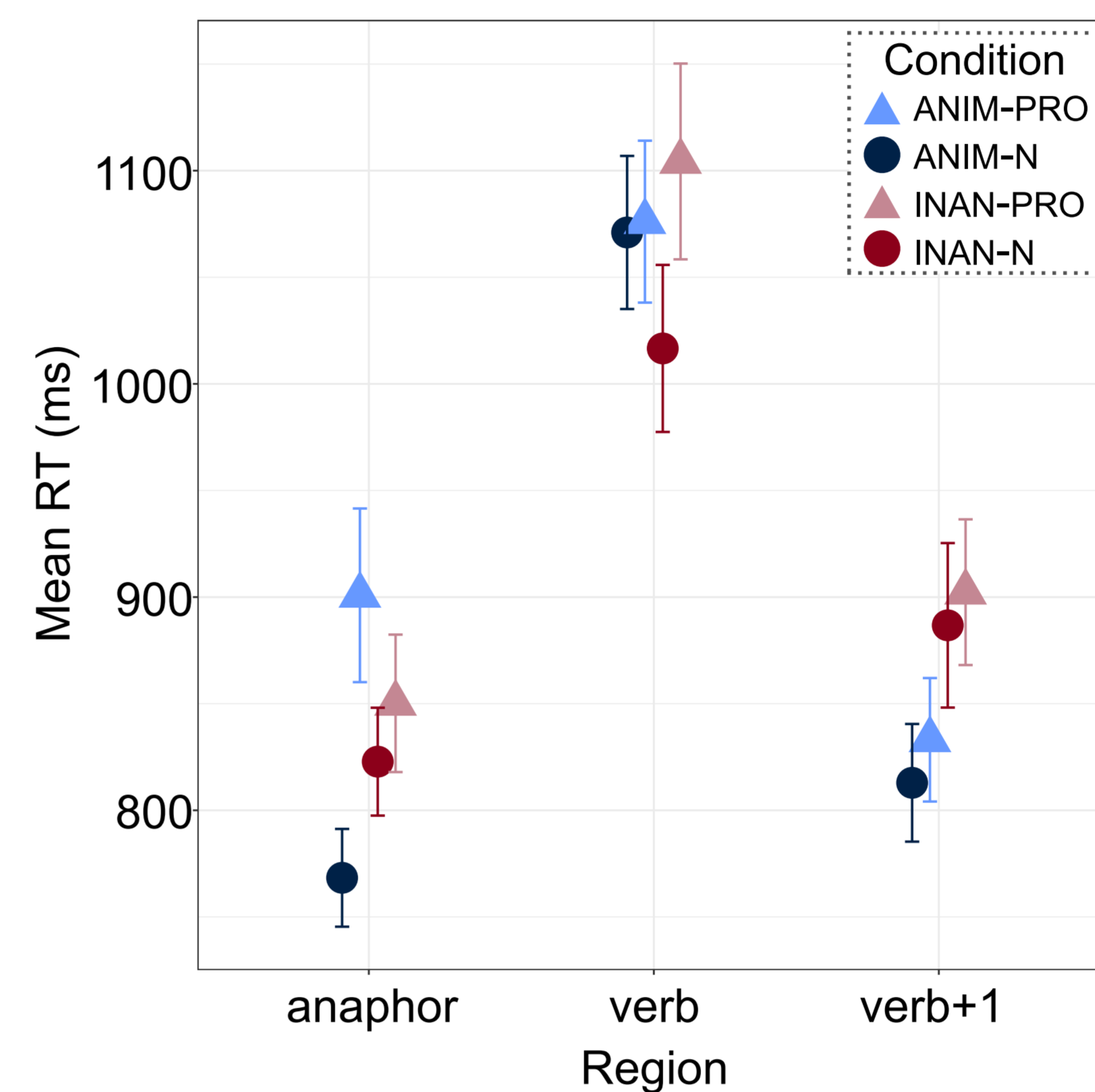
References [1] Foraker, Stefani & Brian McElree. 2007. *Journal of Memory & Language* 56(3). [2] Kaiser, Elsi & John C. Trueswell. 2011. In *The Processing & Acquisition of Reference*. [3] Koornneef, Arnout W. & Jos J.A. Van Berkum. 2006. *Journal of Memory & Language* 54. [4] Kehler, Andrew & Hannah Rohde. 2013. *Theoretical Linguistics* 39(1-2). [5] Klin, Celia M., Kristin M. Weingartner & Alexandria E. Guzmán. 2004. *Memory & Cognition* 32(3). [6] Sasaki, Kelsey, Pranav Anand, & Amanda Rysling. 2023. *Conference on Human Sentence Processing*. [7] Polanyi, Livia. 1988. *Journal of Pragmatics* 12(5-6). [8] Asher, Nicholas & Alex Lascarides. 2003. Cambridge University Press. [9] Smith-Stark, T. Cedric. 1974. *Chicago Linguistic Society* 10(1). [10] Forster, Kenneth I., Christine Guerrera, & Lisa Elliot. 2009. *Behavior Research Methods* 41(1). [11] Boyce, Veronica, Richard Futrell, & Roger Levy. 2020. *Journal of Memory and Language*, 111.

Experiment (n = 58)

Key finding: Long-distance anaphora resolution appears to be harder for pronouns than nouns; the role of animacy is as yet unclear.

2x2 Maze task crossing Animacy (ANIMATE, INANIMATE) and Anaphor Type (Noun, PRONoun) for 40 items (+40 fillers).

Sentence	ANIMATE		INANIMATE	
	N	PRO	N	PRO
1	Diana spotted a butcher at the farmer's market on Wednesday.		Diana spotted a squash at the farmer's market on Wednesday.	
2	She stopped to browse some cheeses.			
3	After a couple minutes, the butcher called her over to his stall.		After a couple minutes, he called her over to his stall.	
	the squash tipped over onto its side.		it tipped over onto its side.	



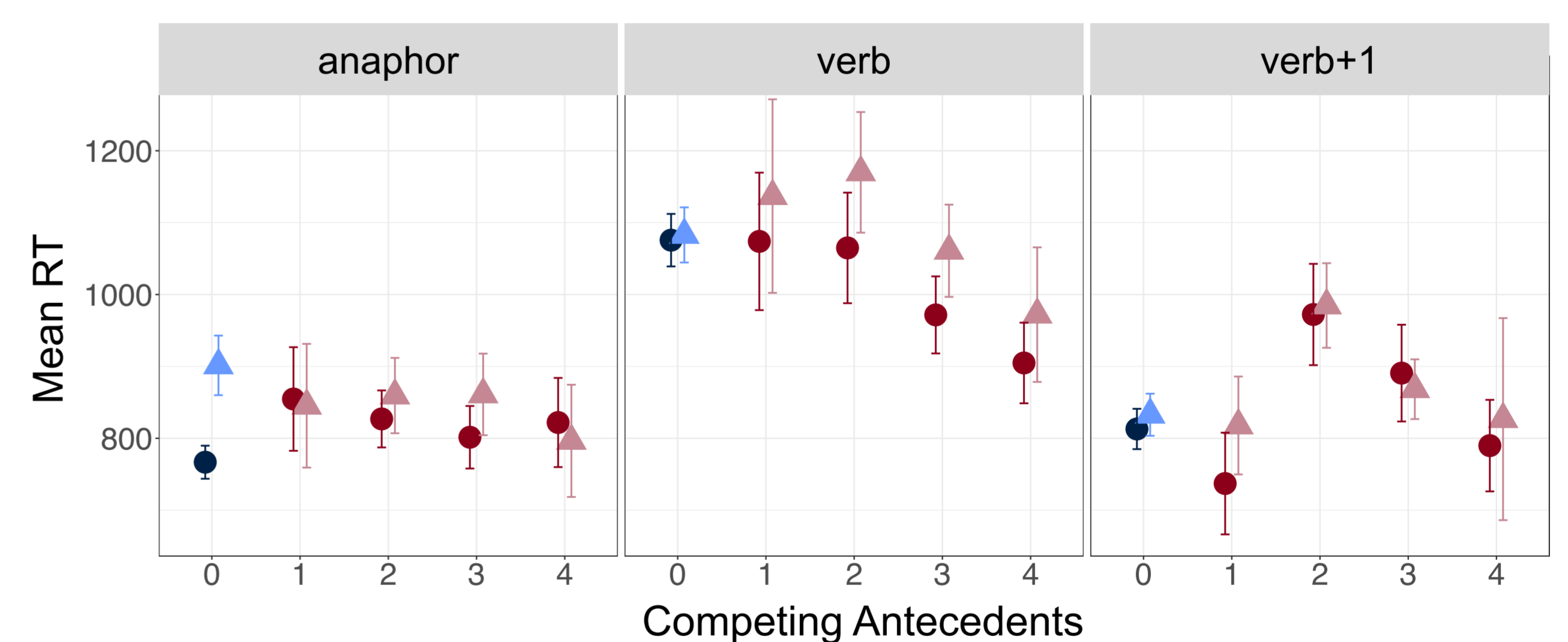
brms linear m/e models for ln(RT)		
Anaphor	β	95% CrI
*N vs. PRO	0.07	(0.02, 0.11)
ANIM vs. INAN	0.02	(-0.02, 0.04)
*Interaction	-0.12	(-0.18, -0.05)
*ANIM, N vs. PRO	0.12	(0.06, 0.19)
INAN, N vs. PRO	0.01	(-0.04, 0.06)
*N, ANIM vs. INAN	0.07	(0.03, 0.10)
*PRO, ANIM vs. INAN	-0.05	(-0.11, 0.00)
Verb		
*N vs. PRO	0.03	(0.00, 0.06)
ANIM vs. INAN	-0.03	(-0.09, 0.04)
*Interaction	0.07	(0.01, 0.12)
ANIM, N vs. PRO	0.00	(-0.04, 0.03)
*INAN, N vs. PRO	0.07	(0.02, 0.11)
Verb+1		
*N vs. PRO	0.03	(0.00, 0.05)
ANIM vs. INAN	0.06	(-0.02, 0.15)
Interaction	0.01	(-0.03, 0.06)

? Prominence, ✓ Grammatical constraint:

- Slower response times for PRO than N with structurally inaccessible antecedent; potential animacy effect can't be isolated in current results.

Discussion

- Confound: ANIM conditions had no competing antecedents between pronoun and intended antecedent; INAN conditions had 1-4.



- Next steps: (i) control for number of competing antecedents, (ii) manipulate structural accessibility of antecedents (as opposed to putting all stimuli with long-distance, structurally accessible anaphora in fillers).

Conclusions

Our findings are consistent with **Grammatical Constraint**:

- Anaphora resolution harder with pronouns than NPs when antecedent is structurally inaccessible.
- Different from our offline findings supporting Prominence.

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