Polite speech emerges from competing social goals

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Language is a remarkably efficient tool for transmitting information. Yet human speakers make statements that are inefficient, imprecise, or even contrary to their beliefs, all in the service of being polite. What rational machinery underlies polite language use? Here, we show that polite speech emerges from the competition of informational, social, and self-presentational (i.e., *appearing* informational or social) goals. We formalize this tradeoff using a probabilistic model of utterance production, which predicts human choices with high quantitative accuracy. This utility-theoretic approach to speech acts takes a step towards explaining the richness and subtlety of social language use.

politeness | computational modeling | communicative goals | pragmatics

We rarely say exactly what's on our mind. Although *close the window!* could be effective message, we dawdle by adding *can you please. . . ?* or *would you mind. . . ?* Rather than tell an uncomfortable truth, socially-aware speakers lie (*Your dress looks great!*) and prevaricate (*Your poem was so appropriate to the occasion*). Such language use is puzzling for classical views of language as information transfer (1–4). On these views, transfer ought to be efficient and accurate: The speaker chooses a succinct utterance to convey their beliefs knows (5, 6), and the information transferred is ideally accurate and truthful to the extent of the speaker's knowledge. Polite speech violates these basic expectations about the nature of communication: It is typically inefficient and underinformative, and sometimes even outright false. Yet even young speakers of a language spontaneously produce requests in polite forms (7, 8), and adults use politeness strategies while arguing, preventing unnecessary offense to their interactants (9).

If politeness only gets in the way of effective information transfer, why be polite? Clearly, we have social concerns, and most linguistic theories assume such a mechanism of action, couched as either polite maxims (10), social norms (11), or aspects of a speaker and/or listener's identity referred as *face* (12, 13). This latter theory predicts that when a speaker's intended meaning contains a threat to the listener's self-image (and potentially the speaker's image), her messages will be less direct, less efficient, and possibly untruthful. But how does a speaker decide to be indirect (*Your pie could use a bit of salt*) vs. false (*It's delicious!*), and when should they tell the truth? Additionally, how does the possibility of a speaker maintaining their own image in the mind of the listener enter into the calculation?

We propose a utility-theoretic solution to the problem of polite language production by quantifying the tradeoff between competing communicative goals. In our model, speakers attempt to maximize informational utility—derived via classical, effective information transmission, social utility—derived by being kind and saving the listener's face, and a self-presentational utility—derived by appearing in a particular way to save the speaker's own face. Speakers then produce an utterance on the basis of its expected utility (including their cost to utter, approximated by the length of the utterance). The lie that a pie was delicious provides social utility by making the baker feel good, but does not provide information about the true state of the world. Further, if the baker suspects that it was in fact terrible, the speaker runs the risk of being seen as uncooperative.

The speaker's utilities are weighed within a probabilistic model of pragmatic reasoning within the Rational Speech Act (RSA) framework (2, 14): Speakers are modeled as agents who choose utterances by reasoning about their effects on a listener relative to their cost, while listeners infer the meaning of an utterance by reasoning about speakers and their goals. This model class has provided a quantitative understanding of a wide variety of complex linguistic behaviors, including vagueness (15), hyperbole (16), and irony (17), among others. In this framework, language use builds on the idea that human social cognition can be approximated via reasoning about others as rational agents who act to maximize their subjective utility (18), a hypothesis which has found empirical support in a wide variety of work with both adults and children (e.g., (19, 20)).

RSA models are defined recursively such that speakers reason about listeners, and vice versa. We use convention in indexing and say a pragmatic listener L_1 reasons about what intended meaning and goals would have led a speaker S_1 to produce a particular utterance. Then S_1 reasons about

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Significance Statement

Politeness violates the standard model of language use as a tool for information transfer. Here, we formalize how politeness emerges in language use through a balance between three potentially conflicting goals: an informational goal (*be informative*), a social goal (*be nice*), and a self-presentational goal (*look nice*). We present a pre-registered, quantitative test of our model, finding all three speech production goals are necessary to explain the nuances of the utterance choices of our participants. This formal work introduces a quantitative understanding of social language use more broadly, and presents a computational perspective on courtesy, to machines that talk with tact.

Please provide details of author contributions here.

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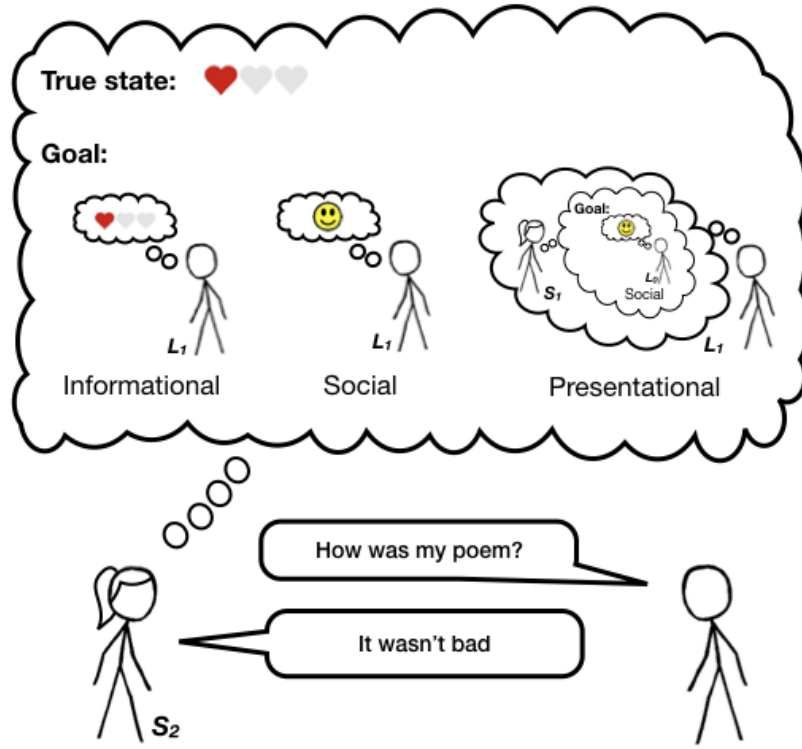
Fig. 1. Diagram of the model: The pragmatic speaker observes the true state and determines her goal between three utilities (informational, social, and presentational), and produces an utterance.

a *literal listener* L_0, modeled as attending only to the literal meanings of words (rather than their pragmatic implications), and hence grounds the recursion. The target of our current work is a model of a polite speaker S_2: S_2 reasons about what utterance to say to L_1 by considering the set of utilities described above (Figure 1).

We evaluate our model on its ability to predict human utterance choices in situations where polite language use is expected to varying degrees. Let's say Bob baked his pie and asks Ann how good was the pie. Ann (S_2) produces an utterance w based on the true state of the world s (i.e., the rating, in her mind, truly deserved by Bob's pie) and a set of goal weights $\hat{\phi}$, that determines how much Ann prioritizes each of the three possible goals. Ann's production decision is softmax, which interpolates between maximizing and probability matching (via λ_{S_2}; (21)):

$$P_{S_2}(w|s,\hat{\phi}) \propto \exp(\lambda_{S_2} \cdot \mathbb{E}[U_{total}(w;s;\hat{\phi})]). \quad [1]$$

We posit that a speaker's utility contains three distinct components: informational, social, and presentational. The total utility of an utterance is the weighted combination of the three component utilities minus the utterance cost $C(w)$:

$$U_{total}(w;s;\hat{\phi}) = \phi_{inf} \cdot U_{inf}(w;s) + \phi_{soc} \cdot U_{soc}(w;s) + \\ \phi_{pres} \cdot U_{pres}(w;s) - C(w). \quad [2]$$

Foremost, we define *social utility* as the expected subjective utility $V(s)$ of the state implied to the listener by the utterance: $U_{soc}(w) = \mathbb{E}_{P_{L_1}(s|w)}[V(s)]$. The subjective utility function $V(s)$ could vary by culture and context; we test our model when states are explicit ratings (e.g., on a 4-pt scale) and we assume a positive linear value relationship between states and values V to model a listener's preference to be in a highly rated state (e.g., Bob would prefer to have made a 4-star pie rather than a 1-star pie). At the same time, a speaker may desire to be epistemically helpful, modeled as standard *informational utility* (U_{inf}). The informational utility indexes the amount of information a literal listener (L_0) would still not know about the state of the world s after hearing the speaker's utterance w (i.e., surprisal; e.g., how likely is Bob to guess Ann's actual opinion of the pie): $U_{inf}(w) = \ln(P_{L_1}(s|w))$. Speakers who optimize for informational utility produce accurate and informative utterances while those who optimize for social utility produce utterances that make the listener feel good.

If a listener is uncertain how their particular speaker is weighing the competing goals to be honest vs. kind, they might try to infer the weighting (e.g., "was she just being nice?"). But then a sophisticated speakers can produce utterances in order to appear as if they had certain goals in mind (i.e., a self-presentational goal). The extent to which the speaker *appears* to the listener to have a particular goal in mind (e.g., to be kind) is the utterance's *presentational utility* (U_{pres}) and is the most novel component of our model. The speaker gains presentational utility when her listener believes she has particular goals – that she is trying to be informative or kind. Formally,

$$U_{pres}(w) = \ln(P_{L_1}(\phi_{S_1} \mid w)) = \ln \int_s P_{L_1}(s, \phi_{S_1} \mid w). \quad [3]$$

The speaker conveys a weighting of informational vs. social goals (ϕ_{S_1}) by considering the beliefs of listener L1, who hears

an utterance and jointly infers the speaker's utilities and the true state of the world:

$$P_{L_1}(s, \hat{\phi}|w) \propto P_{S_1}(w|s, \hat{\phi}) \cdot P(s) \cdot p(\hat{\phi}). \quad [4]$$

This presentational utility is the highest-order term of the model, defined only for a speaker thinking about a listener who evaluates a speaker (i.e., defined for S_2, but not S_1).

Finally, more complex utterances incur a greater cost, $C(w)$ – capturing the general pressure towards economy in speech. In our work, utterances with negation (e.g., *not terrible*) are assumed to be slightly costlier than their equivalents with no negation (inferred from data; see Supplementary Information).

Within our experimental domain, we assume there are four possible states of the world corresponding to the value placed on a particular referent (e.g., the presentation the speaker is commenting on): $S = s_1, ..., s_4$. Since the rating scale is relatively abstract, we assume a uniform prior distribution over possible states of the world. The set of utterances is {*terrible, bad, good, amazing, not terrible, not bad, not good,* and *not amazing*}. We implemented this model using the probabilistic programming language WebPPL (22).

The model exhibits and explains interpretable behavior. If Bob's pie was good, Ann's utilities align to produce a positive utterance. Saying *[Your pie] was amazing* simultaneously is truthful, kind, and appears as both. If Bob's pie was poor, however, the speaker is in a bind: Ann could be kind and say *It was great*, but at the cost of conveying the wrong information to Bob if he believes her to be truthful. If he does not, he might infer Ann is *just being nice*, but is uninformative. Alternatively, she could say the truth (*It was bad*), but then Bob would think Ann didn't care about him. What is a socially-aware speaker to do? Our quantitative model predicts that indirect speech – like *It wasn't bad* – best navigates Ann's dilemma. Her statement is sufficiently open-ended to include the possibility that the poem was good, but her avoidance of the simpler and less costly *It was good* provides both an inference available to Bob that the pie was mediocre and that Ann cares about his feelings.

Results

We made a direct, pre-registered test of our model by instantiating our running example in an online experiment ($N = 202$). Participants read scenarios with information on the speaker's (Ann's, in our example) feelings toward some performance or product (e.g., poem recital; *true state*), on a scale from zero to three hearts (e.g., one out of three hearts). For example, one trial read: *Imagine that Bob gave a poem recital, but he didn't know how good it was. Bob approached Ann, who knows a lot about poems, and asked*How was my poem?" We also manipulated the speaker's *goal* across trials: to be *informative* (*give accurate and informative feedback*); to be *kind* (*make the listener feel good*); or to be *both* informative and kind simultaneously. We hypothesized that each of the three experimentally-induced goals will represent a tradeoff between the three utilities in our model (see Supplementary Information). In a single trial, each scenario was followed by a question asking for the most likely produced utterance by Ann. Participants selected one of eight possible utterances, by choosing between *It was* vs. *It wasn't* and then among *terrible, bad, good,* and *amazing*.
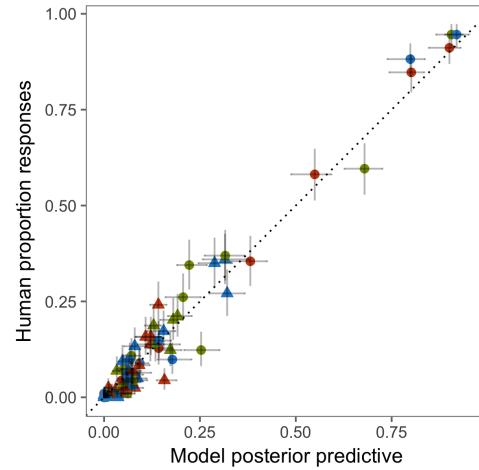
Fig. 2. Full distribution of human responses vs. model predictions. Error bars represent 95% confidence intervals for the data (vertical) and 95% highest density intervals for the model (horizontal).

Table 1. Comparison of variance explained for each model variant and log Bayes Factors quantifying evidence in favor of alternative model in comparison.

Model	Variance explained	log BF
model: informational, social, presentational	0.97	–
model: informational, presentational	0.96	-11.14
model: informational, social	0.92	-25.06
model: social, presentational	0.23	-864
model: presentational only	0.23	-873.83
model: social only	0.22	-885.52
model: informational only	0.83	-274.89

Our primary behavioral hypothesis was that speakers describing bad states (e.g., Bob's pie deserved 0 hearts) with goals to be both informative and kind would produce more indirect, negative utterances (e.g., *It wasn't terrible*). Such indirect speech acts both save the listener's face and providing a little information about the true state, and thus, are the kind of thing that a socially-conscious speaker would say. This prediction was confirmed: a Bayesian mixed-effects model predicts more negation as a function of true state and goal via an interaction such that a speaker with both goals to be informative and kind produced more negation in worse states compared to a speaker with only the goal to be informative (M = -1.33, [-1.69, -0.98]) and goal to be kind (M = -0.50, [-0.92, -0.07]). Rather than eschewing one of their goals to increase utility along a single dimension, participants chose utterances that jointly satisfied their conflicting goals by producing indirect, polite speech.

The model parameters (softmax parameters and each goal condition's utility weights) can be inferred from the behavioral data using a Bayesian data analysis model ((23); see Supplementary Information) To approximate the literal meanings (i.e., the semantics) of the words as interpreted by the literal listener L_0, we obtained literal meaning judgments from an independent group of participants (N=51). The posterior
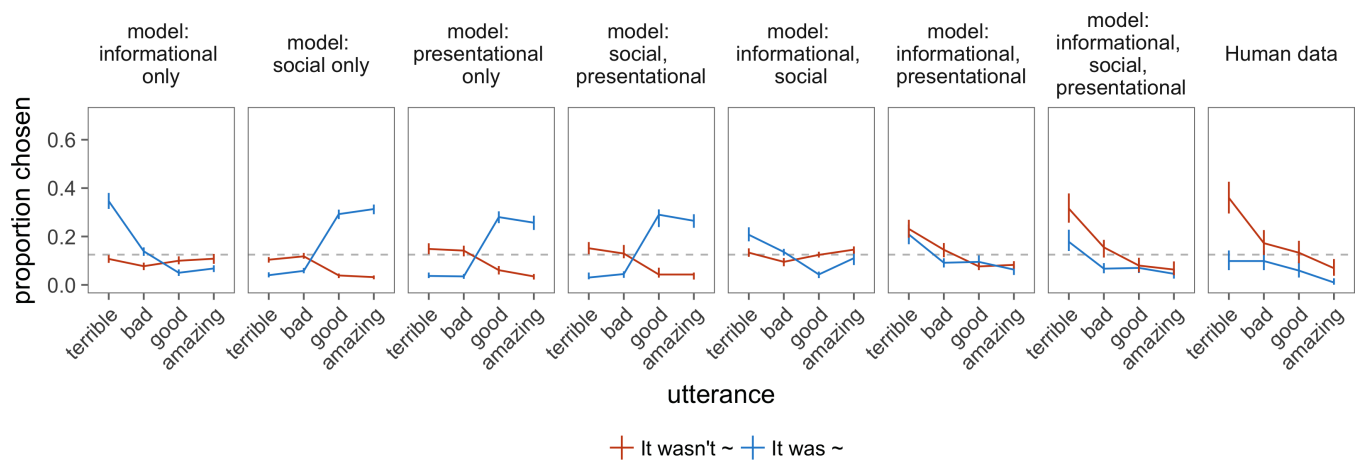
Fig. 3. Comparison of predictions for proportion of utterances chosen by pragmatic speaker from possible model variants (left) and human data (rightmost) for average proportion of negation produced among all utterances, given true state of 0 heart (on a scale of 0 to 3) and speaker with both goals to be informative and kind. Gray dotted line indicates chance level at 12.5%.

Table 2. Inferred phi parameters from all model variants with more than one utility.

Model (utilities)	goal	ϕ_{inf}	ϕ_{soc}	ϕ_{pres}	ϕ_{S_1}
inf, soc, pres	both	0.36	0.11	0.54	0.36
inf, soc, pres	informative	0.36	0.02	0.62	0.49
inf, soc, pres	social	0.25	0.31	0.44	0.37
inf, pres	both	0.64	–	0.36	0.17
inf, pres	informative	0.77	–	0.23	0.33
inf, pres	social	0.66	–	0.34	0.04
inf, soc	both	0.54	0.46	–	–
inf, soc	informative	0.82	0.18	–	–
inf, soc	social	0.39	0.61	–	–
soc, pres	both	–	0.38	0.62	0.55
soc, pres	informative	–	0.35	0.65	0.75
soc, pres	social	–	0.48	0.52	0.66

predictions from the the three-utility polite speaker model (informational, social, presentational) showed a very strong fit to participants' actual utterance choices ($r^2(96) = 0.97$; Figure 2). We compared these to six model variants containing subsets of the three utilities in the full model. Both the variance explained and the marginal likelihood of the observed data were the highest for the full model (Table 1). Only the full model captured participants' preference for negation when the speaker wanted to be informative and kind about truly bad states, as hypothesized (Figure 3). In sum, the full collection of informational, social, and presentational were required to fully explain participants' utterance choices.

The utility weights inferred for the three-utility model (Table 2) provide additional insight into how polite language use operates: *Being kind* requires equal weights on all three utilities, indicating that Gricean informativity needs to be part of language use even when it is explicitly not the goal. *Being informative* pushes the weight on social utility close to zero, but the weight on *appearing kind* stays high, suggesting that speakers are expected to manage their own face even when they are not considering others'. *Kind and informative* speakers emphasize informativity slightly more than kindness.

In all cases, however, the presentational utilities have greatest weight, which may suggest that appearing honest and kind is more important than actually being so! Overall then, our condition manipulation altered the balance between these weights, but all utilities played a role in all conditions.

Discussion

Politeness is puzzling from an information-theoretic perspective. Incorporating social motivations adds a level of explanation, but so far such intuitions and observations have resisted both formalization and precise testing. We present a utility-theoretic model of language use that captures the interplay between competing informational, social, and presentational goals, and provide preregistered experimental evidence that confirmed its ability to capture human judgments, unlike comparison models that used only a subset of the full utility structure.

Precisely estimate choice behavior in the experiment required abstracting away from natural interactions in a number of ways. Human speakers have access to a potentially infinite set of utterances to select from in order manage the three-utility tradeoff (*It's hard to write a good poem*, *That metaphor in the second stanza was so relatable!*). In theory, each utterance will have strengths and weaknesses relative to the speaker's goals, though computation in an unbounded model presents technical challenges (perhaps paralleling the difficulty human speakers feel in finding the right thing to say in a difficult situation; see (14)).

For a socially-conscious speaker, managing listeners' inferences is a fundamental task. Our model builds upon the theory of politeness as face management (12) and takes a step towards understanding it more fully. Our work extends previous models of language beyond standard informational utilities to address social and self-presentational concerns. Previous theories of language use have not explained how informational versus social concerns trade off to inform the speaker's utterance choices. This work breaks through to exploring how informational cooperativity interacts with other social goals, and our approach can provide insight into a wide range of social behaviors beyond speech by considering utility-driven inferences in a social context (24, 25) where agents need to

268 take into account concerns about both self and others.

269 Previous game-theoretic analyses of politeness have either
270 required some social cost to an utterance (e.g., by reducing
271 one's social status or incurring social debt to one's conversa-
272 tional partner; (26)) or a separate notion of plausible deniabil-
273 ity (27). The necessary kind of utterance cost would involve
274 higher-order reasoning about others, and may be able to be
275 defined in terms the more basic social and self-presentational
276 goals we formalize here. A separate notion of plausible deniabil-
277 ity may not be need either. Maintaining plausible deniability
278 is in one's own self-interest (e.g., for controversial viewpoints
279 or covert deception) and; goes against the interest of the
280 addressee. A joint cooperative and conflicting relationship
281 was thought necessary for indirect speech (27), but here we
282 show indirectness arising from purely cooperative goals, which
283 address different aspects of a general utility structure.

284 Utility weights and value functions in our model could pro-
285 vide a framework for understanding systematic cross-cultural
286 differences in what counts as polite. Cross-cultural differences
287 in politeness could be a product of different weightings within
288 the same utility structure. Alternatively, culture could affect
289 the value function V that maps states of the world onto sub-
290 jective values for the listener (e.g., the mapping from states
291 to utilities may be nonlinear and involve reasoning about the
292 future). Our formal modeling approach with systematic behav-
293 ior measurements provides an avenue towards understanding
294 the vast range of politeness practices found across languages.

295 Politeness is but one of the ways that language use deviates
296 from purely informational transmission. We flirt, insult, boast,
297 and empathize by balancing informative transmissions with
298 goals to affect others' feelings or present particular views of
299 ourselves. Our work shows how social and self-presentational
300 motives are integrated with informational concerns more gen-
301 erally, opening up the possibility for a broader theory of social
302 language. Finally, a formal formal account of politeness moves
303 us closer to courteous computation – to machines that can
304 talk with tact.

Materials and Methods

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306

307 **Literal semantic task.** We probed judgments of literal meanings of
308 the target words assumed by our model and used in our main
309 experiment. 51 participants with IP addresses in the United States
310 were recruited on Amazon's Mechanical Turk. We used thirteen
311 different context items in which a speaker evaluated a performance
312 of some kind. For example, in one of the contexts, Ann saw a
313 presentation, and Ann's feelings toward the presentation (true state)
314 were shown on a scale from zero to three hearts (e.g., two out of
315 three hearts filled in red color; see Figure 5 for an example of the
316 heart scale). The question of interest was *Do you think Ann thought*
317 *the presentation was / wasn't X?* and participants responded by
318 choosing either *no* or *yes.* The target could be one of four possible
319 words: *terrible*, *bad*, *good*, and *amazing*, giving rise to eight different
320 possible utterances (with negation or no negation). Each participant
321 read 32 scenarios, depicting every possible combination of states and
322 utterances. The order of context items was randomized, and there
323 were a maximum of four repeats of each context item per participant.
324 For this and the speaker production experiment, we analyzed the
325 data by collapsing across context items. For each utterance-state
326 pair, we computed the posterior distribution over the semantic
327 weight (i.e., how consistent X utterance is with Y state) assuming
328 a uniform prior over the weight (i.e., a standard Beta-Binomial
329 model). Meanings of the words as judged by participants were as
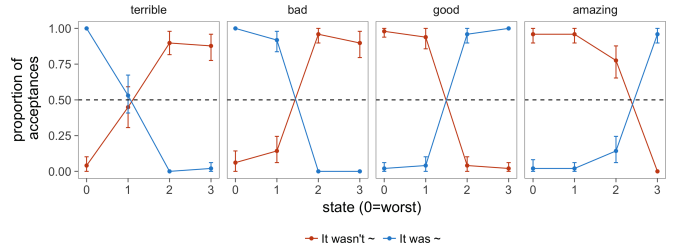330 one would expect (Figure 4).

Fig. 4. Semantic measurement results. Proportion of acceptances of utterance types (shown in different colors) combined with target words (shown in different facets) given the true state represented on a scale of hearts. Error bars represent 95% confidence intervals.

Fig. 5. Example of a trial in the speaker production task.

Speaker production task. 202 participants with IP addresses in the
United States were recruited on Amazon's Mechanical Turk. As in
the literal semantic task above, we used scenarios in which a person
(e.g., Bob) gave some performance and asked for another person
(e.g., Ann)'s opinion on the performance (Figure 5). Additionally,
we provided information on the speaker Ann's goal – to make Bob
feel good, or to give as accurate and informative feedback as possible,
or both – and the true state – how Ann actually felt about Bob's
performance (e.g., two out of three hearts, on a scale from zero
to three hearts; Figure 5). Each participant read twelve scenarios,
depicting every possible combination of the three goals and four
states. The order of context items was randomized, and there were a
maximum of two repeats of each context item per participant. Each
scenario was followed by a question that read, *If Ann wanted to*
make Bob feel good but not necessarily give informative feedback (or
to give accurate and informative feedback but not necessarily make
Bob feel good, or BOTH make Bob feel good AND give accurate
and informative feedback), what would Ann be most likely to say?
Participants indicated their answer by choosing one of the options
on the two dropdown menus, side-by-side, one for choosing between
It was vs. *It wasn't* and the other for choosing among *terrible*, *bad*,
good, and *amazing.*

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