

Processing anaphora in negated and hypothetical discourse

Much psycholinguistic work has asked how mental representations of discourse influence the resolution of anaphora. Here, we draw on insights from formal semantics about anaphora with negated and hypothetical antecedents [1-4], to study how representations of veridicality shape this process. For instance, it is well-established that negated indefinites are semantically inaccessible antecedents for pronouns in veridical indicative contexts [5], as in (1). Evidence from reading suggests that accessibility affects the processing of anaphora early on, ruling out discourse-inaccessible antecedents for pronoun resolution [6]. But negative antecedents are not categorically excluded, and may become accessible in cases like (2), where pronouns appear under modals that introduce a hypothetical scenario [5,7]. Since negated antecedents can support anaphora in principle, they cannot be eliminated from the search space for all anaphora. How the distinction between referents introduced in veridical vs. hypothetical scenarios is navigated during processing remains an open question, however. Prior work has found a general slowdown for hypothetical contexts with *would* compared to veridical ones with *will* [8], but the effect of veridicality on pronoun resolution has not been tested directly (findings are mixed for anaphoric definites; e.g., [9] reports slowdowns for hypothetical antecedents, and [10-11] reports null effects). In line with previous work, two self-paced reading studies crossing antecedent and pronoun type show a processing cost associated with comprehending hypothetical scenarios. Crucially, however, our results show this cost does not arise when the preceding discourse involves only globally accessible antecedents, suggesting this cost may be caused specifically by (re-)accessing otherwise inaccessible antecedents.

Exp1 (N=60) used 32 two-sentence German narratives like (3). The first sentence manipulated ANTecedent type, including either a negative indefinite (NI; 3a-i) or a proper name (PN; 3a-ii) embedded under negation. Names introduce a discourse referent accessible in any context, providing a baseline crucially lacking in previous work, against which to test antecedents only accessible in hypothetical contexts. The second sentence (target) manipulated PRONoun context, where an auxiliary created either a VERidical or HYPothetical context for the anaphoric pronoun. Stimuli were interspersed with 32 fillers, and comprehension questions ensured careful reading of both sentences. **Results.** Log-transformed RTs on the auxiliary, pronoun and first spillover regions (Fig. 1) were analyzed using mixed effects models with fixed effects for ANT and PRON (both coded -0.5/0.5; Tab.1). **(i) aux.** A significant ANT \times PRON interaction emerged, with post-hoc comparisons revealing a slowdown in the NI, HYP vs. NI, VER condition ($t = -2.71$), but no significant difference among the PN conditions ($t = 0.85$). Thus, with an NI antecedent, a hypothetical auxiliary was read more slowly than a veridical one, possibly reflecting a processing cost for creating or re-accessing a representation of a hypothetical discourse context in which this antecedent is accessible. **(ii) pro.** A main effect of PRON indicated longer RTs in HYPothetical contexts, although post-hoc comparisons again suggested only the NI, VER vs. NI, HYP contrast was significant ($t = -2.85$), in line with the slowdown triggered by the HYPothetical auxiliary with NI antecedents. **(iii) spill1.** A main effect of PRON in the opposite direction was found, with faster RTs in HYP than VER conditions, potentially due to the fact that antecedents of any veridicality are accessible in HYPothetical but not VERidical contexts. If the search for VER is guided both by phi-features of the pronoun and veridicality, while that for HYP pronouns is only guided by pronoun features, this slowdown may be due to gender-mismatching antecedents interfering less for HYP pronouns. **Exp2 (N=60)** was a smaller pilot study using 24 narratives like (4). All antecedents were indefinites appearing either in VERidical or HYPothetical contexts. Thus, HYP ANTecedents were only accessible for subsequent PRONouns in HYPothetical contexts, while VER antecedents were accessible regardless of PRONoun context, as in Exp1. Therefore, if the RT effects in Exp1 were driven by semantic accessibility, a similar pattern should emerge in Exp2. Procedure and analyses were analogous to Exp1. **Results.** Although data from Exp2 showed a pattern resembling Exp1, no significant effects emerged at the auxiliary or pronoun. **(iv) spill1.** Models again revealed a main effect of PRON, with faster RTs for HYP than VER PRONouns. **(iv) spill2+3.** A surprising ANT \times PRON interaction emerged, indicating slowdowns in VER VER compared to VER HYP conditions (spill2: $t = 2.7$; spill3: $t = 2.6$), but no significant differences among the HYPothetical ANTecedent conditions. While the source of this effect is unclear, it may be an artifact of the particular items used given the small stimulus set, especially as it appears to emerge already before the auxiliary.

In sum, results from Exp1 showed early slowdowns for hypothetical scenarios triggered at the modal auxiliary. Because this slowdown reached significance only for NIS and not PNs, which introduce globally accessible discourse referents, we take this to index a cost associated with accessing discourse referents whose availability is restricted to hypothetical scenarios. This finding thus confirms that referents introduced by NIS are distinguished from globally accessible ones in comprehenders' mental representations of discourse. Although Exp2 showed a similar trend, it may have lacked the power to detect these early effects. We therefore plan to run a larger item set in future work.

- (1) Paul doesn't have a daughter. # You met her already.
 (2) Paul doesn't have a daughter. You would have met her already.
- (3) a-i. *Nora hat noch **keinen Gewinner** gekürt.*
 Nora has still no winner.MASC chosen
 'Nora hasn't chosen a winner (masculine) yet.' NEGATIVE INDEFINITE
- a-ii. *Nora hat **David** nicht zum Gewinner gekürt.*
 Nora has David not as-the winner chosen
 'Nora hasn't chosen David as the winner yet.' PROPER NAME
- b. *Heute Morgen {hat/hätte} er einen langen Post über den Wettbewerb auf Twitter gepostet.*
 This morning {has/would have} he a long post about the competition on twitter posted.
 'This morning, he (would have) posted a long post about the competition on twitter.'
- (4) a. *{Zum Glück/Eventuell} hat Benedikt sich für den Klinikbesuch eine Begleitperson gesucht.*
 Luckily/Possibly has Ben REFL for the clinic-visit an accompany-person searched
 Luckily/Possibly, Ben arranged for someone to accompany him to the clinic.
- b-i. *Bei dem Besuch **hat** sie bei logistischen Herausforderungen geholfen.*
 At the visit have she with logistical challenges helped
 During the visit, they helped with logistical challenges. VERIDICAL
- b-ii. *Bei dem Besuch **würde** sie bei logistischen Herausforderungen helfen.*
 At the visit would she with logistical challenges help
 During the visit, they would help with logistical challenges. HYPOTHETICAL

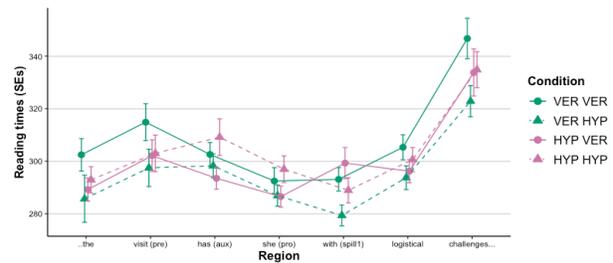
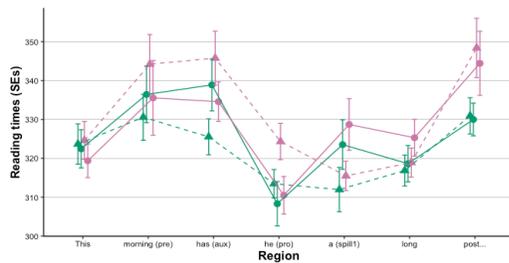


Figure 1: RTs Exp1 across regions (errors bars represent SEs) Figure 2: RTs Exp2 across regions (errors bars represent SEs)

	Exp1									Exp2								
	aux			pro			spill 1			spill 1			spill 2			spill 3		
	Est.	(SE)	t-value	Est.	(SE)	t-value	Est.	(SE)	t-value	Est.	(SE)	t-value	Est.	(SE)	t-value	Est.	(SE)	t-value
Intcpt	2.49	.014	172	2.47	.012	198	2.47	.014	175	2.43	.015	159	2.45	.017	145	2.48	.019	128
Ant Type	.010	.006	1.63	0.01	.004	1.36	0.01	.004	1.44	.008	.004	1.67	-.001	.005	-0.11	-.001	.006	-0.31
Pro Type	-.003	.005	-0.59	0.01	.005	2.89	-0.01	.004	-2.05	-.016	.004	-3.33	-.006	.005	-1.34	-.008	.006	-1.36
AT x PT	.021	.01	2.25	0.01	.008	0.94	0.01	.009	0.56	.007	.010	0.69	.024	.0108	2.47	.029	.012	2.39

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