Integration of top-down and bottom-up information in online interpretations of scalar adjectives

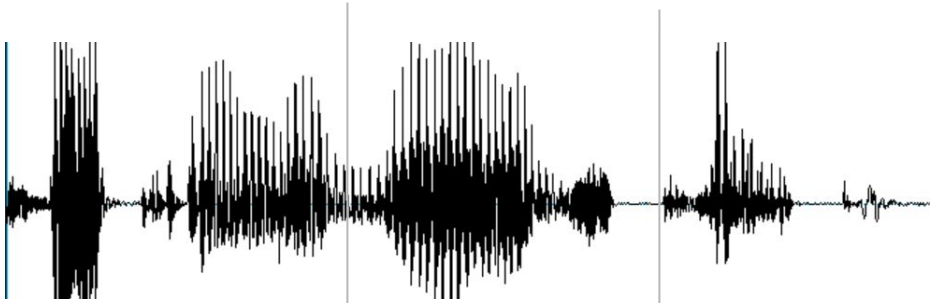
Sadie Dix, Rebecca Lawrence, Cameron Morgan, Chigusa Kurumada

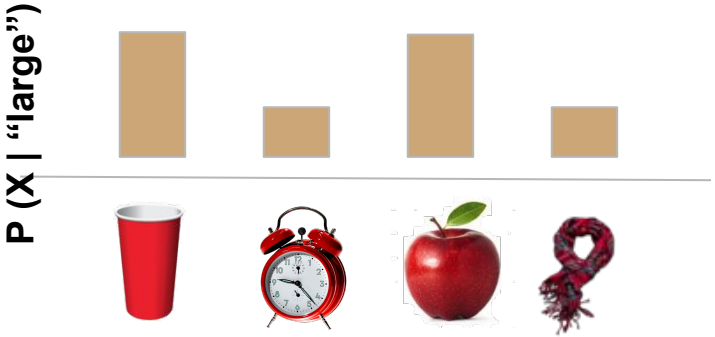
University of Rochester

Real-Time Pragmatic Inferences

- Much work has studied pragmatic inferences affected by many sources of information. [e.g., Grice, 1975; Clark, 1996; Hagoort & van Berkum, 2004]
- But how do we so *rapidly* map the unfolding speech signal onto the speaker's intentions? [e.g., Noveck & Posada, 2003; Huang & Snedeker, 2009; 2011; Grodner et al., 2010; Nieuland et al., 2010; Breheny et al., 2013a,b; Degen & Tanenhaus, 2015]
- One lens through which this has been studied is the contrastive inference. [e.g., Sedivy et al., 1999; Hanna & Tanenhaus, 2003; Kurumada et al., 2014]

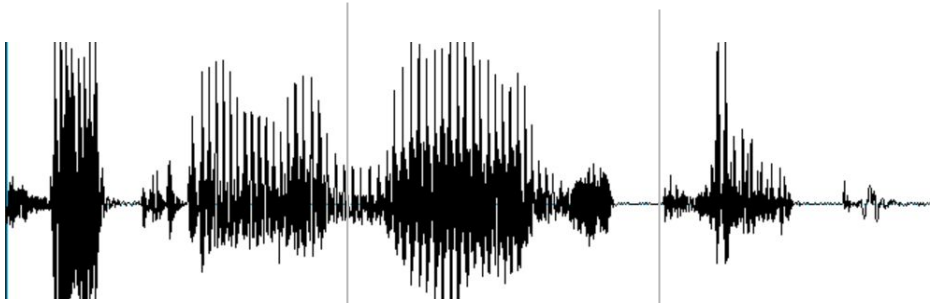
Real-Time Pragmatic Inferences



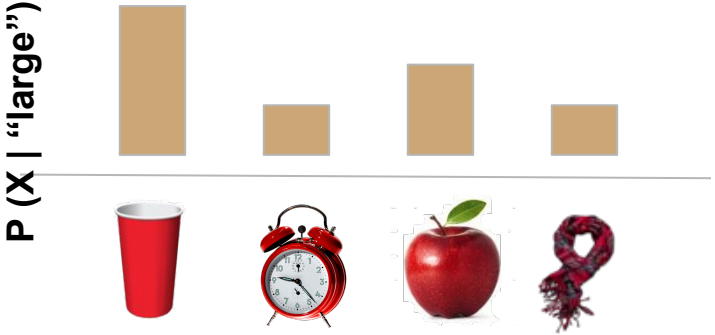


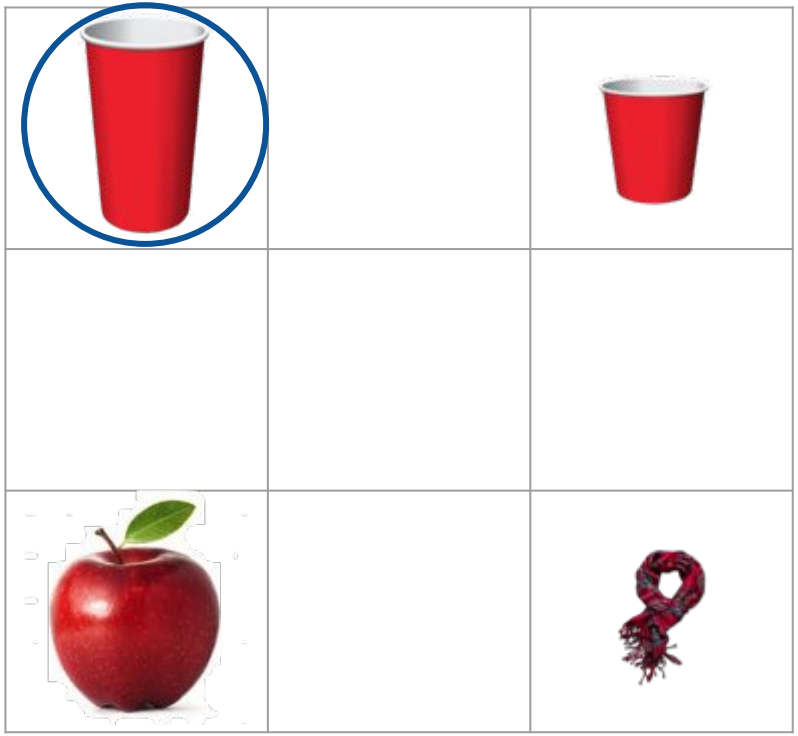
Sedivy et al. (1999)

Real-Time Pragmatic Inferences



Click on the l a r g e c u p





Sedivy et al. (1999)

Research Questions

What's the mechanism behind such fast inferences?

Hypothesis 1

- Store precompiled information about specific lexical items
- Retrieve that information to make inferences

Hypothesis 2

- Assess linguistic input with respect to a dynamic context
- Use that context to make inferences

Inferences must be **defeasible** when unwarranted in a given situation.

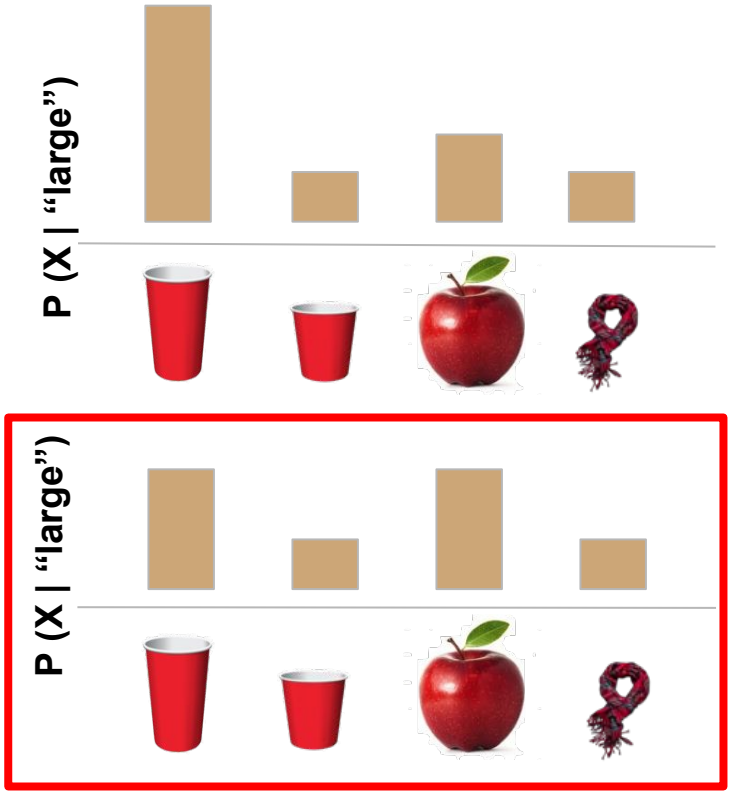
Speaker Reliability

Reliable speaker

- Adjective use only when necessary
- Correct labeling throughout experiment

Unreliable speaker

- Top-down instructions
- Repetitive, redundant adjective use (e.g., “the large red apple”)
- Mislabeling/wrong information (e.g., “toothbrush” for a hairbrush)



Grodner & Sedivy (2011)

Current Study

1) **Experiment 1**
   Conceptually replicating Grodner & Sedivy (2011) with
   - a computer-based paradigm for precise stimulus control
   - significantly fewer trials (200+ vs. 52)

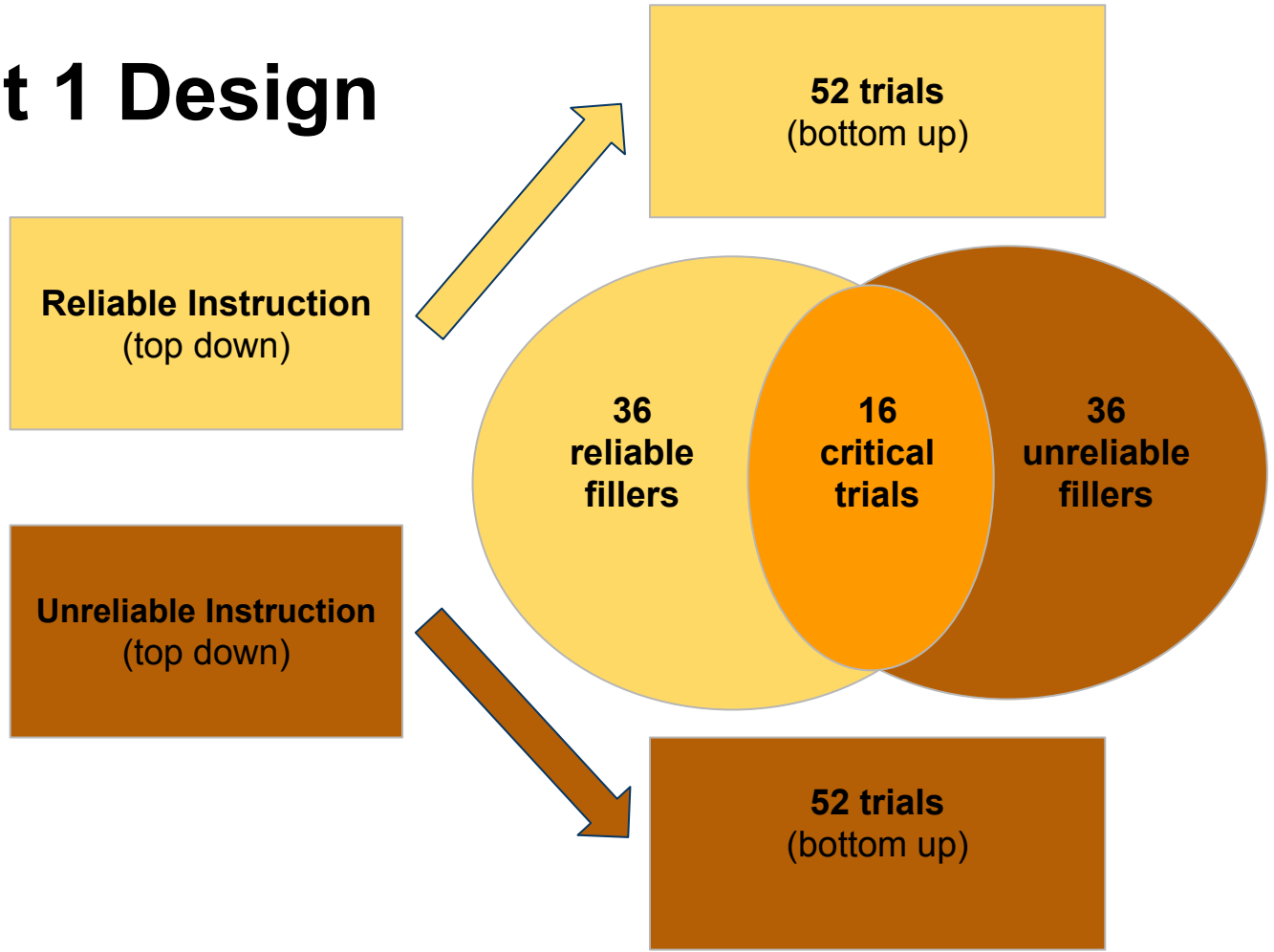
   to establish that contrastive inferences are derived in context

2) **Experiment 2**
   Examining whether top-down information is necessary for speaker-based modulation of real-time pragmatic inferences

Experiment 1 Design

Reliable
(24 Participants)

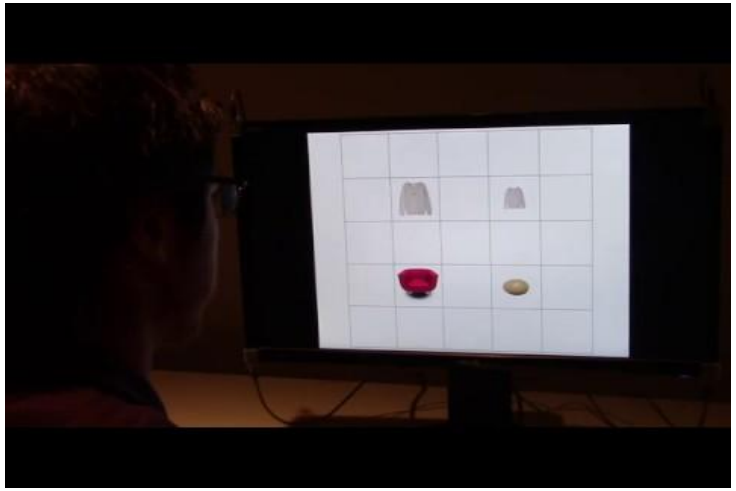
Unreliable
(24 Participants)



Top-down Instructions

Reliable

“The study is intended to measure how effectively people communicate in various situations…..”



Unreliable

“The study is intended to examine communicative aspects of the speaker’s language impairment….”

Filler Instructions

Reliable

<u>36 Informative</u>
“Click on the large doll”

		
Target Competitor		Contrast Distracter
		

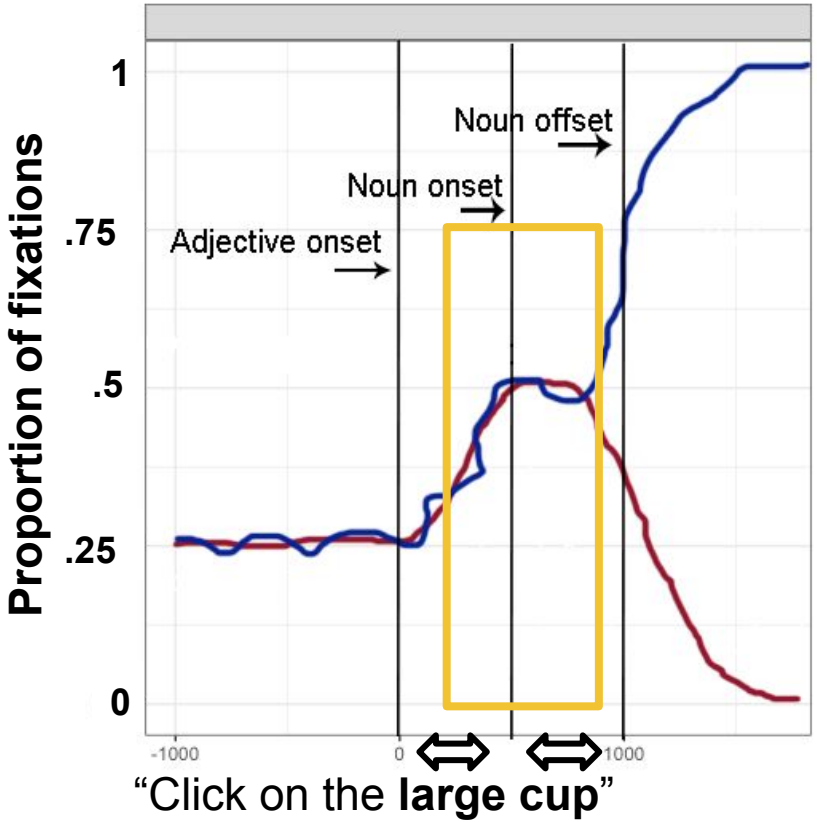
Unreliable

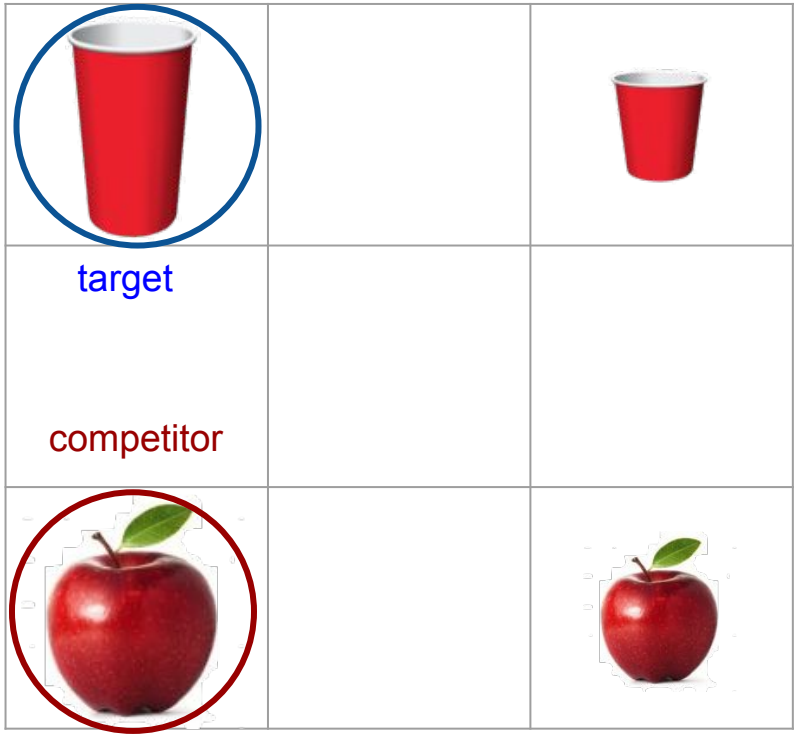
<u>28 Over-informative</u>
“*Click on the large pretty doll”*

<u>4 Under-informative</u>
“Click on the doll”

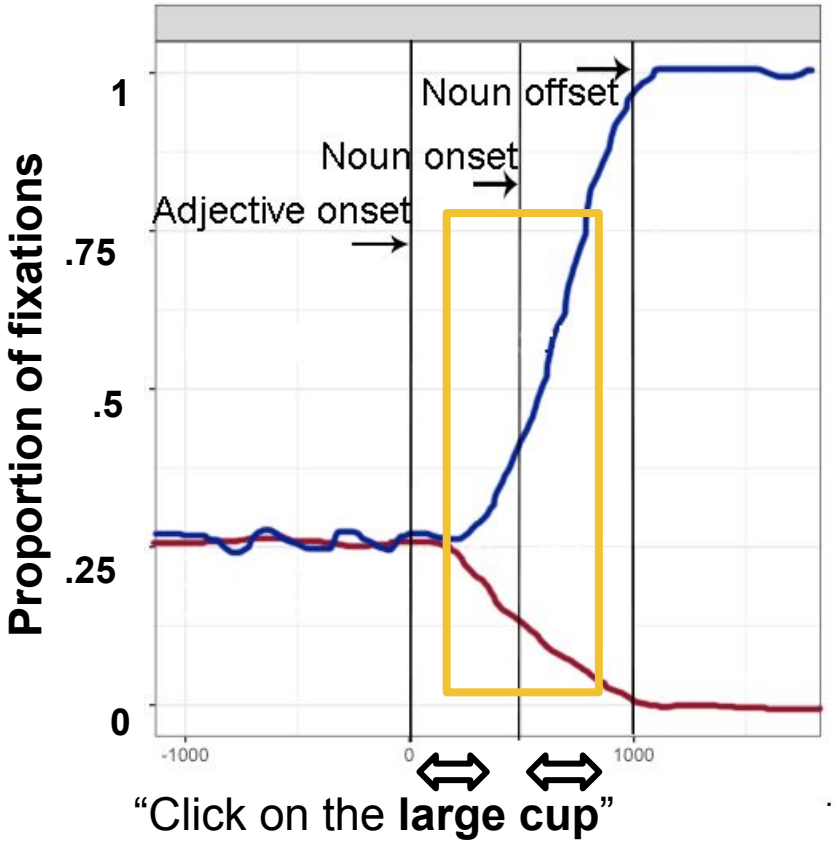
<u>4 Mislabeled</u>
“Click on the stuffed animal”

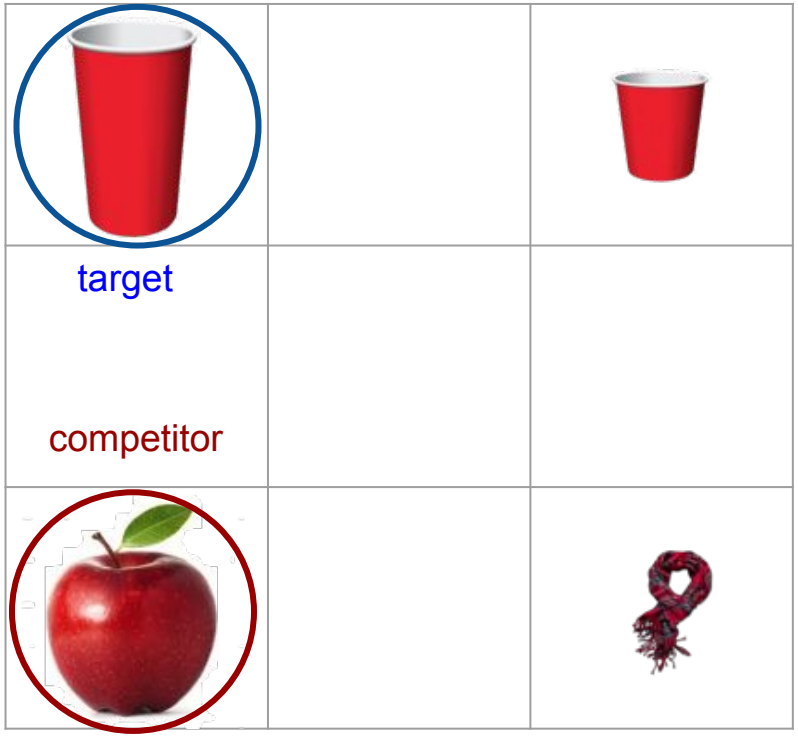
Prediction: Reliable, Two-contrast



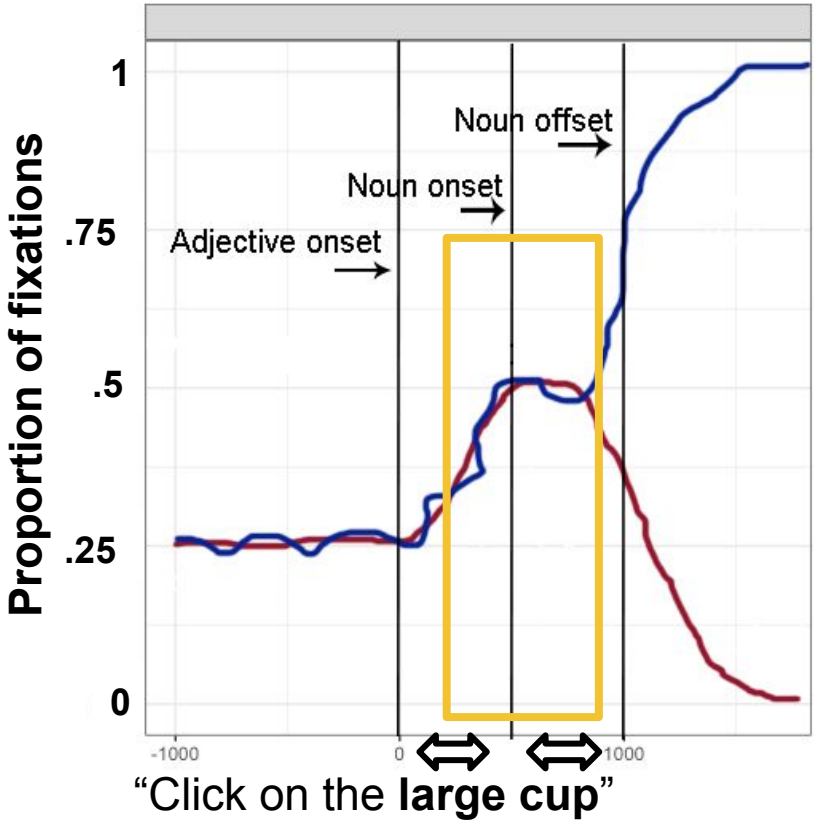


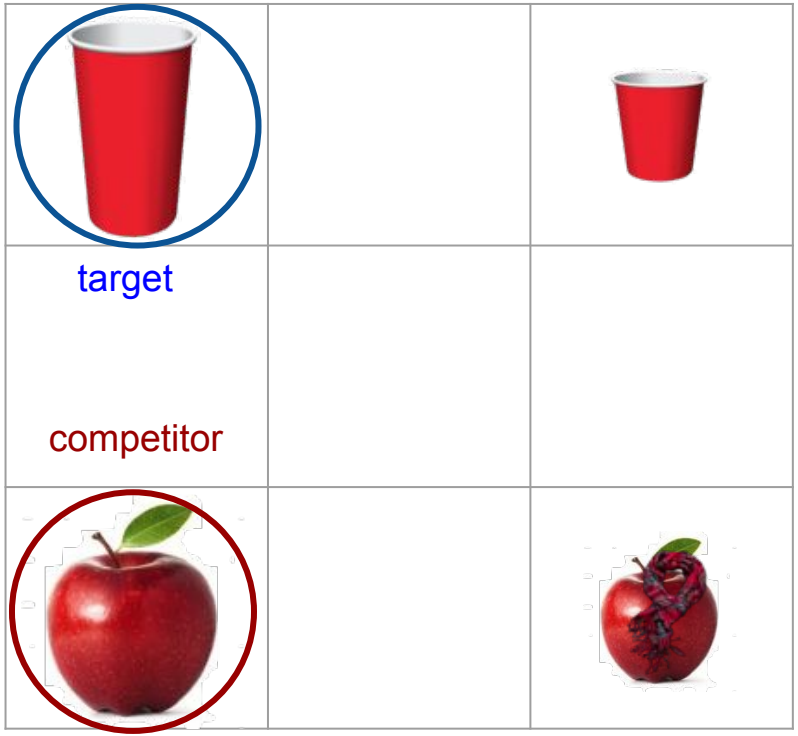
Prediction: Reliable, One-contrast



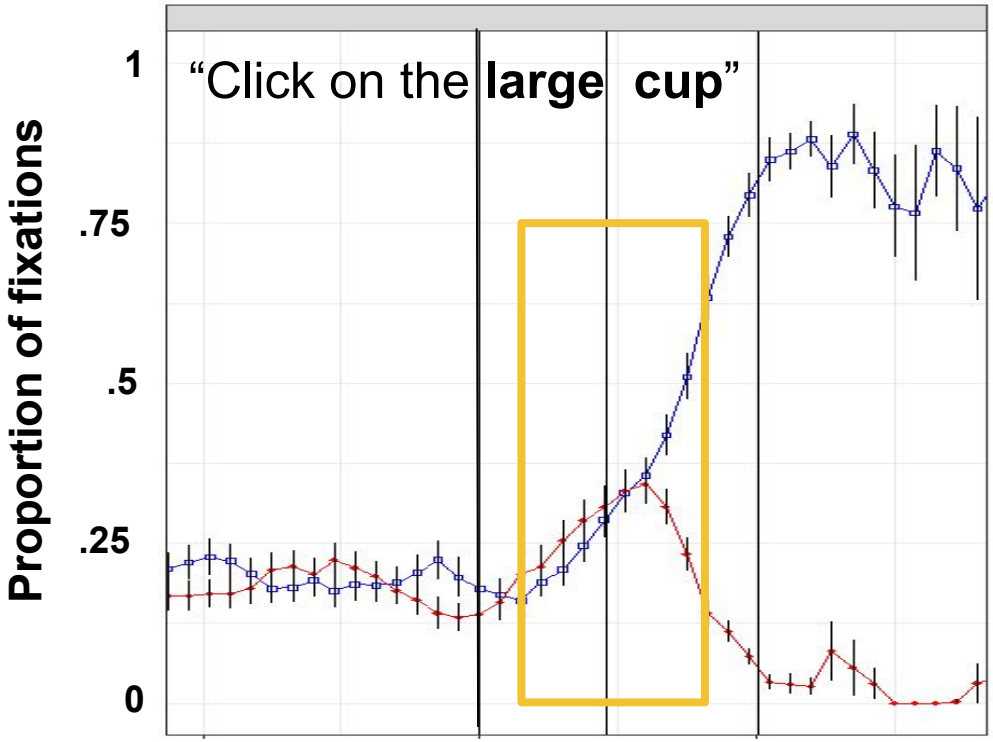


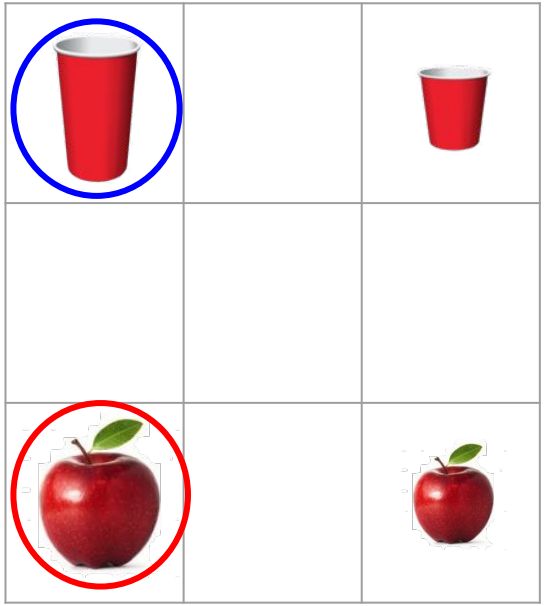
Prediction: Unreliable, One- & Two-contrast



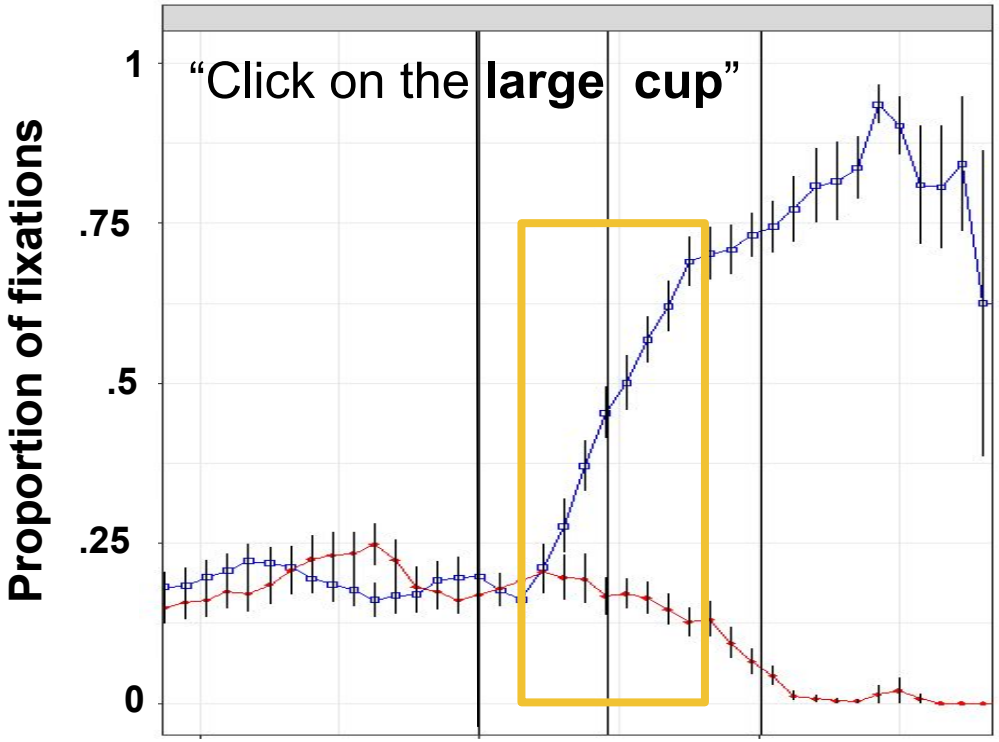


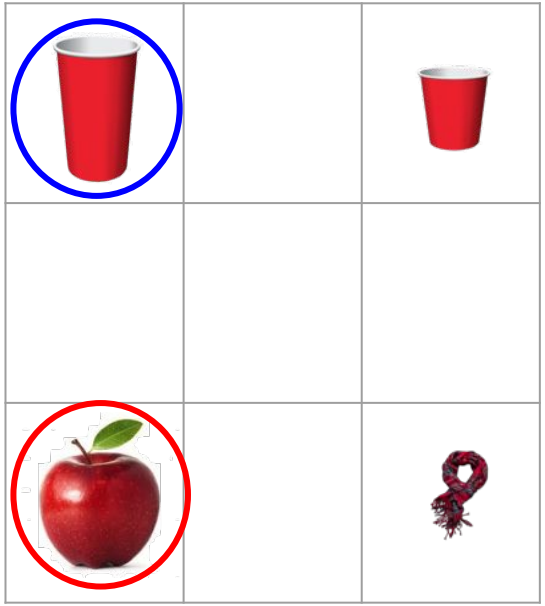
Results: Reliable, Two-contrast



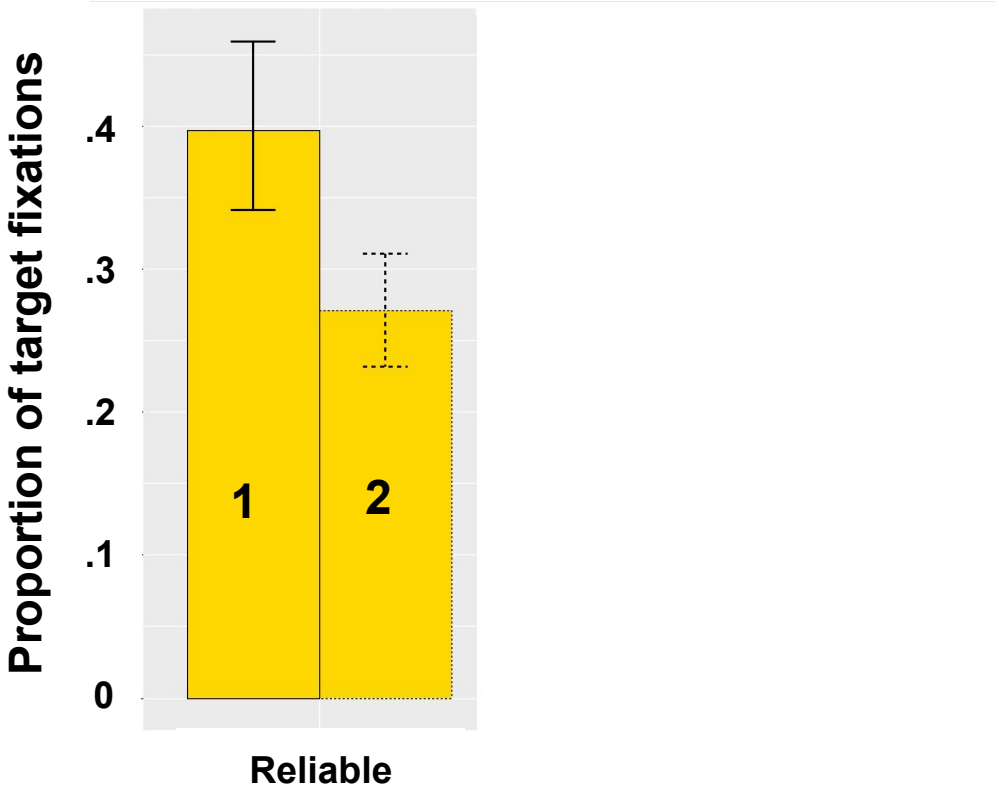


Results: Reliable, One-contrast

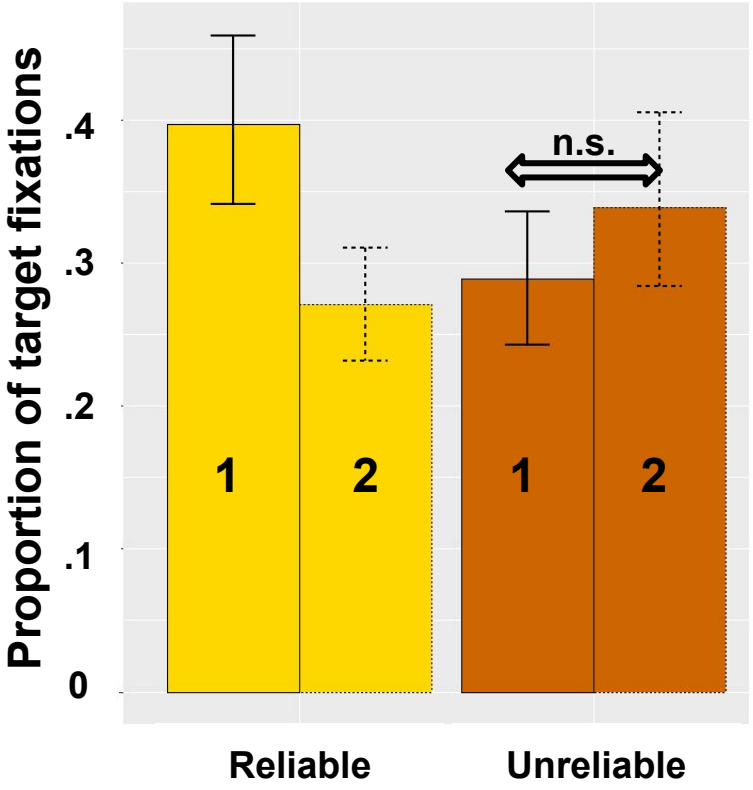




Target Fixations



Target Fixations



Experiment 1 → Experiment 2

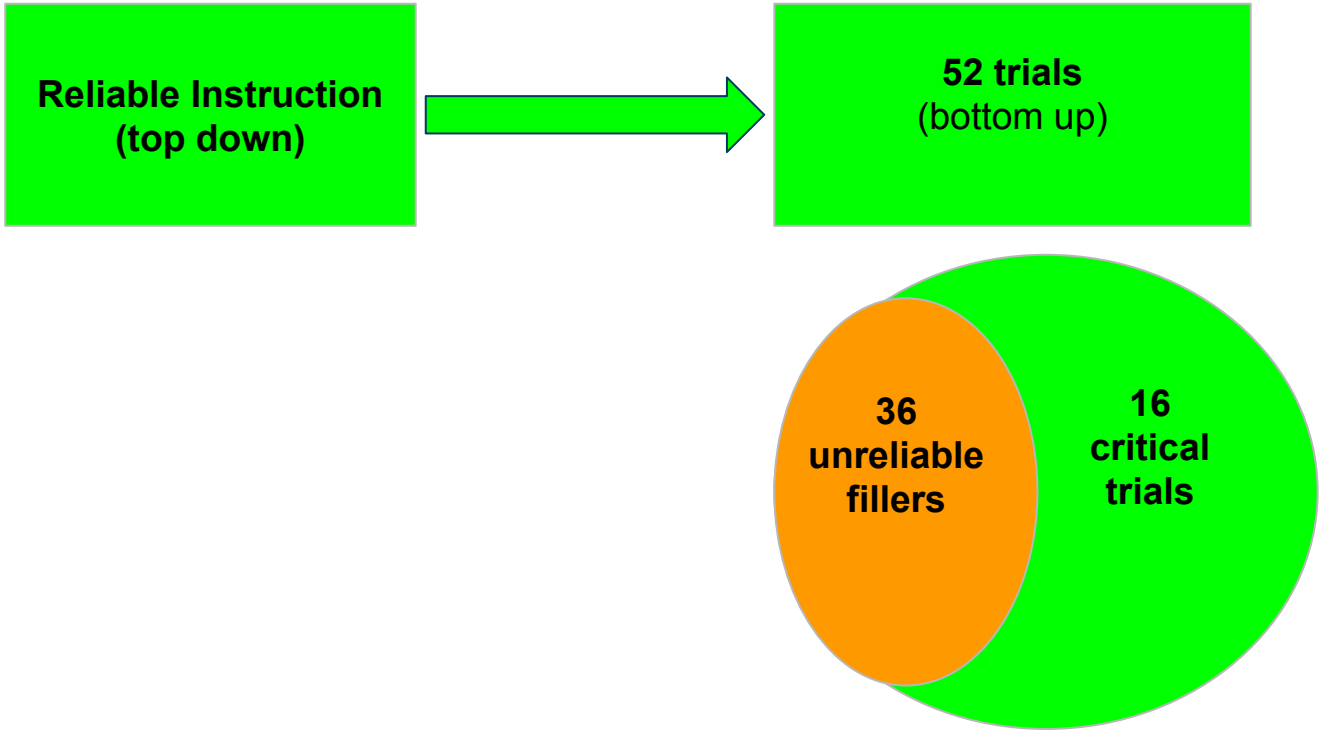
- Results suggest contrastive inferences are modulated with respect to speaker reliability.

- Is the top-down information necessary for this modulation? Or is the bottom-up linguistic input sufficient?

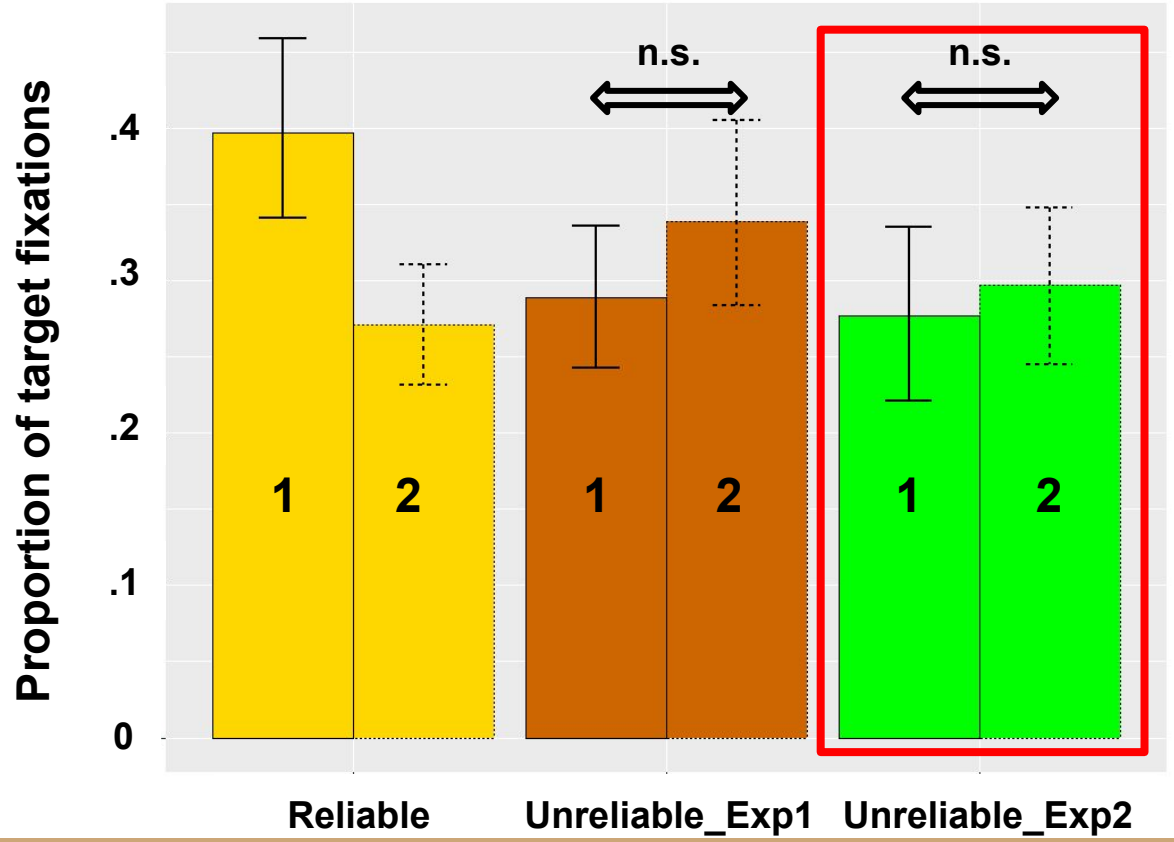
- We test this by rerunning same Unreliable condition — without the explicit instructions that the speaker is unreliable.

Experiment 2 Design

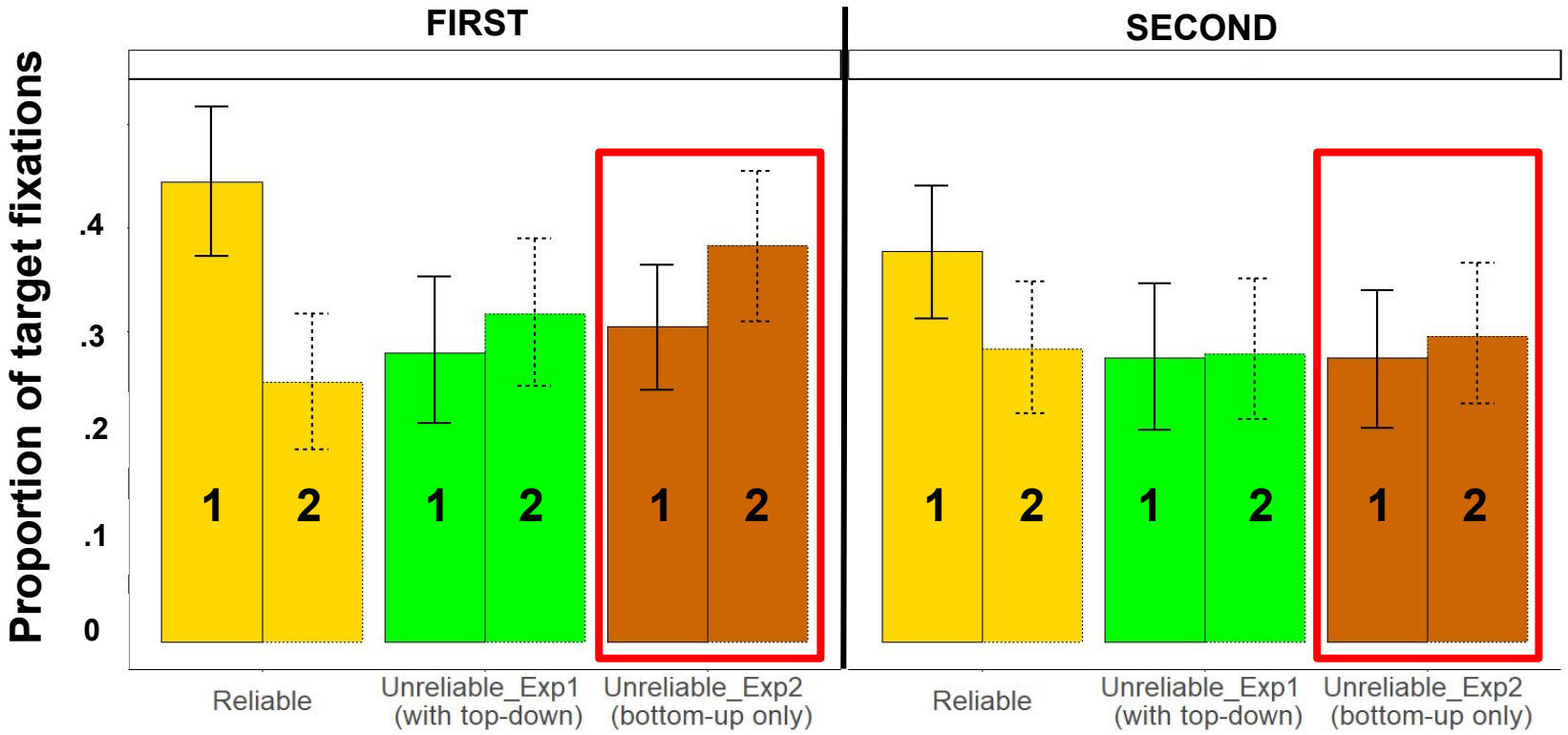
Unreliable [Exp 2]
(24 Participants)



Target Fixations



Target Fixations by Experiment Halves



Discussion

- Results suggest that contrastive inferences are generated online with respect to speaker reliability.

- These earliest inferences seem sensitive enough to change with bottom-up linguistic input alone.

- This all suggests that pragmatic mechanisms for efficient communication are dynamic and probabilistic.

Future work

- Does this truly illustrate judgments of a speaker's pragmatic reliability?
    - Alternatively, do participants think there are experimental errors in the unreliable conditions?
- Morgan, Lawrence, and Kurumada (forthcoming) testing this by presenting two within-subject speaker of different reliabilities.
    - Different inference patterns for the two speakers would corroborate conclusions.

Thank You

- **We appreciate your time!**

- **Acknowledgments:** We'd like to thank Ralf Haefner, Anne Pier Salverda, Mike Tanenhaus, Chelsea Marsh, Jennifer Andrews, Bethany Gardner and Anaclare Sullivan for their help throughout our research.

- This research was funded by the **Department of Brain and Cognitive Sciences at the University of Rochester**.

References

- Breheny, R., Katsos, N., & Williams, J. (2006). Are generalised scalar implicatures generated by default? An on-line investigation into the role of context in generating pragmatic inferences. *Cognition*, *100*, 434-63.
- Clark, H. H. (1996). Communities, commonalities, and communication. In J. Gumperz and S. Levinson (Eds.), *Rethinking linguistic relativity* (pp. 324-355). Cambridge: Cambridge University Press.
- Degen, J., & Tanenhaus, M.K. (2015). Processing scalar implicature: A constraint-based approach. *Cognitive Science, 39*(4), 667-710.
- Grice, H. P. (1975). Logic and conversation. In P. Cole, & J. Morgan (Eds.), *Syntax and semantics 3: Speech acts* (pp. 41–58). New York: Academic Press.
- Grodner, D., Klein, N. M., Carbary, K. M., & Tanenhaus, M. K. (2010). “Some,” and possibly all, scalar inferences are not delayed: Evidence for immediate pragmatic enrichment. *Cognition*, *116*(1), 42-55.
- Grodner, D. & Sedivy, J. (2011). The effect of speaker-specific information on contrastive inferences. In N. Pearlmutter & E. Gibson (eds). *The Processing and Acquisition of Reference.* MIT Press: Cambridge, MA.
- Hanna, J.E. & Tanenhaus, M.K. (2004). Pragmatic effects on reference resolution in a collaborative task: evidence from eye movements. *Cognitive Science*, *28*(1), 105-115.
- Huang, Y. T., & Snedeker, J. (2009). Semantic meaning and pragmatic interpretation in 5-year olds: Evidence from real-time spoken language comprehension. *Developmental Psychology*, *45*(6), 1723-1739.
- Huang, Y. T., & Snedeker, J. (2011). Logic and conversation revisited: Evidence for a division between semantic and pragmatic content in real-time language comprehension. *Language and Cognitive Processes*, *26*(8), 1161-1172.
- Kurumada, C., Brown, M., Bibyk, S., Pontillo, D., & Tanenhaus, M. K. (2014). Is it or isn't it: Listeners make rapid use of prosody to infer speaker meanings. *Cognition*, *133*, 335-342.
- Nieuwland, M. S., Ditman, T., & Kuperberg, G. R. (2010). On the incrementality of pragmatic processing: An ERP investigation of informativeness and pragmatic abilities. *Journal of Memory and Language*, *63*(3), 324-346.
- Noveck, I. A., & Posada, A. (2003). Characterizing the time course of an implicature: An evoked potentials study. *Brain and Language*, *85*(2), 203-210.
- Sedivy, J. C., Chambers, C., Tanenhaus, M., & Carlson, G. (1999). Achieving incremental semantic interpretation through contextual representation. *Cognition*, *71*, 109-147.