Communicating, interpreting, and learning from uncertainty: Could be a promising approach?

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Background & Main Questions

- Source reliability and commitment are important to pragmatics (Gunlogson, 2008; Bibyk, 2016; Brown-Schmidt, Yoon & Ryskin, 2015)
- Communicating reliability requires a speaker to appropriately mark her confidence, and for a listener to accurately interpret that reliability
- Complicated by individual and group differences in the use of confidence and its implications (e.g., politeness markings, mansplaining, etc) and costs/benefits of appearing too confident or not confident enough

1. Do speakers systematically mark their uncertainty, and do listeners systematically recover this information?
2. Can we test whether a speaker's objective certainty maps onto their linguistic certainty?
3. How do listeners incorporate certainty marking when acquiring new information, or throughout continued experience with a speaker?

Pre-test: Marking / Interpreting Uncertainty

1. It could be a goose
2. It might be a robin
3. I think it's a falcon
4. It looks like a hummingbird
5. I'm pretty sure it's a woodpecker
6. I'm sure that it's a sparrow
7. It's a blackbird
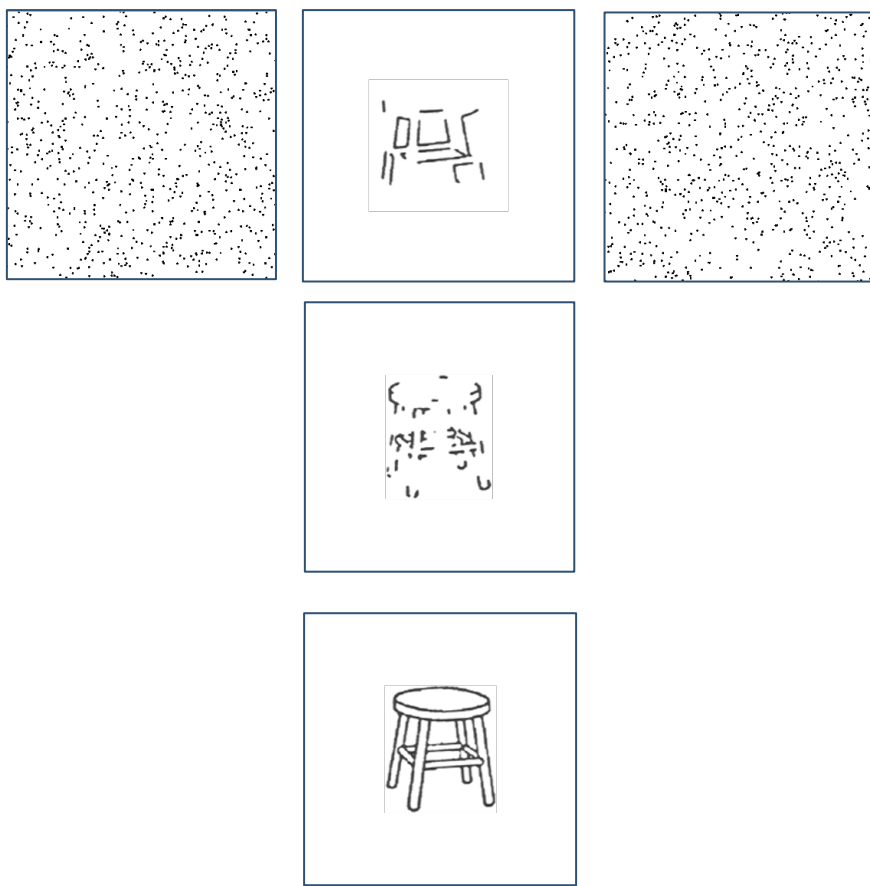8. It's definitely a canary
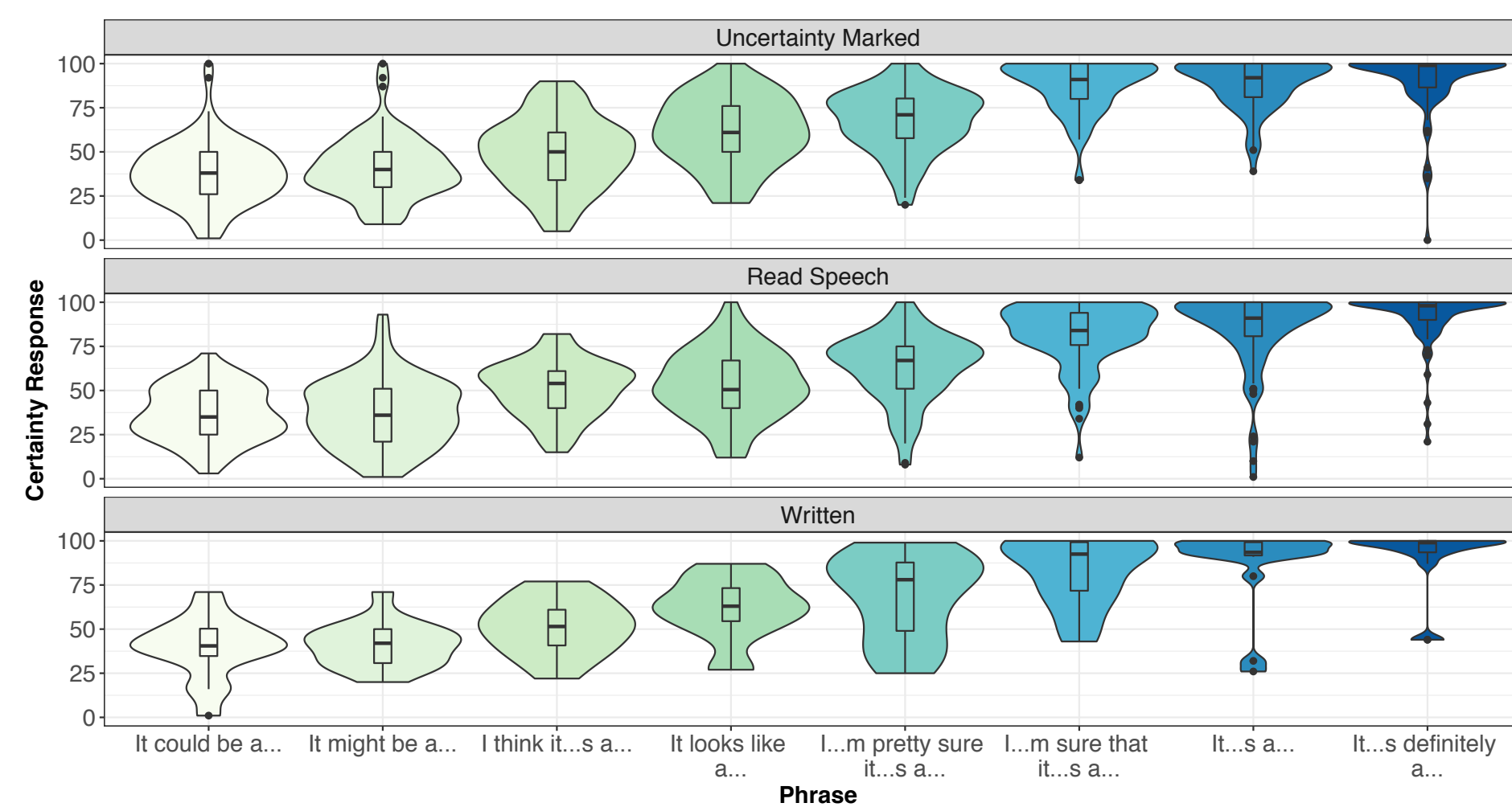
General Findings: listeners systematically interpret these phrases as differing in certainty

Phrase	Pre-test Read-text Confidence	Pre-test Listen (Read)	Pre-test Listen (Uncertainty)	Read-text Rank	Listen Rank	Experiment 1 (mean confidence)	Experiment 2 (mean confidence)
1	36.994	37.706	36.283	7.125	7.063	25.163	24.68
2	39.294	41.094	37.494	6.375	6.375	28.798	
3	49.918	48.918	50.919	5.688	5.644	46.458	25.46
4	57.080	61.362	52.797	5.25	5.381	45.828	
5	65.476	68.110	62.842	4.063	4.319	68.577	
6	84.220	87.510	80.930	2.688	2.919	80.300	
7	86.777	88.864	84.689	2.625	2.525	91.765	80.40
8	90.935	90.246	91.624	2.188	1.775	93.192	
Control							64.55

E1: Mapping Visual Uncertainty onto Visual Uncertainty
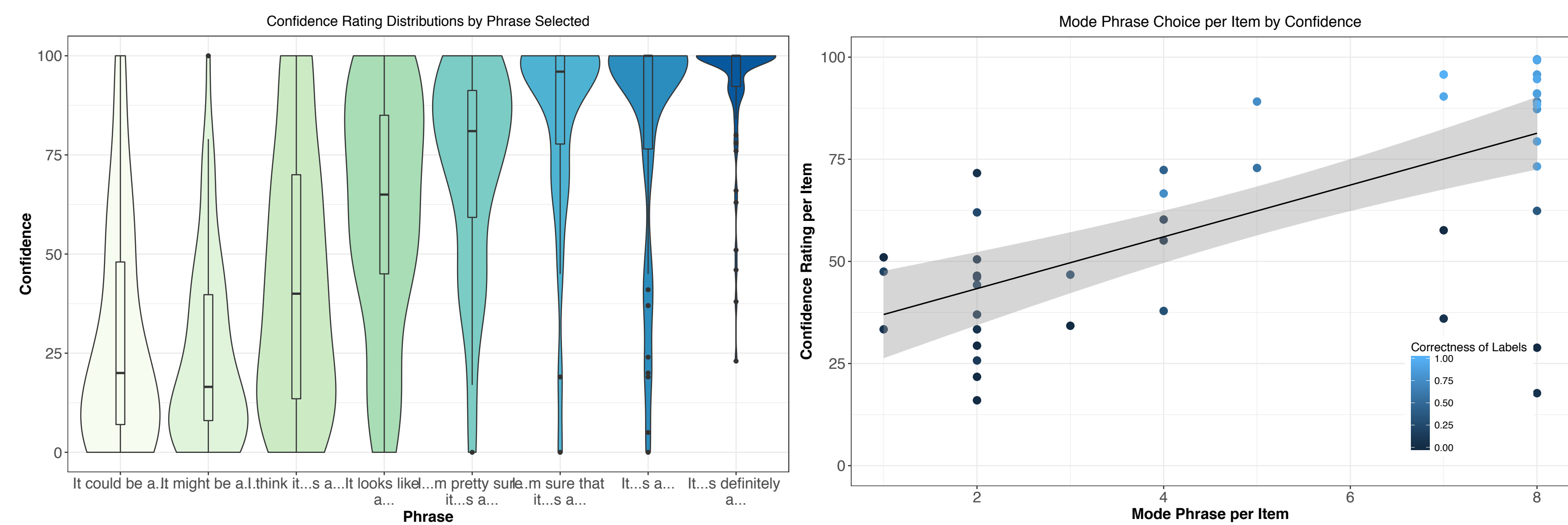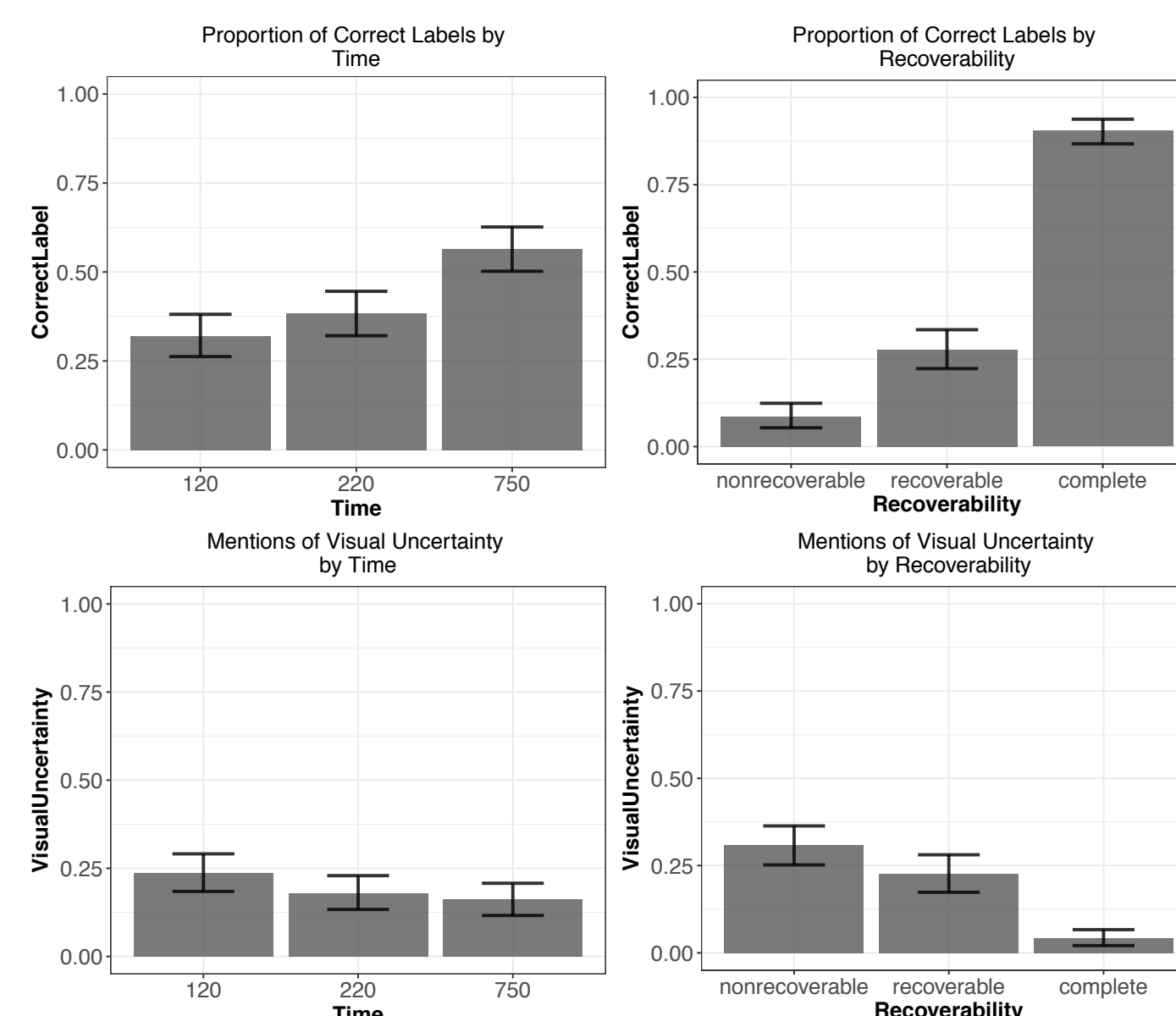
(Stimuli adapted from Biederman, 1987)

3 measures:

- What did you see?
- How confident are you that you correctly labeled the image?
- Which is the most likely phrase that you would use to describe what you saw to another person?

Time: 120/220/750 ms
Recoverability: Non-recoverable, Recoverable, Complete
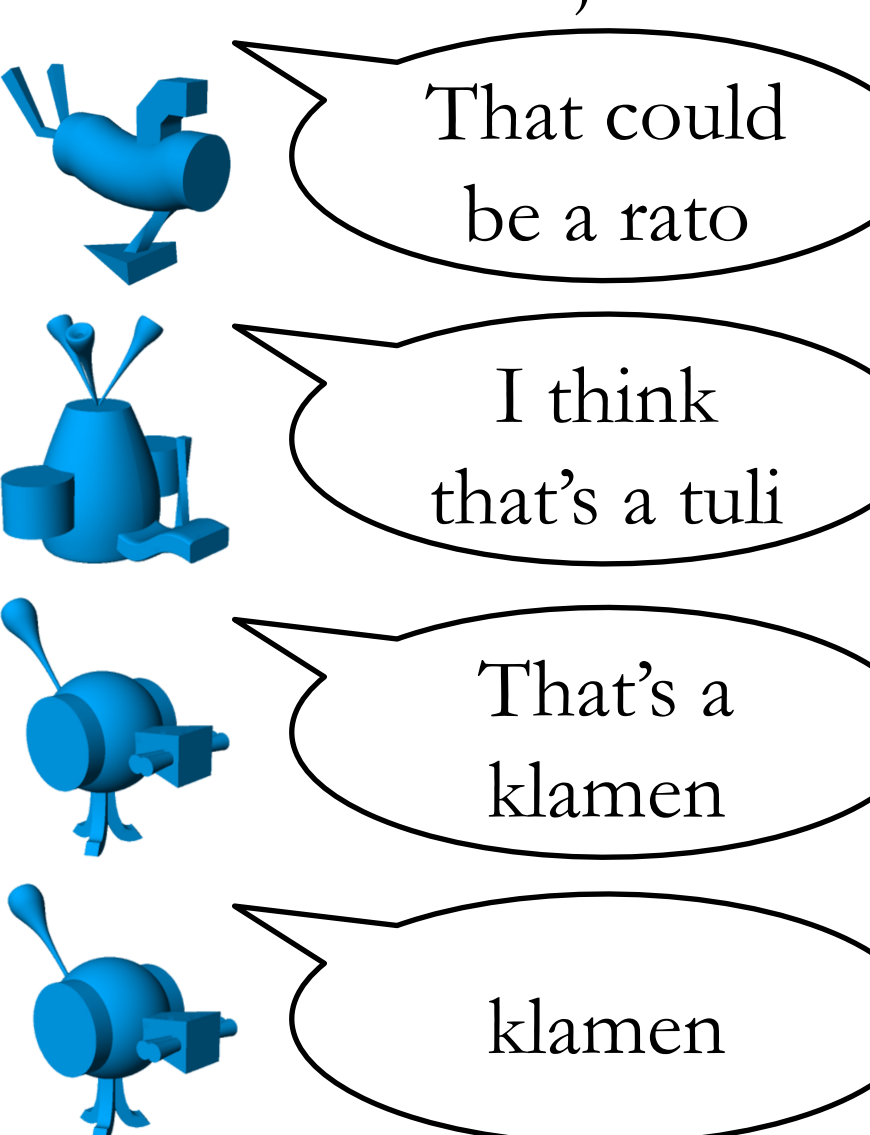
Manipulation Check:

General Findings:
- We can measure empirically how certain a speaker should be
- Can then investigate how speaker certainty maps onto their linguistic choices
- Can ask how this influences listener behavior

E2: Behavioral Effects of Certainty on Learning

Learning:
12 novel objects

- That could be a rato
- I think that's a tuli
- That's a klamen
- klamen

Test:
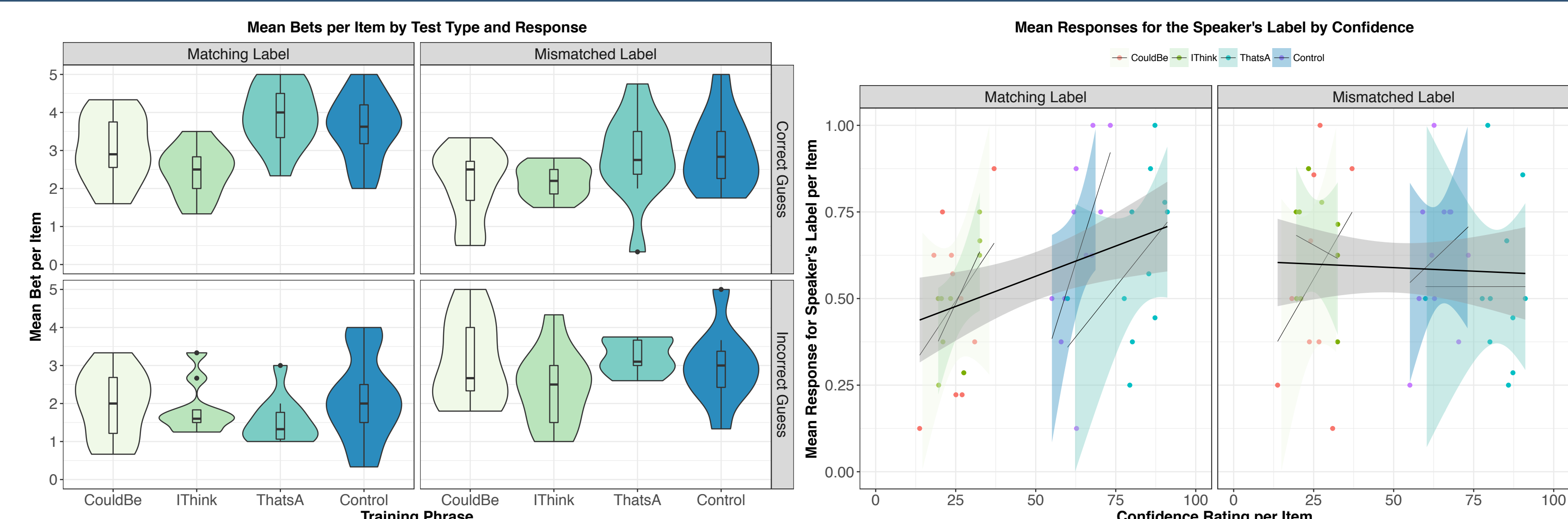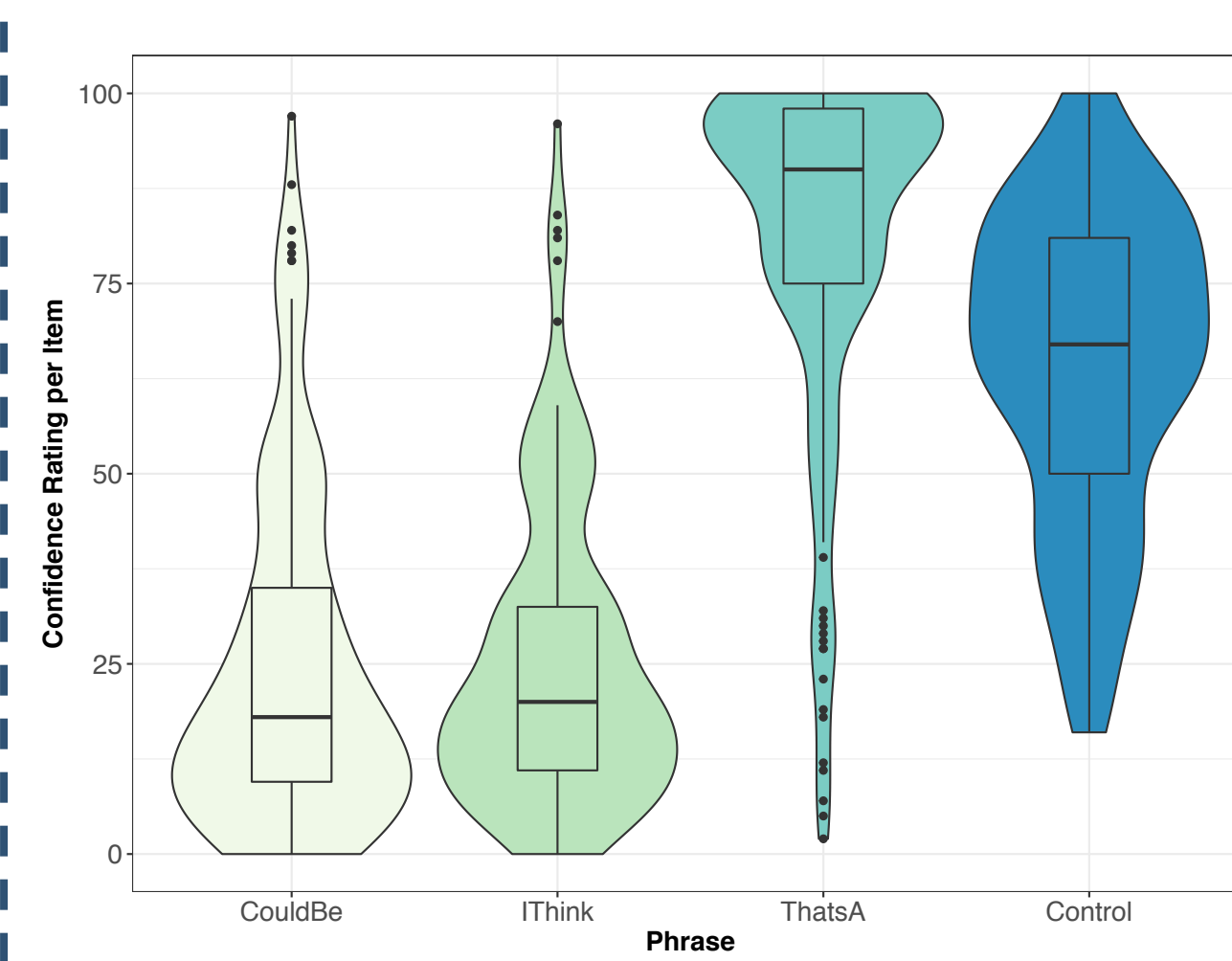6 matching labels
6 mismatched labels

tuli (match)
klamen (mismatch)

Bet:
Up to $0.05 that you're correct

Norming:
How certain does the speaker sound about their label?

General Findings:
- Can investigate how speaker certainty maps onto a listener's judgment about the speaker's knowledge (about a label), and consequently their beliefs about the veracity of the information / their commitment to that information

Summary: a **promising** approach

1. Speakers and listeners systematically produce and interpret utterances marked with uncertainty.
2. We have successfully designed tasks manipulating speaker certainty, and then evaluating how certainty maps onto linguistic choices.
    - Future work will quantify objective certainty by grounding objective certainty with visual stimuli.
3. A speaker's certainty influences a listener's learning behaviors, suggesting listeners make inferences about the information being conveyed in a nuanced way.
    - Ongoing and future work explores scenarios where sources express different levels of confidence, for converging and conflicting judgments by speakers who might differ in reliability, knowledge, gender, etc.

Current and Future Directions

Learning from 2 speakers:
12 novel objects
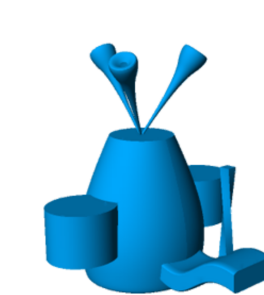
- That's definitely a tuli
- That could be a mafer

Learning from an un/certain speaker:
Domain expertise

- A kale stripper
- The leaf shaped tool with holes in it

Adapting to un/reliable speakers:
Over/under-confidence

- That's definitely a klamen
- I know that is called a "tuli"

References: Bibyk, S. A. (2016). *A Rise by Any Other Name: An Investigation of the Production and Comprehension of Rising (and Falling) Intonation in Questions. Dissertation.* Biederman, I. (1987). Recognition-by-Components : A Theory of Human Image Understanding, *Psychological Review*, 94, 115–147. Brown-Schmidt, S., Yoon, S. O., & Ryskin, R. A. (2015). People as contexts in conversation. In *Psychology of Learning and Motivation* (Vol. 62, pp. 59-99). Academic Press. Gunlogson, C. (2008). A question of commitment. *Belgian Journal of Linguistics*, 22, 101–136. Williams, P. (1998). Representational organization of multiple exemplars of object categories, 1–21. **Acknowledgements:** The authors would like to acknowledge the members of the Human Language Processing (HLP) Lab, and attendees of XPrag 2017 for their helpful feedback on these projects. Also, the BCS graduate students and research assistants, for recording some of the stimuli. AP was funded by a fellowship through the University of Rochester Center for Language Sciences for a portion of the duration of these studies.