No cost for canceling causal inferences in the comprehension of short English narratives

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Online commitment to pragmatic inferencing

- Are inferences generated actively and incrementally?
- Do inferences require costly reanalysis to retract?

Our test case: Causal inferences in discourse.

α Sally voted for the candidate β that has a progressive platform .

EXPLANATION(α, β): α *because* β

Comprehenders use schemata like EXPLANATION(α, β) to expect certain form and content in running discourse [9–12, 14].

- When is the associated inference α *because* β computed?
- Does it become a firm representational commitment?

What does incremental commitment look like?

Two features diagnose active and firm representational commitment in lexical [6, 8], aspectual [4, 13], and quantificational [5, 7] ambiguities:

Representation costs at the ambiguous region when content or recent context is inconsistent with a heuristic preference or default. (e.g. subordinate access, coercion)

Reanalysis costs at late disambiguation if incompatible with a heuristic preference.

Hypotheses & Predictions

Causal inferences are incremental and heuristic:

- When α begs explanation, readers predict α *because* β.
- Predicts difficulty on β when it is not a plausible or possible explanation for α.

Causal inferences are firm:

- Readers register α *because* β as a representational commitment.
- Predicts difficulty when an explicit, contrary explanation is later given for α.

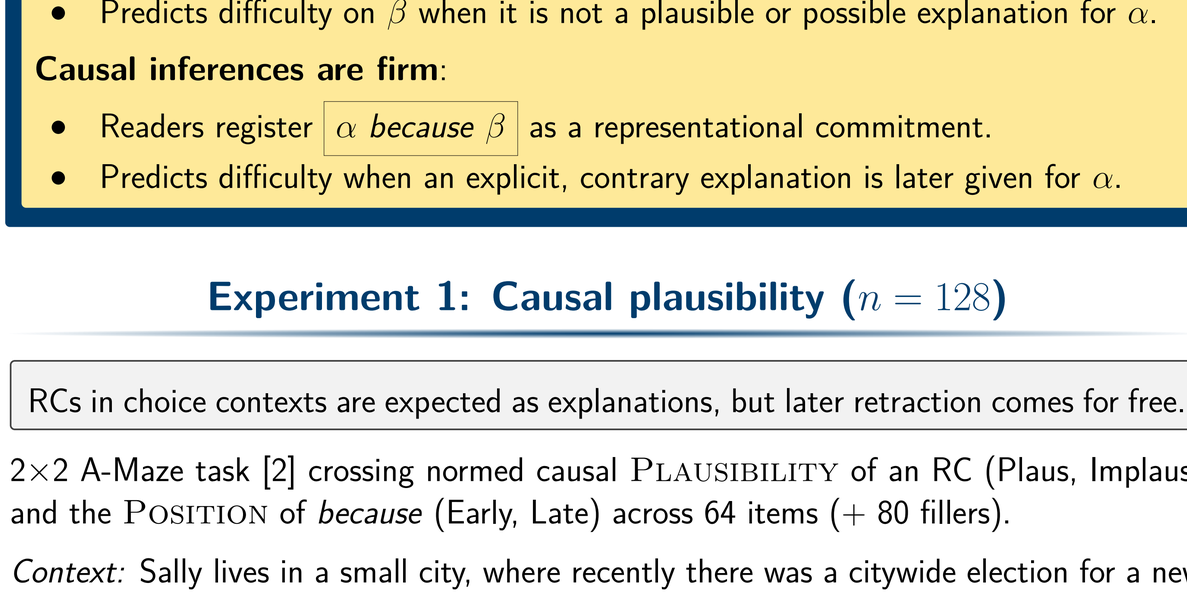
Experiment 1: Causal plausibility ($n = 128$)

RCs in choice contexts are expected as explanations, but later retraction comes for free.

2×2 A-Maze task [2] crossing normed causal PLAUSIBILITY of an RC (Plaus, Implaus) and the POSITION of *because* (Early, Late) across 64 items (+ 80 fillers).

Context: Sally lives in a small city, where recently there was a citywide election for a new mayor with several candidates, and she had to decide among them on her mail-in ballot.

	Plausible	Implausible
Early	Last week, because his name is first on this year's ballot, she voted for the candidate that has a progressive platform, Pat Mirabella.	Last week, because his name is first on this year's ballot, she voted for the candidate that has a large mustache, Pat Mirabella.
Late	Last week, she voted for the candidate that has a progressive platform, Pat Mirabella, because his name is first on this year's ballot.	Last week, she voted for the candidate that has a large mustache, Pat Mirabella, because his name is first on this year's ballot.



`brms` **linear m/e models for Resid.** $\ln$(**RT**)**:**

RC (*has a...*)	95% CrI	**Because**	95% CrI
Plausibility (Plaus)	(-0.49, -0.27)		(-0.06, 0.04)
Position (Late)	(-0.08, 0.02)		(-0.44, -0.27)
Plaus × Pos	(-0.09, 0.05)		(-0.06, 0.08)

RC RTs better predicted by GPT-2 surprisals given causal context (*because he has a large mustache*) than RC context. ($BF > 10^{100}$)

✓ **Incremental**: Implausible = slow, even after early *because*.

✗ **Not firm**: No reanalysis cost for *because* after plausible explanation. ($BF_{10} = 0.05$)

Experiment 2a/b: Protagonist knowledge ($n = 71$, 80)

Prolonged task-dependent difficulty with ignorant protagonists, no clear results.

A-Maze and SPR tasks manipulating contextual possibility of inference via normed protagonist KNOWLEDGE of the potentially causal property, 40 items (+ 70 fillers).

Sally lives in a small city, where recently there was a citywide election for a new mayor with several candidates, and she had to decide among them on her mail-in ballot.

Knowledgeable She spent some time reading everything she could about the candidates before mailing in her ballot.

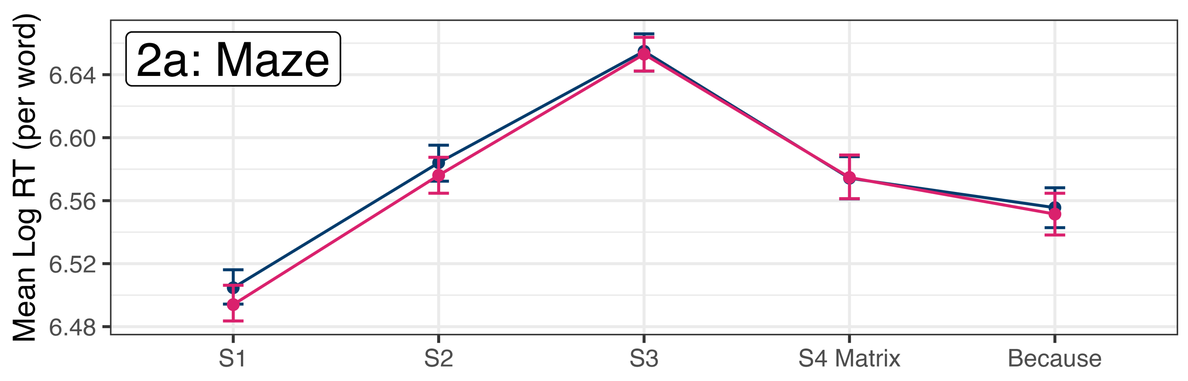
Ignorant She didn't have any time to read anything about the candidates before mailing in her ballot.

S1 In the end, she voted for Pat Mirabella.

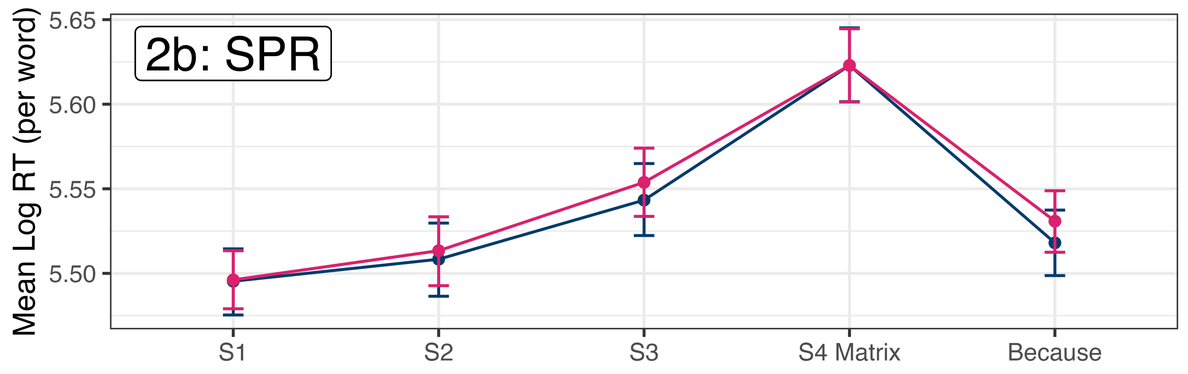
S2 He has the most progressive platform in the race.

S3 He's from a very socio-economically diverse area...

S4 She voted for him because his name was first on the ballot.



S2	95% CrI	**S3**	95% CrI	**Because**	95% CrI
Knowledge (Kn.)	(-0.02, 0.01)		(-0.02, 0.01)		(-0.02, 0.01)



S2	95% CrI	**S3**	95% CrI	**Because**	95% CrI
Knowledge (Kn.)	(-0.04, 0.00)		(-0.04, -0.00)		(-0.04, -0.00)

? **Incremental**: In SPR, protagonist ignorance led to slightly slower reading across the board: general difficulty rather than difficulty with causal inference.

✗ **Not firm**: No reanalysis cost for *because* after possible explanation. ($BF_{10} < 0.2$)

Discussion

- Evidence of slowdowns on implausibly causal properties supports **early, heuristic expectations for a causal inference**.
  - In E1, automatic enough that context (pre-existing explanation) cannot supercede.
  - E2 nulls perhaps attributable to this context-insensitivity.
- No apparent reanalysis costs: **no evidence for firm commitment**.
  - Cf. lack of cancellation costs for scalar implicatures [1].
- Task comparisons in E2 suggest that Maze performance may be less sensitive to subtle discourse manipulations.
  - SPR slightly more sensitive to differences in narrative typicality? (but cf. [3])
  - SPR-specific slowdown at the S4 matrix: Costs for unexpected topic resumption?

Conclusions

- We find evidence that **causal inferences are considered incrementally, and without reference to context**.
- Nevertheless, a persistent lack of reanalysis costs suggests that **readers hedge these inferences**, rather than forming a firm commitment.

References

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Supplementary materials for E1: https://osf.io/gf64q/?view_only=152a684014334f22bfde21aee5a85a05 and E2: https://osf.io/a4vx6/?view_only=fb61c88454ed4448914223651daeeb50

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