To know what you *might* say, I will *probably* need to know the event type

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Introduction: The use of uncertainty expressions like *might* and *probably* differs across people [1]. For example, when participants were asked to describe what gumball a machine with 60% orange gumballs would dispense, some preferred A while others preferred B [2; SD].

A: You might get an orange gumball B: You'll probably get an orange gumball

Given this inter-person variability, how can people communicate successfully about uncertain events? SD hypothesize that successful communication proceeds because listeners adapt to uncertainty expression usage of speakers. Using the RSA framework [3], they argue that pragmatic listeners could adapt to two properties of pragmatic speakers: semantic representations (i.e, mapping from expressions to event probabilities) and preferences for different expressions. But do pragmatic speakers use uncertainty expressions consistently when describing different types of probabilistic events? For example, consider a speaker asked to describe which political party in an unknown country would win, based on predictions from a reliable company. In this case the speaker only has access to the *predicted* probability of Party X winning, not the actual probability of the party winning. This is different from the gumball scenario, where the actual probability of an orange gumball being dispensed is inferrable from the image. In this work we investigate whether speakers' use of uncertainty expressions is the same in these two scenarios. Since current RSA models do not explicitly model the type of probabilistic events, any differences in utterance preferences can highlight concrete ways in which existing RSA models need to be extended to model more complex phenomena.

Experimental design: We used a within-subject blocked design in which participants were presented with images, and asked to describe the image to a person A who couldn't see the image. Participants were presented with images of gumballs in the first block, and of election predictions in the second block [Fig 1]. They used sliders to indicate their *relative* preferences for three utterances: *might*, *probably* and bare *not*; we normalized their preferences to probabilities for analysis. Before each block participants had to demonstrate they understood the instructions [Fig 2].

Methods: We recruited 118 participants from Prolific, but included only 85 participants after filtering for location, English usage, and accuracy on attention checks. There were 36 trial types: 2 event types (gumball, election), 2 outcome types (orange vs. purple gumball dispensed/party winning), and 9 event probabilities (10% to 90% of the outcome); there were 2 trials per type, resulting in 72 trials in total with 24 attention checks [Fig 3] inserted randomly.

Results: In the gumball scenario, replicating SD, participants preferred *might* over other utterances for 30-60% probabilities, whereas in the election scenario this was true only when the event probability was 50% [Fig6]. To model this inverse u-shape pattern, we fit a mixed effects logistic regression on the probability of *might* for the just first 50% event probabilities. The observed interaction between event type and event probability was significant [Fig 4].

Discussion: If speakers' usage of uncertainty expressions is only shaped by their semantic representations and their preferences, a simplifying assumption made in many RSA models, then we would not expect to see the difference in the use of *might* across the election and gumball scenarios that we observed. One way of extending vanilla RSA models to account for our data is to posit a Pragmatic Listener turn for the participant prior to their selection of an uncertainty expression (a Pragmatic Speaker move), where they interpret the predicted probability according to their trust in the information source and/or their world knowledge about elections. This in turn suggests that a listener would need to additionally adapt to a speaker's trust in the information source and world knowledge given a specific event type.

References:
[1] Wallsten,T.S, Budescu, D.V., Rapoport, A., Zwick, R., & Forsyth, B.(1986). Measuring the vague meanings of probability terms. Journal of Experimental Psychology: General, 115(4), 348–365
[2] Schuster, S., & Degen, J. (2020). I know what you're probably going to say: Listener adaptation to variable use of uncertainty expressions. Cognition, 203, 104285.
[3] Frank, M. C., & Goodman, N. D. (2012). Predicting pragmatic reasoning in language games. Science, 336(6084), 998-998.

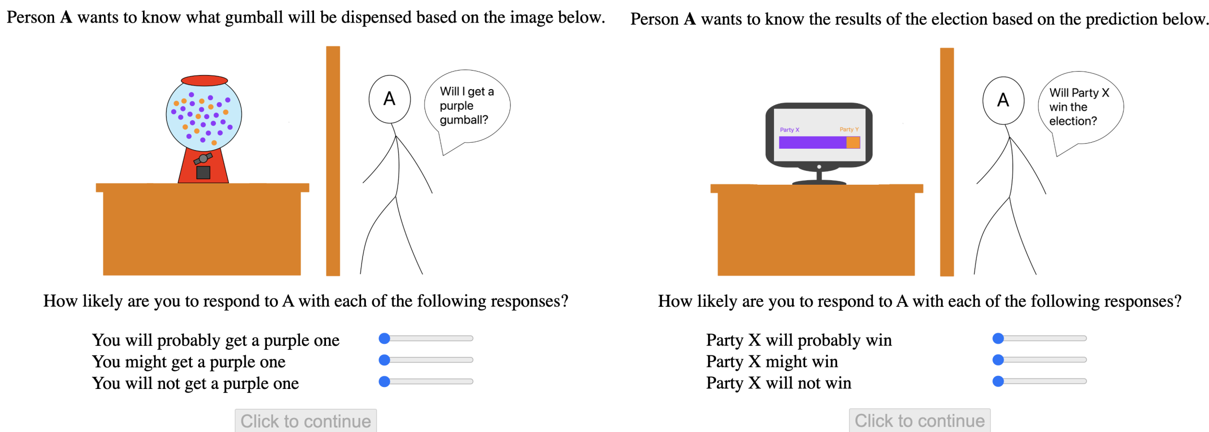

Figure 1: Sample trials from gumball scenario and election scenario

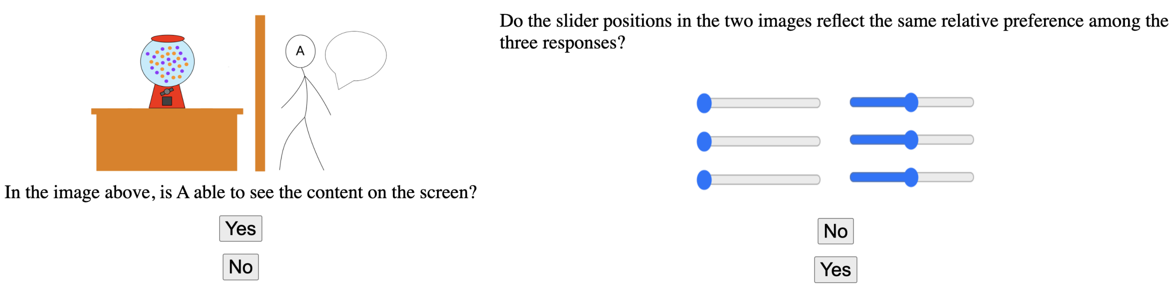

Figure 2: Checks to verify participants understood instruction

Figure 3: Attention check

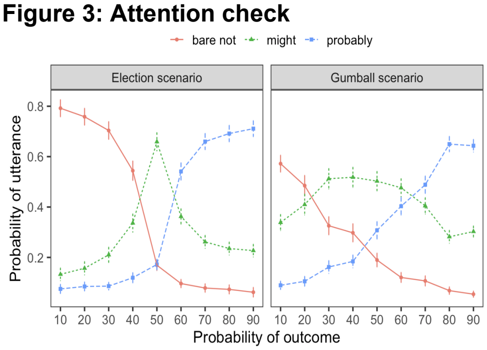

Figure 4: Mean probability of utterances. Error bars indicate 2 SE above and below the mean.

Maximal random effects structure that converged:

prob_might ~ scale(outcome) * event_type +
(1 + scale(outcome) + event_type || random_id)

Coding for event_type: 1 for gumball, 0 for election

Model estimates (p-values)

outcome: 1.68 (< 2e-16)
event_type: 1.79 (< 2e-16)
outcome: event_type: -1.33 (< 2e-16)

Figure 5: Details about the statistical analysis