

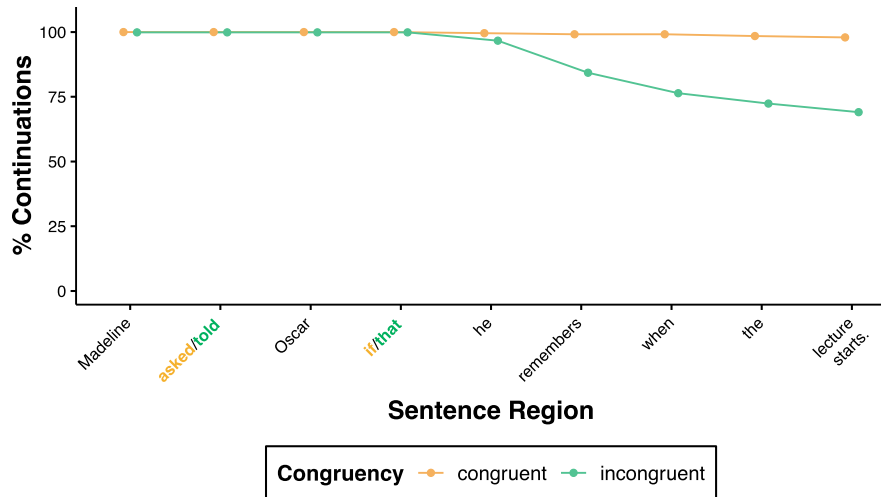
## Pronoun Interpretation Highlights the Robustness of Social Perspective Reasoning

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Work in psycholinguistics continues to expand its empirical evaluation of how perspective taking is involved in core aspects of language processing. For example, recent work shows that, in pronoun interpretation, readers overwhelmingly interpret the ambiguous pronoun *she* in assertions like “Madeline told Anna that she remembers when the lecture starts” as referring to Madeline [1]. This is because a report of “remembering when the lecture starts” most naturally reflects Madeline’s intention to tell Anna something that Anna did not already know (cf. the convention to “be informative” [2,3]). This reasoning explains why the preference reverses with a *question* (cf. [4], “Madeline asked Anna if she remembers when the lecture starts”, where readers now near-categorically judge Anna as the intended antecedent). The latter case contrasts with the notion of a bias toward subject/first-mentioned entities [5,6], and demonstrates that pragmatic cues, when available, are especially strong determinants of pronoun resolution [see also 3,7,8]. Although these patterns appear to demonstrate a robust effect of perspective, could they instead reflect a reliance on shallow sentential or lexical cues stemming from the matrix verb (*ask/tell*)? We report two English studies showing the effects in fact arise from “deep” pragmatic reasoning, as shown by (i) readers’ use of the full sentence information and (ii) ways in which context can overrule the potential bias from the matrix verbs.

As background, using a self-paced reading study with unambiguous versions of the above sentences (“Madeline [told/asked] Oscar [that/if] he remembers when the lecture starts”), [9] showed that, e.g., in the *tell-that* case, readers showed significantly slower reading times (reflecting the oddness of telling Oscar what HE knows) after the subordinate verb rather than at the pronoun (where a bias from the matrix verb should be apparent). This supports a pragmatically-rich explanation, where comprehenders conduct a fulsome evaluation of the communicated state-of-affairs. However, this result could arguably reflect slow/delayed use of perspective information. In **Expt 1** ( $n = 60$ ), we used a stops-making-sense (SMS) task, where participants make explicit word-by-word assessments of sentences’ sensibility **with no time pressure**. If readers are simply slow to apply perspective cues from the matrix verbs during online reading, the SMS task should reliably judge the “incongruent” version as non-sensical beginning at the pronoun. However, the results continued to show that readers began judging perspectively-incongruent sentences as not making sense only downstream of the pronoun (see Fig. 1), supporting the idea that the effects are not driven by shallow cues but instead by a rich consideration of the full situation. To further evaluate the flexibility of perspective reasoning, **Expt 2** ( $n = 60$ ) assessed the potential for a **preceding context sentence** to overcome the default patterns in *ask* vs. *tell* sentences containing ambiguous pronouns. In the “neutral” baseline condition, a non-biasing context sentence was used (see 1a). In the “test” condition, the context sentence (S1, see 1b & 1c) was designed to sway readers away from the interpretation patterns reported previously for *ask/tell* sentences (S2) by providing information that would plausibly change which character is the subject of the subordinate predicate. The results showed that, with the test cases, readers indeed “reversed” the preference reported in [1], now preferring subject antecedents 23% of the time for *tell* and 68% for *ask* (compared to neutral cases: 95% for *tell*, 10% for *ask*), see Fig. 2, with analyses confirming the strong switch in antecedent selection preferences with the biasing test context sentences relative to neutral ones ( $\beta = -2.48$ ,  $SE = 0.25$ ,  $z = -10.1$ ,  $p < .001$ , via GLME modelling). This outcome provides even more compelling evidence that the interpretive patterns reflect full-blown perspective reasoning.

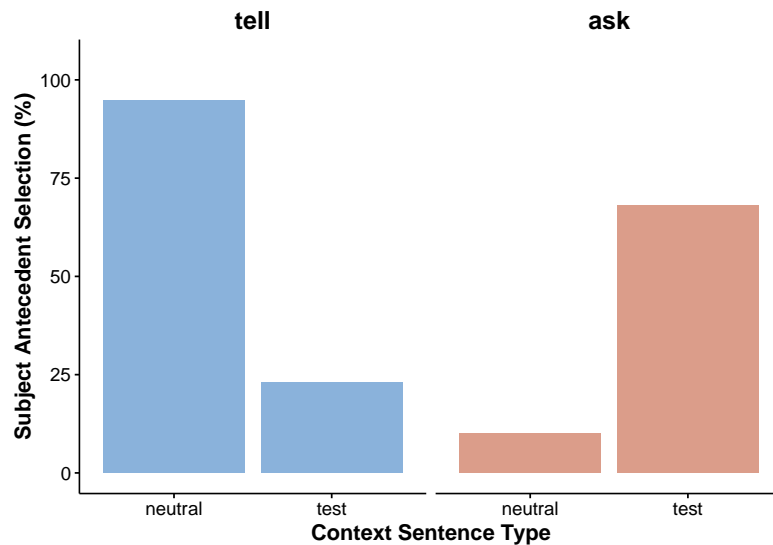
In summary, Expt 1 confirmed that processing perspective information in pronoun resolution is not driven by lexical (matrix verb) cues but instead a consideration of broader sentence information, suggesting a “pragmatically deep” interpretive process. Expt 2 demonstrates this further by showing that preferred antecedents switch when the context provides relevant details about characters’ knowledge states/intentions. Together, the findings underscore the robustness and richness of social perspective reasoning in core aspects of language understanding.



**Figure 1:** Cumulative proportion of sentence continuations by region, showing that participants do not commit to referent identity early on using only the matrix verb and pronoun. (Expt 1,  $n_{\text{trials}}=24$ )

## Experiment 2: Stimulus Sentence Examples

- (1a) Molly, who noticed it was almost 12:30 PM, was walking with her good friend Hana. (S1)  
Molly asked/told Hana if/that she had enough cash to buy a sandwich. (S2) *[neutral case]*
- (1b) Molly, a tour guide, was talking to Hana, who is unfamiliar with Japanese currency. (S1)  
Molly told Hana that she had enough cash to buy a sandwich. (S2) *[test case - tell]*
- (1c) Molly, who is unfamiliar with Japanese currency, was talking to her tour guide, Hana. (S1)  
Molly asked Hana if she had enough cash to buy a sandwich. (S2) *[test case - ask]*



**Figure 2:** Subject antecedent selections (by matrix verb), showing how the **test** context sentences effectively “reverse” the preferred antecedent. (Expt 2,  $n_{\text{trials}}=20$ )

**References:** [1] Simovic & Chambers (2023). *Proceedings of 6<sup>th</sup> Workshop on Comp. Models of Reference, Anaphora and Coreference*. [2] Grice (1975). In *Syntax & Semantics Vol. 3*. [3] Smyth (1995). *J. Child Lang.* [4] Brown-Schmidt et al. (2008). *Cognition*. [5] Gordon et al. (1993). *Cog. Sci.* [6] Arnold et al. (2000). *Cognition*. [7] Kaiser (2015). *Sem. & Ling Theory*. [8] Jones & Bergen (2021). *Proceedings of 43<sup>rd</sup> CogSci Society*. [9] Simovic & Chambers (2022). *Proceedings of 63<sup>rd</sup> Psychonomic Society*.