Listeners Adapt to Speakers' Pragmatic Competence

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A message that appears ambiguous under literal interpretation might be successfully resolved using pragmatic reasoning about the speaker's intentions and the communicative context. The Rational Speech Act framework (Goodman & Frank, 2016) formalizes this as Bayesian reasoning over the behavior of a cooperative partner. Such reasoning on the listener's side is the right strategy if the speaker also engaged in pragmatic reasoning during production. On the other hand, the listener's pragmatic effort to resolve ambiguities may lead to the wrong interpretation if the speaker did not select her utterance cooperatively. Previously, Mayn et al. (2024) showed that people adjust their interpretations based on information about the speaker: participants were less likely to interpret a child speaker pragmatically than an adult speaker. In our study, instead of revealing the speaker's pragmatic profile, we expect the listeners to adjust their application of reasoning based on **task success** during repeated interaction with the same partner. Bottom-up adjustments like this have been noted in work on contrastive inferences from scalar adjectives (Ryskin et al., 2019).

Method We situate our participants in a collaborative reference game (Frank & Goodman, 2012), where they play the role of listeners. Participants are paired with two partners, one of which follows a **pragmatic** (S_1) and the other a **literal** (S_0) production strategy. Each participant is exposed to both speakers across two blocks in a randomized order.

Candidate images have one of three possible shapes and three possible colors. A trial consists of three candidate images, a set of four available shape and color messages, and the message sent by the speaker. On critical trials, the speaker's message is **ambiguous** and can be literally true of two possible referents. With a pragmatic partner, applying reasoning about the alternative messages will always yield the correct referent. With a literal speaker, however, the ambiguous message may apply to any literally valid candidate, hence applying pragmatic reasoning will sometimes result in choosing an incorrect object. After each trial, we reveal the speaker's intended referent. Figure 1 shows an example critical trial from the literal speaker block.

Note that in critical trials, the pragmatically plausible target only has one available message, while there are always two messages for the competitor. Thus, with a literal speaker choosing from the valid messages by chance, the ambiguous message will have the pragmatically plausible candidate as the target in ⅔ of trials, and the competitor as the target in the remaining ⅓.

We also record participants' confidence about their selections on a 4-point scale throughout the experiment, and examine how it changes as they gain experience with each speaker's behavior.

Each block contains 24 critical and 8 filler items. In the filler items, the message is unambiguous.

Hypothesis If participants adapt to their partner's behavior, their confidence ratings on critical trials in the literal speaker block should decrease through exposure. Responses on filler items should not change.

Results 96 participants were recruited on Prolific. Their responses (Figure 2) were analyzed by fitting ordinal mixed effect regressions to a combination of referent selection and confidence rating (Table 1). On critical trials, participants widely preferred the pragmatically-correct referent in both blocks, but expressed more confidence in their interpretations when interacting with the pragmatic speaker. Confidence developed through repeated interactions, differently for the two speaker types, growing with experience in pragmatic speaker blocks, and falling in literal speaker blocks. Filler trials showed none of these effects.

Discussion When interacting with a literal speaker, participants tended to select the pragmatic target, but with a lower confidence than when interacting with a pragmatic speaker. We take this to provide further evidence that comprehenders can quickly adjust pragmatic interpretation to the demonstrated competence of a partner. While this adjustment is only evident here in metacognitive responses, in a natural interaction lower confidence could drive comprehenders to request clarification. In a follow-up study we will test this prediction with a more naturalistic paradigm.

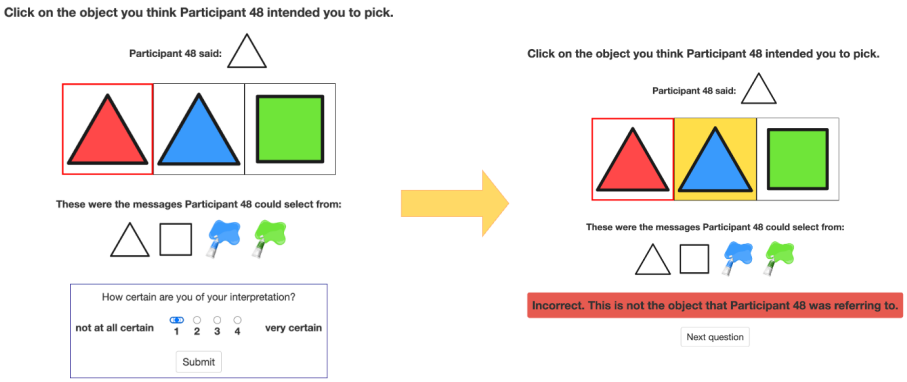

Figure 1: Example trial item from the literal speaker block. The participant chooses the pragmatically plausible interpretation which ends up being wrong. This is the learning signal for the participant that the speaker is picking messages without reasoning about alternative messages.

Parameter	$\hat{\beta}$	95% HDPI
Speaker Type (S_1)	0.72	(0.54, 0.90)
Block Number (Block 2)	-0.02	(-0.19, 0.15)
Quarter of Block	0.13	(0.05, 0.22)
Speaker Type $\times$ Block Number	-0.05	(-0.34, 0.23)
Speaker Type $\times$ Quarter of Block	0.22	(0.14, 0.31)
Block Number $\times$ Quarter of Block	-0.08	(-0.16, -0.01)
Speaker Type $\times$ Block Number $\times$ Quarter of Block	0.00	(-0.08, 0.07)

Table 1: Excerpted parameters from Bayesian ordinal regression fit in `brms` to responses in critical items. Binary factors were sum-coded (-1, 1), with positive levels indicated in parentheses. Quarter of Block was centered. Effects are taken as noteworthy if the 95% highest density posterior interval excludes 0.

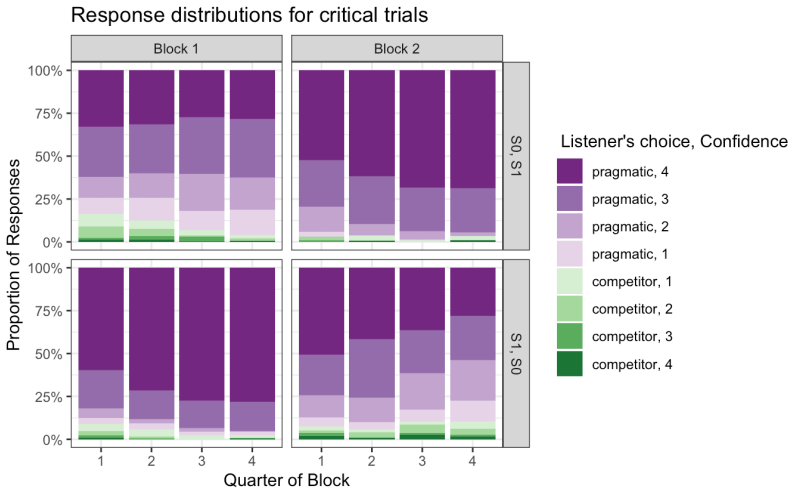

Figure 2: Listeners' responses over the course of the interaction. In the first row we see participants who encountered the literal S_0 first, then pragmatic S_1, in the second row the speaker order is reversed. Responses are shown on the combined choice/confidence scale used for analysis.

Preregistration

https://osf.io/w7yqg?view_only=fa7f9034042946f0928d2c772e0a23ad.

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