

Making the Question Under Discussion explicit shifts **counterfactual** interpretation

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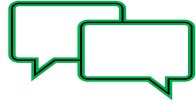
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How do we get from message to thought?



If there had been zebras, then there would have been lions in the zoo.





suppositional state





implied actual state



Mental Model Theory (Johnson-Laird & Byrne, 2002)

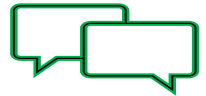
- Dual meaning  
- **Default (as imagined):** Factually false **suppositional state** $p \ \& \ q$ [+ZEBRA, +LION]
- **Default (as facts):** **Implied actual state** $not-p \ \& \ not-q$ [-ZEBRA, -LION]

Suppositional Theory (Evans & Over, 2004; Evans, 2007)

- Pragmatic factors
- **Default:** Factually false **suppositional state** $p \ \& \ q$ [+ZEBRA, +LION] 
- **If required by the context:** **Implied actual state** $not-p \ \& \ not-q$ [-ZEBRA, -LION] 

This project:

What are the driving forces behind the interpretation of counterfactuals?



'If cats were vegetarians, families could feed them with a bowl of carrots' (Ferguson & Sanford, 2008)



- subjunctive ('were')
 - the modal ('could')
 - the conjunction ('if')
 - **the causal clause structure (antecedent and consequent)**
- grammatical cues



Cats are not vegetarians and do not eat carrots.



Speaker's intentions behind the utterance (Roberts, 1996; 2004; Sperber & Wilson, 2002):

- QuD [about a cat's hypothetical eating habits] → **suppositional alternative** (i.e., vegetarian cats)
- QuD [the real-world/actual state of affairs] → **implied actual state alternative** (i.e., non-vegetarian cats)

Mixed evidence from empirical literature on causally structured counterfactuals: The nature, strength, and plausibility of the causal relationships within counterfactual scenarios introduce noise that can obscure the mechanisms behind counterfactual comprehension itself (e.g., Ferguson & Sanford, 2008; Nieuwland & Martin, 2012).

Here we ask:

Can comprehenders reach the actual state interpretation relying only on **grammatical cues** (i.e., non-causal counterfactuals), or is this interpretation triggered by **communicative goals**?

- 2 preregistered studies (<https://osf.io/3zy6v/>), **visual world paradigm**
- PennController for Ibex (Zehr & Schwarz, 2018), remote **eye-tracking study** via participants' own webcam.
- Replicating [Exp 1] and extending [Exp 2] Orenes, Garcia-Madruga, Gomez-Veiga, Espino & Byrne (2019)
- N & n decided doubling Orenes et al., (2019)
- Growth curve analyses (Mirman et al., 2008)

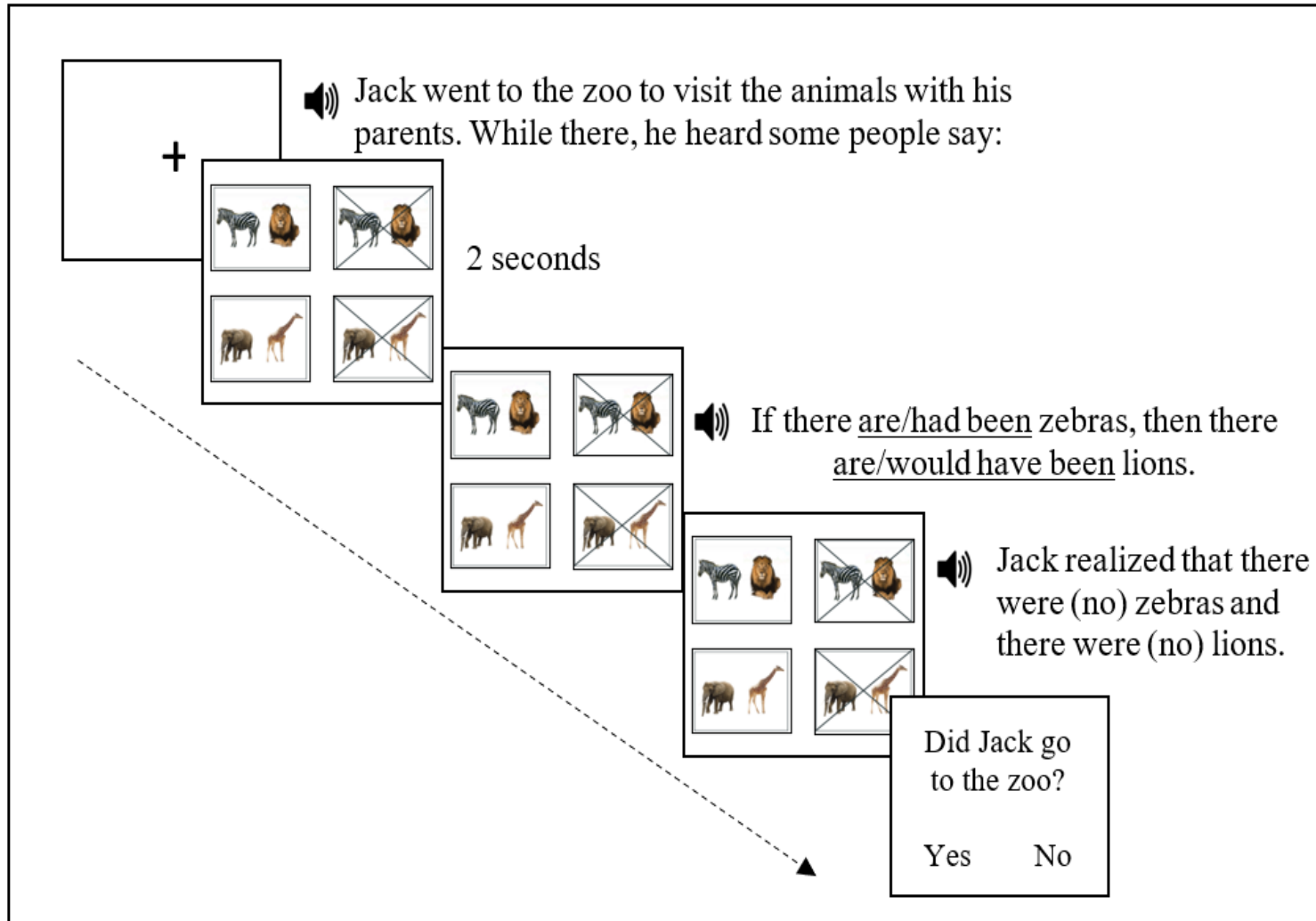
- **Mental Model Theory** → The communicative context is not relevant



- **Suppositional Theory** → The QuD explicitness referring to the actual world matters



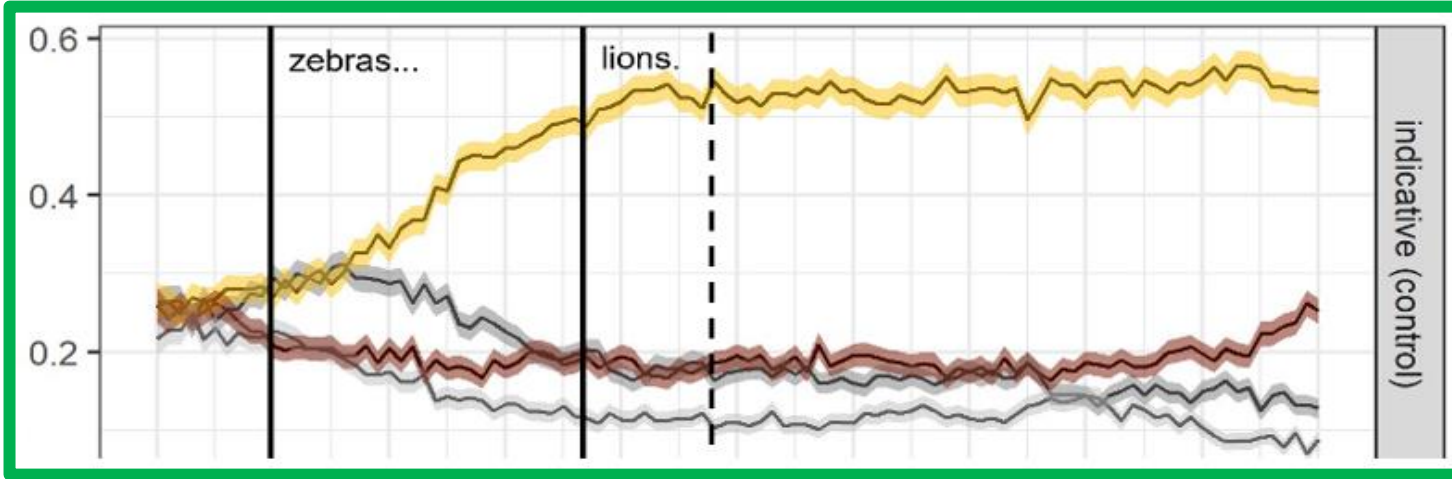
Exp 1: No Explicit QuD (N=82)



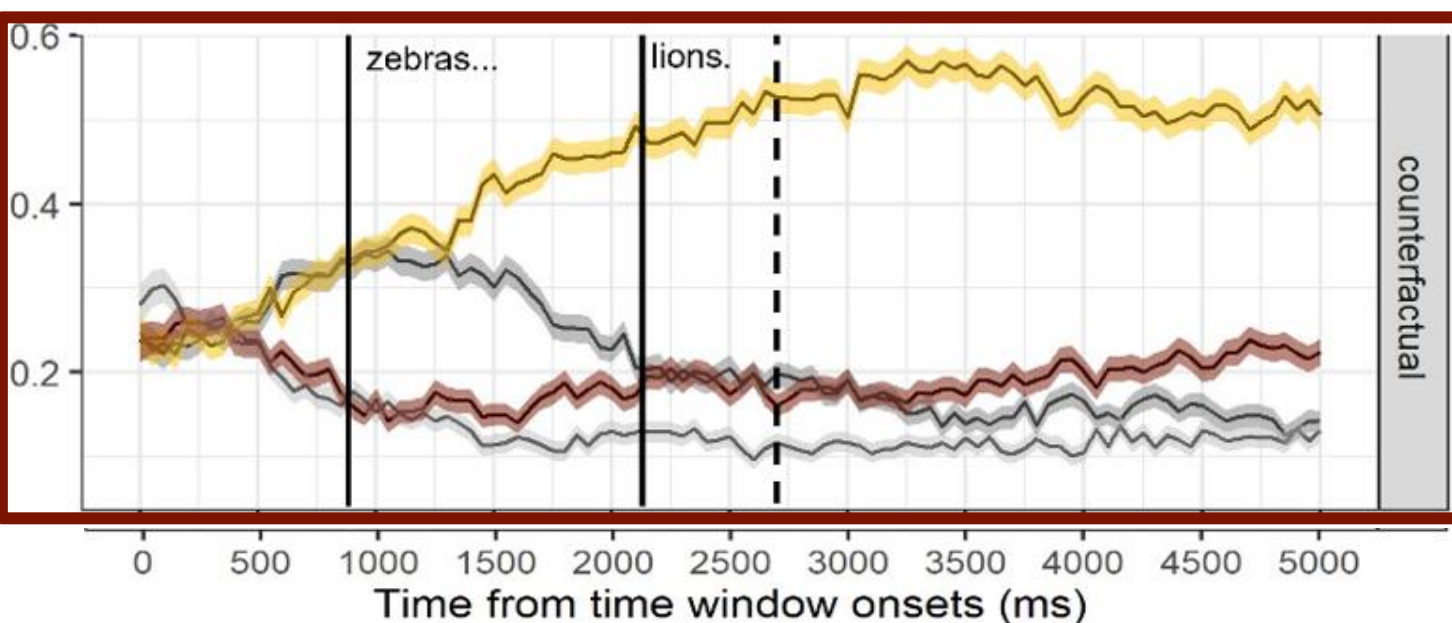
- Design by Orenes et al. (2019), translated into English
- Simultaneous auditory and visual input.
- 2x2 within-subject design: **Conditional (counterfactual vs indicative[control])**
Continuation (affirmative vs negative).
- Counterbalanced, Latin-squared 8 lists containing 36 critical trials each (18 per each condition)

Exp 1: No Explicit QuD

If there are zebras, then there are lions.



If there had been zebras, then there would have been lions.



suppositional state



implied actual state



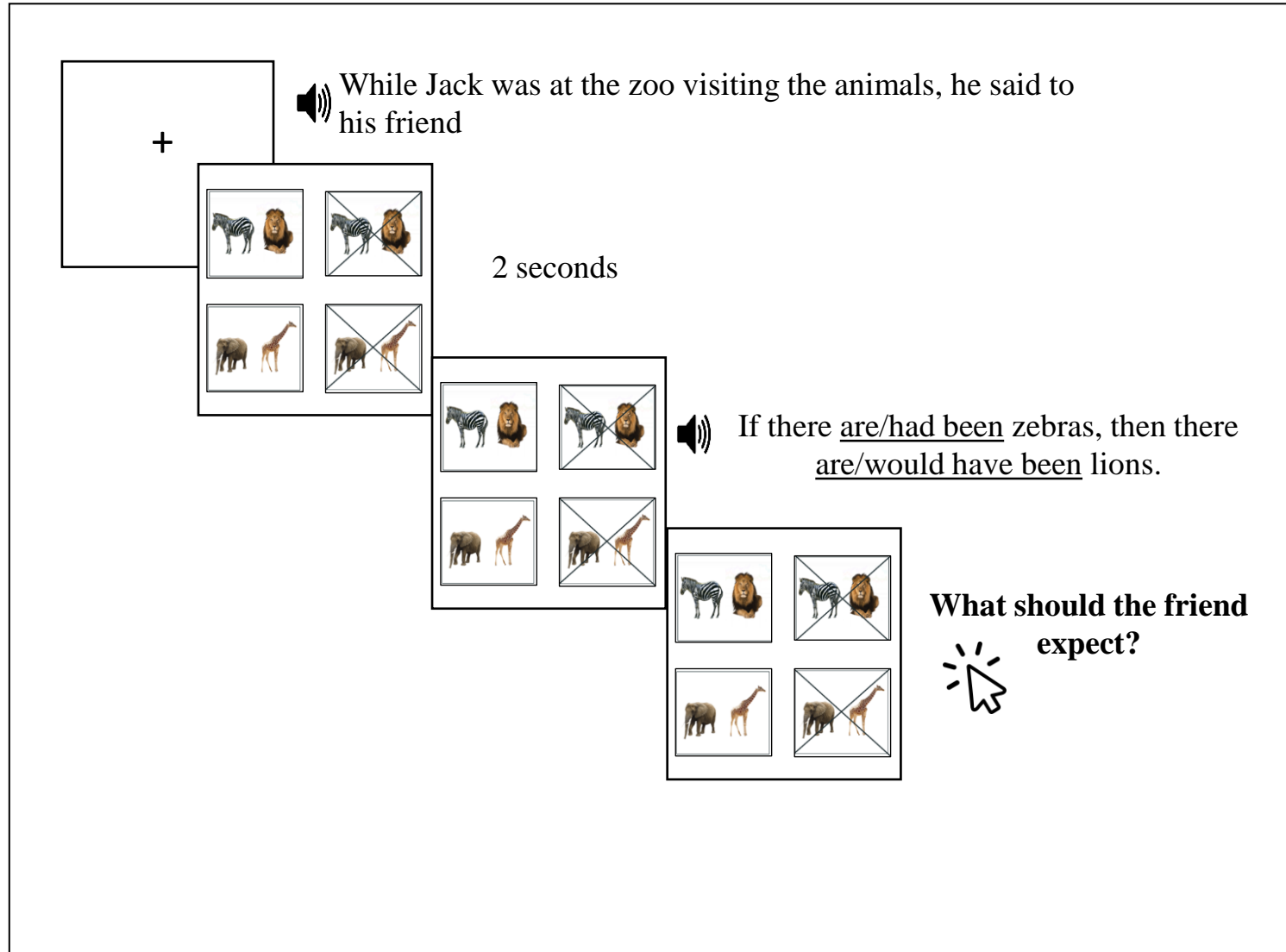
affirmative distractor



negative distractor

- Looks to the suppositional state [+ZEBRA, +LION] only
- Overall looks to the images did not differ across conditions.

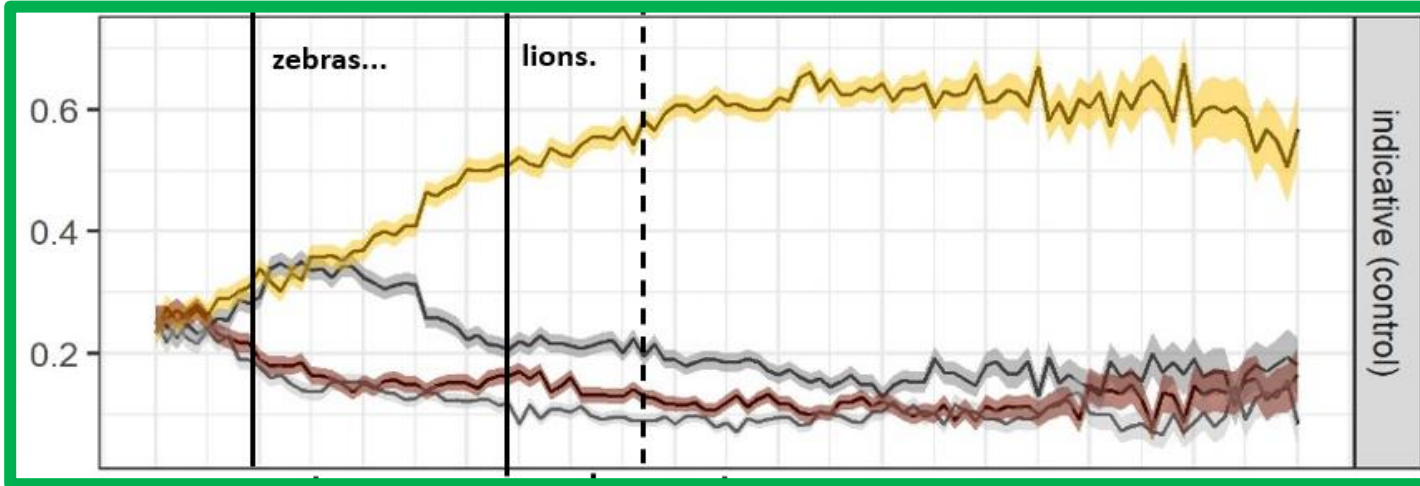
Exp 2: Shifting the QuD to the implied actual state (N=56)



- The question first presented in the instructions and repeated after every trial:
‘What should the friend expect?’
- Participants are instructed to focus what the fictional listener should expect to see *while they listen to the stories*.
- Participants clicked on the corresponding picture.

Exp 2: Shifting the QuD to the implied actual state (N=56)

If there are zebras, then there are lions.



suppositional state



implied actual state



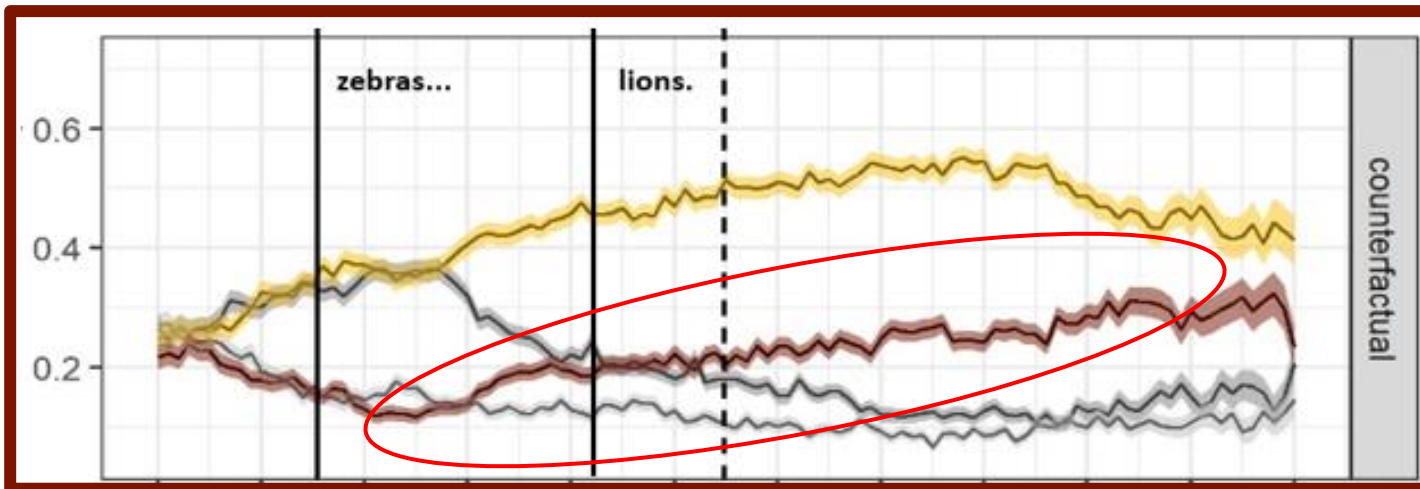
affirmative distractor



negative distractor

- Similar to Exp 1, only considered suppositional state [+ZEBRA, +LION]

If there had been zebras, then there would have been lions.



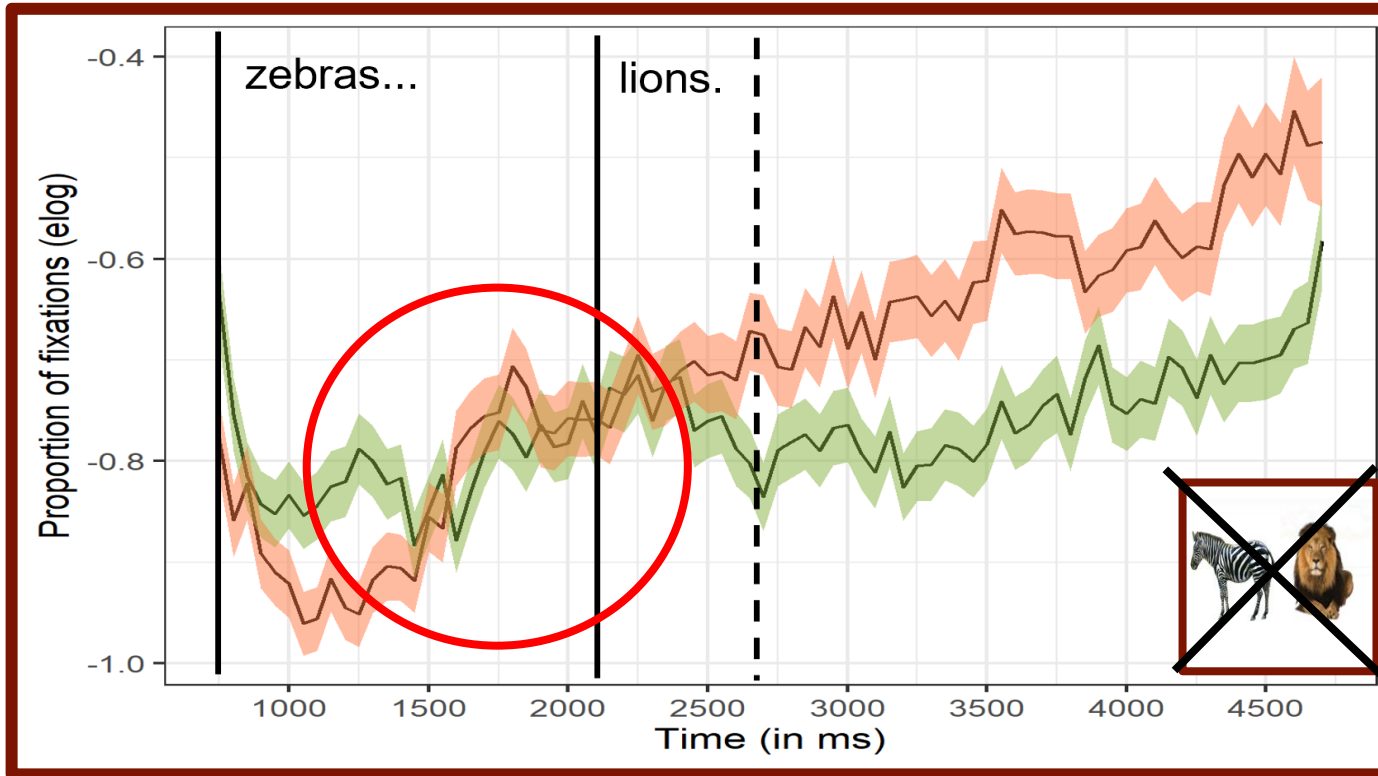
- **U-shaped pattern** in looks to the implied actual state

Proportion of looks

Time from time window onsets (ms)

Exp 1 vs Exp 2:

If there had been zebras, then there would have been lions.



Exp 1 Exp 2

Exp 1 → Looking behavior of the participants to the implied actual state did not differ through time.

Exp 2 → Upon hearing the word 'zebras', participants' look to the implied actual state started to increase gradually.

Two main findings:

1. Participants did not consider the implied actual state in counterfactual conditionals (**Exp 1**).
 2. Participants shifted their interpretation to the implied actual state more often when there was a well-defined QuD (**Exp 2**).
- Making implied actual state interpretation a **contextually relevant alternative** shifted counterfactual interpretation in non-causal counterfactuals.
 - Absence of causal structure is what allows us to see the effect of grammatical cues and QuD manipulation:
Causality → *Pragmatic confound*
 - Comprehenders, in general, considered suppositional state alternatives when they did not rely on causal inferences, but with the explicit QuD referring to the actual world, consideration of the implied actual state increased.
 - The driving forces behind counterfactual processing seem to depend on pragmatic considerations as well as grammatical cues.

Thank you!

- Isabel Orenes for kindly sharing their stimuli.
- RAs in LCL at UCSD Miguel Mejia & Lea Zaric for helping with the stimuli creation.
- David Barner and anonymous reviewers for helpful feedback.



Data & analyses are available here: <https://osf.io/3zy6v/>