

**Say it Like You (Don't) Mean it:
The Contributions of Adjectival Semantics and Intonation
to the Detection of Non-Literal Content**

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Abstract

A speaker who utters the sentence, “You gave me an awesome gift” could genuinely mean it. However, in the context of receiving a truly undesirable present, especially with certain prosody, such an utterance would take on an entirely different meaning, which conveys precisely the opposite message. By contrast, it’s harder to think of how the utterance “You gave me an awful gift” could ever be perceived as positive. While previous research (Capelli, Nakagawa & Madden, 1990; Ackerman, 1983; Hancock et al., 2000; Chaeng, 2008) has probed the contribution of intonation, situational context, or expectations to the detection of non-literal statements or sarcasm, it has been virtually silent on the role of lexical semantics. Only certain nominal modifiers give rise to sarcastic, non-literal meaning: gradable adjectives with positive valence (e.g., *awesome*). The same “negative” prosody with a gradable adjective with negative valence (e.g., *awful*) or a non-gradable adjective or noun modifier (e.g., *birthday*) maintains literal meaning but still conveys or underscores a negative speaker stance. This research experimentally investigates how the interaction between adjective semantics and intonation contours gives rise to a difference in literal or non-literal (sarcastic) meaning. We manipulated these factors in a 2 x 3 design, fully crossing intonation and adjective type/semantics, resulting in 6 within-subject conditions administered in a Latin-square design. Following previous designs (Glenwright & Pexman, 2010; Glenwright et al., 2014), participants were asked to assess (a) if the character liked the object, (b) if they meant what they said, and (c) how nice/mean the character was on a scale. Results demonstrate that adults recognize that the sarcastic intonation cues a negative speaker perspective, and opposite meaning with certain modifiers. Children ages 5-6 appear to pattern similarly to adults and distinguish between the prosodies but do not appear to recognize the speaker’s intent in using them. The sarcastic intonation decisively introduces a negative speaker perspective across all three adjective types, suggesting its role as an intonational morpheme.

Keywords: adjectives, prosody, sarcasm, non-literal meaning

1. Introduction

Effective communication is necessary in order to exchange information, build relationships, and simply navigate through life. But communication is layered with verbal and nonverbal cues, all while picking up on nuances and deciphering a speaker's intentions. Given all that, how often can a statement or utterance truly be taken at face value? To communicate effectively, adults must interpret not only literal content, where what is conveyed is derived directly from lexical information and semantic composition, but also figurative content, which is conveyed beyond strict lexical-semantic meaning. One example of this is sarcasm. Sarcasm is a form of linguistic discourse in which a non-literal utterance is used to make a criticism. Although used in a variety of forms, a sarcastic statement appears positive on the surface, but it is intended to be interpreted inversely and often negative. While adults can reliably recognize sarcasm and non-literal statements, it is unclear what specifically cues a sentence to be sarcastic and how people distinguish them. Previous literature has investigated several potential sources, including situational context, intonation, and incongruity, all of which contribute to the recognition of different types of sarcasm.

People encounter all different types of sarcasm in their daily lives and in media. Someone can deadpan, "What lovely weather!" while it's raining outside, and listeners will pick up on the contradiction between the state of the weather and the adjective *lovely*. In such cases, the sarcastic intonation is not required, and the situational irony is enough. However, in others, it would be impossible to recognize sarcasm without its typical prosody. For example, in *Inside Out 2*, the emotion characters encounter the "sar-chasm," which echoes all their utterances sarcastically. When Joy tries to communicate with the mind workers on the other side of the chasm, she says: "Boy, are we so lucky we ran into you guys." On the surface, this is a perfectly

harmless sentence that expresses excitement. However, the sarcasm warps the utterance to the mind workers, and they hear a version dripping in exaggerated enunciation, elongated vowels, and a nasal tone. The very sentence that was spoken positively suddenly transforms into a skeptical and rude remark. But why does this occur? How is the prosody of a sentence altering the propositional value?

Words that typically appear in sarcasm—like *lovely*, *so*, and *lucky* from the examples above—are adjectives and adverbs, and they are essential in signaling sarcasm. But there is a recurring pattern in the adjectives, where in all these cases, the adjectives used are gradable and subjective adjectives with a positive valence. An adjective is gradable when it describes a property that can be measured on a scale (e.g. height) and can felicitously appear in a comparative construction (e.g. taller than) (Kennedy, 1997; Syrett, 2016). An adjective is subjective when it describes something based on the speaker's perspective and personal opinions (e.g. *beautiful*, *silly*), over objective facts (e.g. *wooden*, *red*). Sarcasm that has gradable, subjective adjectives typically uses one of a positive valence (e.g. *yummy*) over a negative valence (e.g. *yucky*). Despite regular use of sarcasm featuring these linguistic elements, little research has focused on the predicate itself, especially in spoken contexts where intonation can play a factor. Thus, it is unclear whether individuals rely on these commonly used lexical items when interpreting non-literal utterances. It is also unclear how the semantics of adjectives interact with sarcastic prosody to produce what adults readily comprehend and use as sarcasm. Furthermore, children's films that are not restricted to particular age groups, like *Inside Out 2*, feature examples of sarcasm. But what age group is actually picking up on the jokes, and when are they even able to do so?

This research aims to investigate the role of linguistic cues, specifically adjectival semantics and prosody. We are interested in whether these cues contribute to the detection of non-literal content and how children interpret manipulations of the predicate in comparison to adults.

2. Background

2.1 Adjectives & Sarcastic Prosody

To understand what makes the role of adjectives so crucial in sarcasm, we must consider the lexical semantics of gradable and subjective adjectives. As mentioned above, gradable adjectives contain properties such that they can be measured on a scale, and subjective adjectives describe the speaker's opinions. These gradable, subjective adjectives can, in turn, have a positive or negative valence, which expresses a speaker's approval and perspective. It should also be noted that these predicates do not just express opinions, but more specifically personal taste. Lexically encoded into these adjectives is a judge parameter. It may be true for one individual that a cake was yummy (positive valence) or yucky (negative valence) but it can be false for others, suggesting that there is an underlying contextual parameter based on the individual saying them (Lasersohn, 2005). The use of these predicates of personal taste does not establish a singular truth value of the object to which they are applied. A listener can only know that the speaker believes it to be that way as the truth value can vary from person to person.

On the other hand, adjectives can also be neither subjective nor gradable and merely describe the objective state of something. These adjectives (like *rectangular*, or *plastic*) do not lend themselves to speaker opinion or taste, and do indicate a particular truth value of an event.

When any of these adjectives are delivered in an utterance with a declarative prosody, the listener has no reason to doubt the speaker's stance on the subject. For the gradable, subjective adjectives, it may not be a reliable account of the actual event, but the speaker is still being truthful from their perspective.

Considering the properties of these three types of adjectives, we are interested in studying how sarcastic intonation—characterized by a nasal tone, lower pitch, and elongated vowels—interacts with the semantic value of the utterance. We know through prior examples that there is a commutative effect of prosody and adjective type that results in unique listener interpretations. The sarcastic intonation works by interacting with a lexically positive utterance and altering the semantic interpretation, but it is unclear how exactly it functions and how far it extends.

2.2 Previous Research

There is currently little research that investigates the combined role of adjectives and their intonation in the detection of sarcasm. While some studies use gradable, subjective adjectives in their stimuli to contrast literal compliments with sarcastic criticisms, they tend to ignore the semantic implications of the adjectives used. Lexical factors are considered for their potential role in discovering and detecting sarcasm, but they have not been extended to comprehension of spoken non-literal content (Kreuz & Caucci, 2007). Few studies also study the effects of intonation in sarcasm free from situational irony, which makes it unclear which factor is more decisive in marking sarcasm.

Children appear to recognize non-literal utterances and speaker intents around the age of six (Harris & Pexman, 2003; Hancock, Dunham & Purdy, 2000). More so, children appear to

rely on intonation more than they do context to interpret sarcasm. They are better at detecting sarcasm when the speaker uses a sarcastic prosody, suggesting that they require the intonation even if the context indicates a non-literal interpretation (Capelli, Nakagawa & Madden, 1990). They cannot consistently infer speaker intent or distinguish types of non-literal content until several years later (Ackerman, 1983). The sarcastic intonation is generally characterized by lower pitch, overall reductions in mean F0, and changes in voice quality, although where this falls varies based on the type of utterance. There are competing accounts on whether pitch variability indicates sarcasm, as this cue is cited as dependent on the context (Chaeng, 2008). However, previous research sometimes does not specify the sarcastic contour used or uses various contours based on context and type of utterance, especially in studies featuring children. This inconsistency can influence children's interpretation of compliments and criticisms.

2.3 Current Research & Predictions

This research investigates whether and when children comprehend non-literal utterances, specifically asking how adjectival semantics and intonation contribute to detecting sarcasm. In certain instances of sarcasm or irony, adjectives appear to cue non-literal meaning, especially adjectives that encode subjectivity and speaker perspective. Still, they have seldom been investigated in isolation and free from situational context. This study presented participants with short videos narrating scenarios where a speaker commented on another character's action, thus being target-specific. For example, in one scenario, a subject made a cake for someone's birthday, and the expectation was set up that he thought it would taste good. The second person then tasted it, and the subject asked what she thought. This second person (the speaker) then

answered the question. Across experiments, there were two different intonation versions, and three different modifiers used.

Participants were then given three questions based on the target utterance, asking about the speaker's (1) approval of the modified referent, (2) sincerity and commitment to the truth of the proposition delivered, and (3) intended attitude. Although we expected certain utterances to lend to a particular interpretation—compliment or criticism—participants were not otherwise aware of whether the subject's attempt at e.g., making a tasty cake was a success. Therefore, participants solely had to decide based on what was said and how it was said. The study was first run with adults to confirm whether they interpreted conditions as anticipated, thereby acting as a baseline for children's responses.

Participants were first asked whether they believed the speaker liked the modified referent. Intonation would contribute to the recognition of criticism if participants believed the speaker disapproved in the sarcastic conditions more than the declarative conditions. Because our scenarios do not explicitly state whether the target utterance's subject was successful, it forces the participants to decide based on the adjective and intonation used. If the speaker believes that the task was successfully completed, they will view it positively with approval, and vice versa if not. We reasoned that children would determine the scenario's outcome less accurately than adults, but would make the distinction nonetheless. We expect an overlap between this question and ratings of speaker attitude, but this question also serves to illustrate how participants interpret non-subjective adjectives. As the usage of the non-subjective adjectives does not directly answer the question and rather recounts the event that happened, it invites participants to calculate the inference based on its relevance (Grice, 1975). Each non-subjective adjective is expected to be interpreted differently based on the scenario. As such,

we expect participants to approve or disapprove in the non-subjective-declarative condition at a chance level.

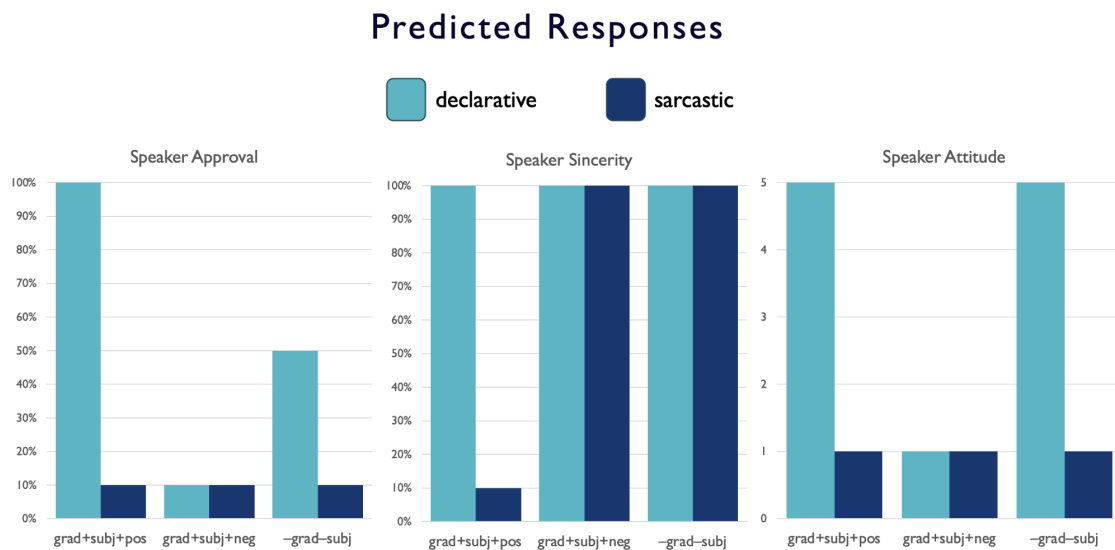
By asking participants whether the speaker was sincere, we could verify that the sarcastic intonation used for a positive adjective gives rise to a non-literal interpretation. The sarcastic intonation alone naturally lends itself to disapproval and thus negativity but does not qualify as sarcasm unless negating a positive utterance. We expected that if children begin to recognize non-literal criticisms between five and six years of age, they would view the speaker as being sincere in the positive-sarcastic condition less than any other condition. Recognition of this insincerity would suggest that children can detect the difference between literal compliments and non-literal criticisms by changes in intonation alone.

Participants were also asked to rate the speaker's attitude, indicating how nice or mean they believed the speaker intended to be when making the target utterance. If children rated speaker attitude as more mean for sarcastic conditions than declarative conditions, it would suggest that this prosody signals a mean intent, regardless of the adjective type used. Similar to the question of speaker approval, the rating of speaker attitude indicated the speaker's belief of whether the target succeeded or failed at the task. We expected participants to recognize that sarcastic intonation indicated meanness, but for children to be more reluctant at doing so than adults for the positive-sarcastic condition. We also expected participants to have varying opinions on the non-subjective-declarative condition but to lean more nice compared to its sarcastic counterpart.

While children may not be familiar with terms like sarcasm or irony, we expect they may be able to distinguish between literal and non-literal criticisms by indicating speaker sincerity. We hypothesized that they would perceive the use of a sarcastic intonation to indicate criticism at

a higher chance than declarative prosody. Even if children could not recognize the insincerity of non-literal criticisms, they may be able to recognize that the speaker disapproved and their attitude leaned mean.

Figure 1: Predicted Responses



3. Methods

3.1 Participants

Adult participants were 139 undergraduate students from Rutgers University. Child participants were recruited from Children Helping Science, where studies were conducted over Zoom. The study was conducted with five- to six-year-olds, as children appear to recognize non-literal meaning and ill intent around this age range (Nakassis & Snedeker, 2002). All participants spoke English as their primary language.

3.2 Materials

12 test scenarios were created, each depicting a situation between two characters. The first target character raises the expectations for a particular task and believes they will meet those expectations. After completing the task, they ask a second character what they think. The second character then delivers the target utterance, commenting on the target’s ability. Scenarios were roughly modeled after Glenwright and Pexman (2010), such that a certain expectation can be elicited from the scenario. Rather than distinguishing scenarios by performance, possession, and situation, all scenarios maintained a consistent context and raised expectations.

Table 1: Sample Scenario & Target Utterance

Scenario: Mike made a cake for Lori’s party. He used lemons from his garden to make it, and thinks it’s going to be delicious. When Lori takes a bite, Mike asks Lori what she thinks. Lori says:

Adjective Type	Intonation	Utterance	Condition
Gradable+subjective adjectives, positive	Declarative	“You made a <u>yummy</u> cake.”	positive-declarative
	Sarcastic	“You made a <u>yummy</u> cake.”	positive-sarcastic
Gradable+subjective adjectives, negative	Declarative	“You made a <u>yucky</u> cake.”	negative-declarative
	Sarcastic	“You made a <u>yucky</u> cake.”	negative-sarcastic
Non-subjective adjectives	Declarative	“You made a <u>lemon</u> cake.”	non-subjective-declarative
	Sarcastic	“You made a <u>lemon</u> cake.”	non-subjective-sarcastic

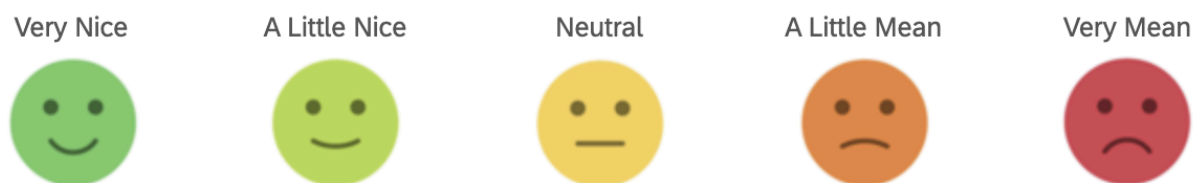
The speaker can use three types of adjectives to describe the target’s ability, which could be delivered in two intonations (see Table 2). Adjectives were chosen based on their ability to act as a compliment, criticism, and descriptive in the declarative and in the context of their specific scenario. All utterances, save for the positive+sarcastic condition, were expected to be

interpreted literally, regardless of intonation. The positive-declarative condition acted as a literal compliment, and the negative-declarative and negative-sarcastic conditions acted as criticisms, thus serving as control groups. The non-subjective-declarative condition was expected to be interpreted neutrally, while the non-subjective-sarcastic condition was expected to be viewed as a criticism. All conditions were created to be target-specific, commenting on the specific subject's ability rather than a general critique of a situation.

Different characters were used for each scenario so that generalizations could not be made about any particular speaker. Each scenario featured one male and one female character, with the delivery of the target utterances divided equally between genders. The chosen adjectives were controlled for phonological form and prosody. We selected bisyllabic sonorant troches as much as possible to allow for a smooth pitch contour. Stimuli was recorded by a native female speaker of American English (the thesis author) on Praat, following declarative and "sarcastic" contours documented in previous literature.

For this paper, the intonation that cues non-literal meaning and disapproval will be referred to as a "sarcastic" intonation. We understand that applying this intonation to negative or non-subjective adjectives does not necessarily allude to sarcasm but marks negativity. This particular intonation remains consistent across conditions. Sarcastic prosody was characterized by prolonged articulation and a lowered pitch (Chaeng, 2007). The exaggerated articulation was primarily at the vowels of the modifier and the referent, with lengths increasing for the sarcastic condition. Sound files were normalized for intensity to 67dB. The declarative intonation was used regardless of whether the target statement was a compliment or criticism, unlike Glenwright & Pexman, who used warm and cold tones, respectively, for their literal statements.

Figure 2: Nice/Mean Scale for rating speaker attitude



After each scenario, participants were asked about the speaker's approval of the referent and the sincerity of their remark. Then, participants were asked to rate the speaker's intended attitude on a five-point Likert scale of very nice-very mean, as seen in Figure 1.

3.3 Design

Each participant watched 14 scenarios, with two training scenarios and 12 test scenarios. Fully crossing intonation and adjective type, the study applies a 2 x 3 Latin square design. Six versions of the study were created, such that within them, there were all six conditions, with each appearing twice. Scenarios were ordered so that conditions would not appear back-to-back. Half of the studies began with sarcastic intonation, while the other half began with declarative. Each condition appeared first once across the six versions.

3.4 Procedure

Participants completed 2 training trials prior to the test section to familiarize them with the presentation of the scenarios and questions. Training trials used declarative prosody on literal utterances without adjectives to not predispose participants to expect prosody or adjectives to influence their answers. If participants answered the binary choice questions incorrectly in the training trials, they were prompted to listen to the scenario and answer again. Child participants viewed the scenarios through an experimenter-operated PowerPoint, while adults viewed video

versions of the same slides. After listening to the scenario, participants were presented with the following questions.

(1) “Did CHARACTER like the OBJECT?”

Participants were asked whether the speaker approved of the modified referent.

(2) “Did CHARACTER mean what he/she said?”

Participants were asked about the speaker’s commitment to the truth of the proposition encoded in the assertion delivered.

(3) “How nice or mean is CHARACTER trying to be?”

Participants were asked to rate the speaker’s attitude on a 5-point Nice/Mean Likert scale.

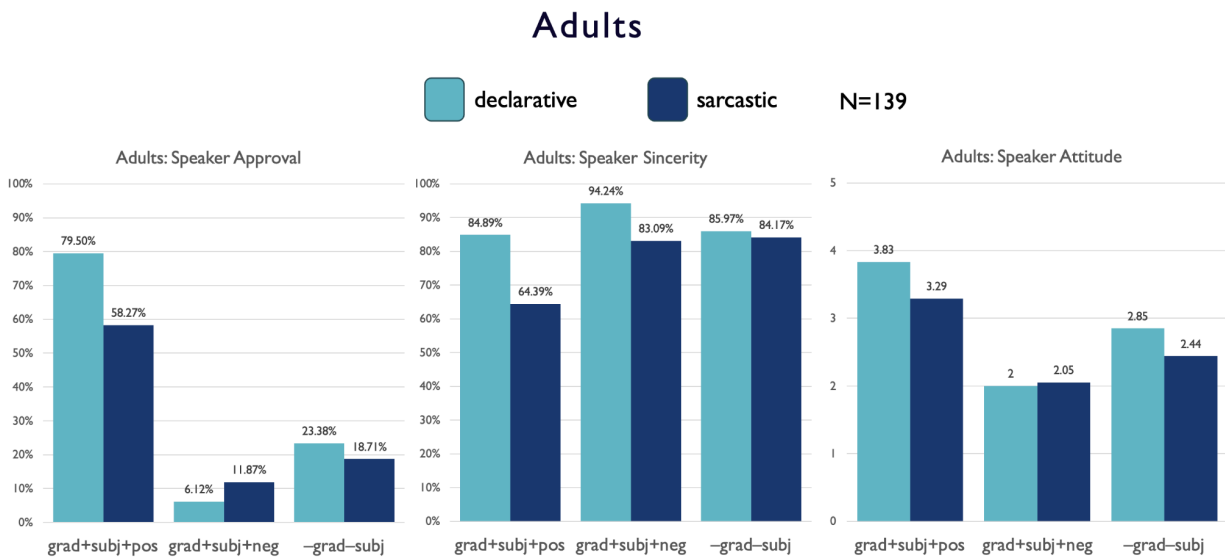
Participants listened to the target utterance separately after listening to the scenario fully. Isolating the statement ensured saliency from the rest of the scenario. Adults were prompted to the target statement once before being presented with all three questions. They were allowed to refer back to the entire scenario if needed. Children were prompted to the target statement before Question 1 and Question 3. The experimenter could return to the scenario and target statement again as needed.

4. Results

The results were analyzed by a statistical consultant, who also prepared some of the visualizations.

4.1 Adults

Figure 3: Adult Responses



4.1.1 Speaker Approval Responses

Figure 4: Adult responses of speaker approval across modifier type and intonation

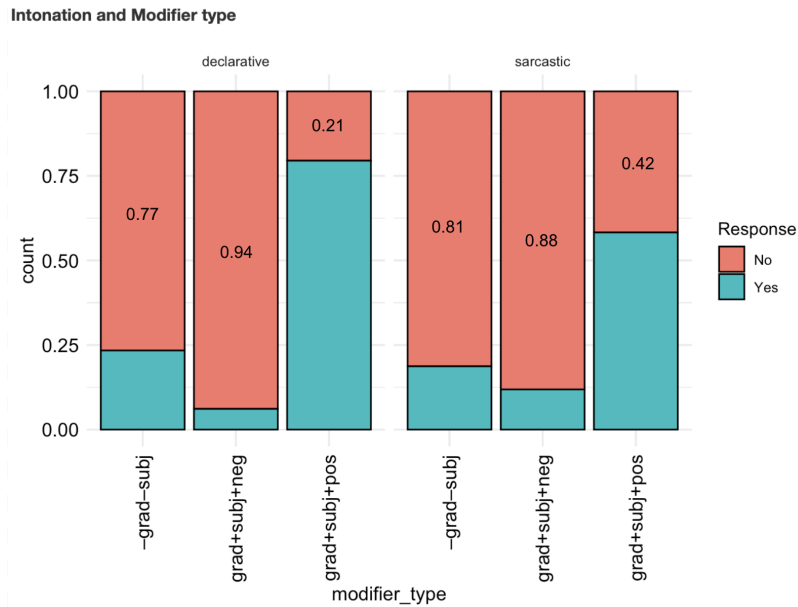


Table 2: Interaction of modifier type and intonation regarding speaker approval

Parameter	Median	Mean	MAP	CI	CI_low	CI_high	pd	ps	Rhat	ESS
b_Intercept	-1.561	-1.560	-1.577	0.95	-2.206	-0.931	1.000	1.000	1.003	2399.796
b_intonationsarcastic	-0.424	-0.425	-0.414	0.95	-0.910	0.056	0.956	0.842	1.000	3917.525
b_modifier_typegradPsubjPneg	-2.070	-2.075	-2.161	0.95	-3.053	-1.150	1.000	1.000	1.001	2817.179
b_modifier_typegradPsubjPpos	3.427	3.439	3.388	0.95	2.636	4.304	1.000	1.000	1.001	2546.460
b_intonationsarcastic:modifier_typegradPsubjPneg	1.292	1.296	1.164	0.95	0.450	2.149	0.999	0.996	1.001	4378.395
b_intonationsarcastic:modifier_typegradPsubjPpos	-1.019	-1.015	-1.081	0.95	-1.680	-0.366	0.999	0.997	1.000	4657.255

Speaker approval responses determined whether participants felt the speaker approved of the modified referent or not and the total proportion of responses were compared in tandem through predictors of modifier and intonation type. Table 2 shows this interaction. This model predicts to log-odds of a response of as a function of 2 intonations and 3 modifier types and their interaction. The intercept of this model thus represents the log-odds of a choice of “yes” when the modifier type is grad-subj and the intonation is declarative ($\beta = -1.574$; 95% HDI = -2.24 - -0.905; pd = 1.0). The fixed effect *b_intonation_sarcastic* represents the change in the predicted

log-odds of choosing “yes” when we change the predictor for intonation from declarative to sarcastic. This is negative, which suggests that the probability of choosing “yes” is less for the sarcastic intonation relative to declarative when the modifier type is grad-subj ($\beta = -0.41$; 95% HDI = $-0.894 - 0.058$; $pd = .958$). This means the participants were more likely to say the speaker was disapproving of the modified referent when using the sarcastic intention for the non-subjective adjective. There was also evidence that modifier type impacted the probability of a “yes” response. In particular, for declarative items, the modifier type *b_modifier_typegradPsubjPneg* was less likely to elicit a response of “yes” relative to the baseline grad-subj ($\beta = -2.056$; 95% HDI = $-3.065 - -1.131$; $pd = 1.0$). Oppositely, the modifier type *b_modifier_typegradPsubjPpos* was more likely to elicit a “yes” response than the baseline ($\beta = 3.437$; 95% HDI = $2.597 - 4.306$; $pd = 1.0$). This is expected, as *b_modifier_typegradPsubjPneg* is a literal criticism that cues speaker disapproval and the *b_modifier_typegradPsubjPpos* is a literal compliment that cues speaker approval. Finally, we viewed the effects of the sarcastic intonation on each of the positive and negative adjectives. The final two terms are the interaction term and this represents the change relative to the declarative modifier combinations. The positive estimate for row 5 suggests that the probability of choosing “yes” when the modifier type is grad+subj+neg is higher for when the intonation is sarcastic than declarative ($\beta = 1.277$; 95% HDI = $0.455 - 2.168$; $pd = 1.0$). We did not expect to see an effect of the sarcastic intonation here, but it was not significant. The negative value for row 6 suggests that the probability of choosing “yes” when the modifier type is grad+subj+pos is lower for when the intonation is sarcastic than declarative ($\beta = -1.021$; 95% HDI = $-1.709 - -0.379$; $pd = 1.0$). This suggests that participants are viewing this condition as a non-literal criticism at a higher rate than the positive-declarative condition. In each comparison, the row “pd” (probability of

direction) tells us how sure we can be about the given comparison. In this case, all of the comparisons' directions are highly probable (over .95).

4.1.2 Speaker Belief & Sincerity Responses

Figure 5: Adult responses of speaker sincerity across modifier type and intonation

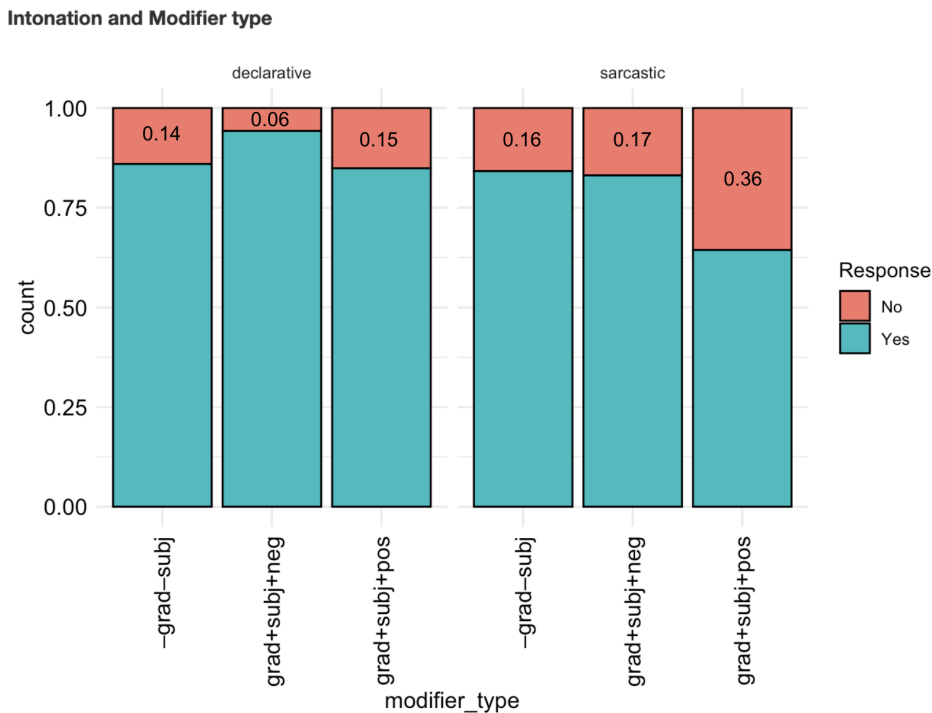


Table 3: Interaction of modifier type and intonation regarding speaker sincerity

Parameter	Median	Mean	MAP	CI	CI_low	CI_high	pd	ps	Rhat	ESS
b_Intercept	2.214	2.221	2.233	0.95	1.715	2.773	1.000	1.000	1.003	1335.634
b_intonationsarcastic	-0.160	-0.162	-0.143	0.95	-0.663	0.356	0.730	0.470	1.003	1977.960
b_modifier_typegradPsubjPneg	1.188	1.194	1.177	0.95	0.479	1.966	1.000	0.998	1.000	2007.261
b_modifier_typegradPsubjPpos	-0.055	-0.056	-0.071	0.95	-0.678	0.548	0.573	0.335	1.000	2173.966
b_intonationsarcastic:modifier_typegradPsubjPneg	-1.260	-1.273	-1.206	0.95	-2.124	-0.490	1.000	0.995	1.001	2163.393
b_intonationsarcastic:modifier_typegradPsubjPpos	-1.242	-1.240	-1.224	0.95	-1.927	-0.542	1.000	1.000	1.001	2055.112

Speaker sincerity responses demonstrated whether the participant believed the speaker meant what they said. In this field, we mostly expect to see differences between the positive-sarcastic condition and all other conditions, so we will take a look at the interactions between all six conditions. Like the previous model for speaker approval, this model predicts log-odds of a “yes” response as a function of both 2 intonations and 3 modifier types and their interactions. The intercept of this model remains the log-odds of a choice of “yes” when the modifier type is grad-subj and the intonation is declarative ($\beta = 2.214$; 95% HDI = 1.175 - 2.773; $pd = 1.0$). The fixed effect $b_intonation_sarcastic$ represents the change in the predicted log-odds of choosing “yes” when we change the predictor for intonation from declarative to sarcastic with the modifier type grad-subj.

The model did not find evidence of a difference in this case ($\beta = -0.160$; 95% HDI = -0.663 - 0.356; $pd = 0.73$), which was anticipated. In particular, for declarative items, the modifier type $b_modifier_typegradPsubjPneg$ was more likely to elicit a response of “yes” relative to the baseline grad-subj ($\beta = 1.188$; 95% HDI = 0.479 - 1.966; $pd = 1.0$). This suggests that a literal criticism is not likely to be questioned in terms of sincerity. On the other hand, there was no evidence the modifier type $b_modifier_typegradPsubjPpos$ was more or less likely to elicit a “yes” response than the baseline ($\beta = -0.055$; 95% HDI = -0.678 - 0.548; $pd = 0.55$). Finally, the model predicted whether there were differences in the log-odds of a “yes” response holding modifier type constant and comparing intonation. Both cases were negative; meaning that sarcastic items with both grad+subj+neg ($\beta = -1.260$; 95% HDI = -2.124 - 0.490; $pd = 1.0$) and grad+subj+pos ($\beta = -1.242$; 95% HDI = -1.927 - 0.542; $pd = 1.0$) were less likely to be answered “yes” than declarative items with the same modifier type. This means that in comparison to the positive-declarative condition, the positive-sarcastic condition was more likely

to be viewed as insincere. This is supported by Figure # as well, as 36% of participants, at a higher rate than all other conditions, viewed the speaker as insincere for the positive-sarcastic condition.

4.1.3 Speaker Attitude Rating Responses

Figure 6: Adult distribution of ratings according to intonation

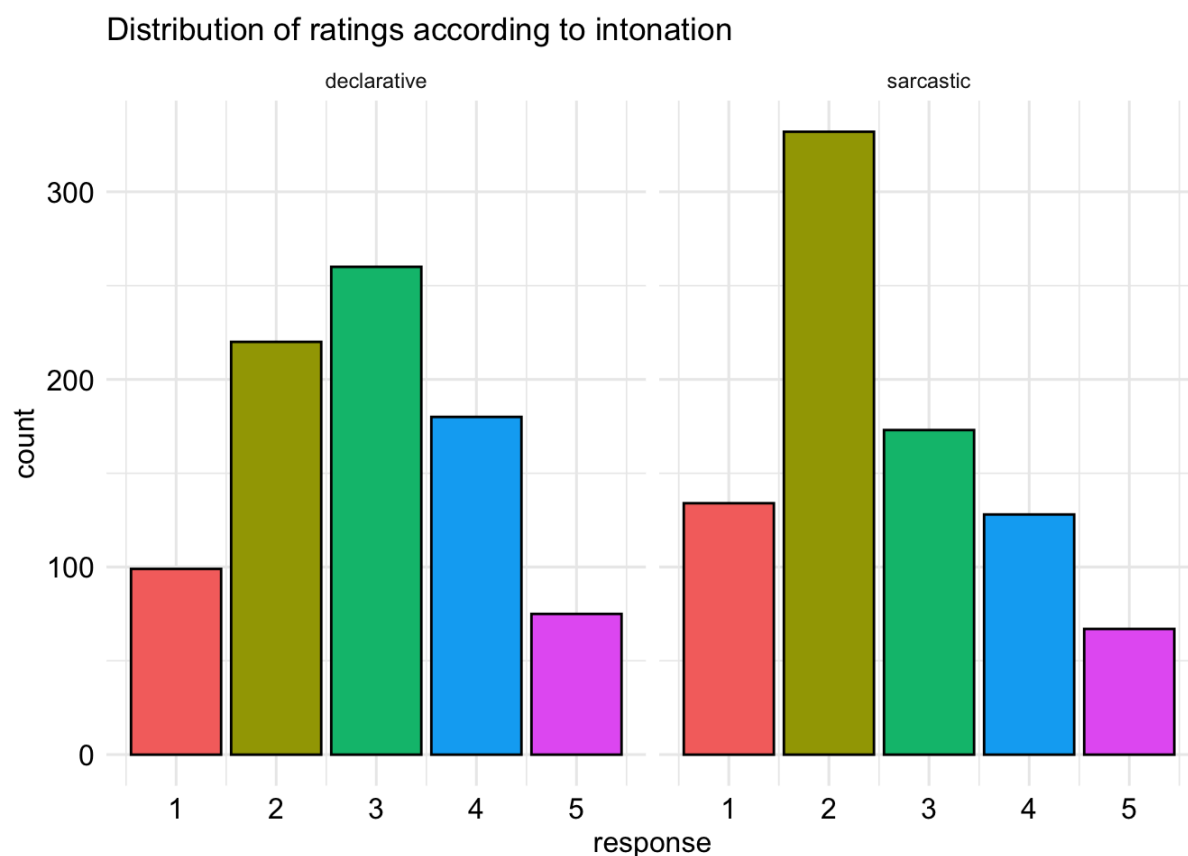
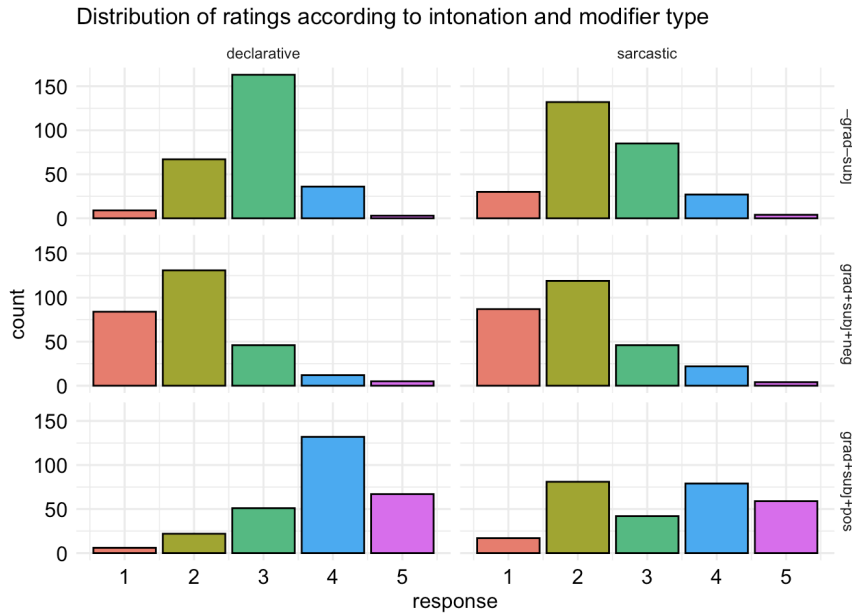


Table 4: Interaction of intonation regarding speaker attitude

Parameter	Median	Mean	MAP	CI	CI_low	CI_high	pd	ps	Rhat	ESS
b_Intercept[1]	-3.182	-3.195	-3.164	0.95	-3.926	-2.525	1.000	1.000	1.004	391.660
b_Intercept[2]	-0.609	-0.619	-0.543	0.95	-1.344	0.055	0.964	0.911	1.005	400.568
b_Intercept[3]	1.205	1.200	1.201	0.95	0.477	1.882	1.000	0.998	1.004	394.135
b_Intercept[4]	3.234	3.229	3.253	0.95	2.484	3.961	1.000	1.000	1.005	396.604
b_intonationsarcastic	-0.746	-0.747	-0.730	0.95	-0.928	-0.559	1.000	1.000	1.002	3710.753

Speaker attitude rating demonstrated what participants believed the speaker's intended attitude was. Speaker attitude ratings on the Nice/Mean scale were coded so that 1=*very mean*, 2=*little mean*, 3=*not mean or nice*, 4=*little nice*, and 5=*very nice*. Figure 6 shows the ratings first according to intonation. The declarative items follow a normal distribution, in which 3 was chosen most often (31.2%), followed by 2 and 4 (26.4% and 21.6% respectively), and finally by the outermost choices, 1 (11.9%) and 5 (8.9%). The sarcastic items show a left skew. The most frequent rating for these items was 2 (39.8%) of ratings, followed by 3 (20.7%), and 1 (16.1%). 4 and 5 were chosen the least (15.3% and 8% respectively). These results are meaningful, as we suspect the sarcastic intonation to cue a mean attitude over the declarative intonation. The ordinal model in Table 4 is a Bayesian ordinal logistic regression, where the intercepts predict the probability of a response in the baseline declarative condition. The predictor *intonationsarcastic* assesses whether there is a difference in ratings based on whether the statement was declarative or a sarcastic. The model suggests that there was and that the difference specifically was $-.75$ log-odds [95% HDI $-.94$ - $-.55$]. The probability of direction was approaching 1, suggesting that participants were more likely to rate meaner for the sarcastic condition.

Figure 7: Adult distribution of ratings according to intonation and modifier type



intonation	modifier_type	1	2	3	4	5
declarative	grad+subj+neg	0.3021583	0.4712230	0.1654676	0.0431655	0.0179856
declarative	grad+subj+pos	0.0215827	0.0791367	0.1834532	0.4748201	0.2410072
declarative	-grad-subj	0.0323741	0.2410072	0.5863309	0.1294964	0.0107914
sarcastic	grad+subj+neg	0.3129496	0.4280576	0.1654676	0.0791367	0.0143885
sarcastic	grad+subj+pos	0.0611511	0.2913669	0.1510791	0.2841727	0.2122302
sarcastic	-grad-subj	0.1079137	0.4748201	0.3057554	0.0971223	0.0143885

Table 5: Interaction of intonation and modifier type regarding speaker sincerity

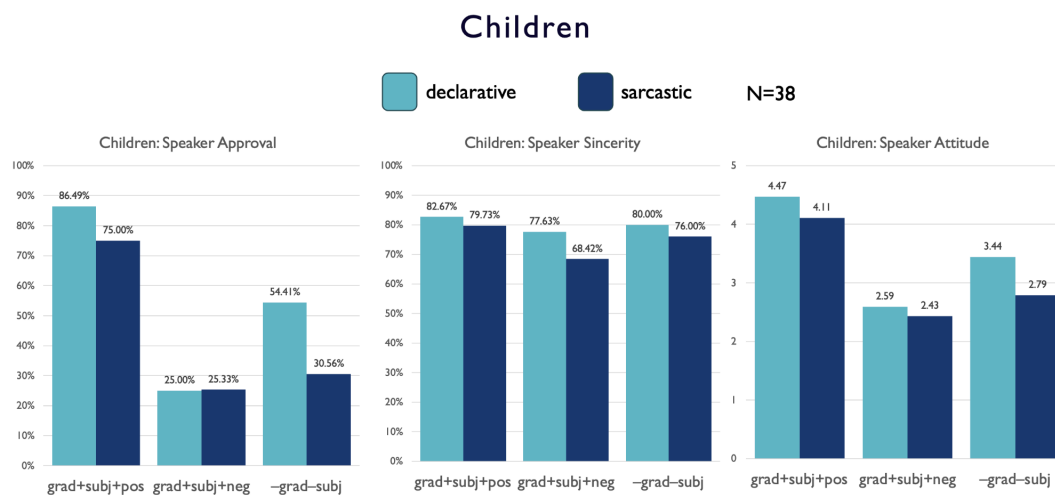
Parameter	Median	Mean	MAP	CI	CI_low	CI_high	pd	ps	Rhat	ESS
b_Intercept[1]	-3.190	-3.192	-3.185	0.95	-3.861	-2.530	1.000	1.000	1.004	757.745
b_Intercept[2]	-0.595	-0.601	-0.554	0.95	-1.243	0.031	0.964	0.900	1.004	727.596
b_Intercept[3]	1.259	1.261	1.239	0.95	0.597	1.908	1.000	1.000	1.004	734.036
b_Intercept[4]	3.319	3.326	3.229	0.95	2.621	3.997	1.000	1.000	1.004	771.654
b_intonationsarcastic	-0.992	-0.993	-0.988	0.95	-1.307	-0.680	1.000	1.000	1.001	1802.079
b_modifier_typegradPsubjPneg	-2.097	-2.112	-2.025	0.95	-3.063	-1.265	1.000	1.000	1.007	688.615
b_modifier_typegradPsubjPpos	2.091	2.087	2.100	0.95	1.184	2.980	1.000	1.000	1.007	828.088
b_intonationsarcastic:modifier_typegradPsubjPneg	0.961	0.962	0.955	0.95	0.502	1.416	1.000	0.999	1.001	2035.242
b_intonationsarcastic:modifier_typegradPsubjPpos	-0.210	-0.204	-0.250	0.95	-0.665	0.262	0.816	0.550	1.001	2365.010

In Figure 7, we take a look at the ratings according to modifier type and intonation. The intercepts represent the break points for the baseline which is the non-subjective-declarative condition. The fixed effect for sarcastic here compares the non-subjective-declarative condition with the non-subjective-sarcastic condition, showcasing a negative effect. The effect $b_{modifier_typegradPsubjPneg}$ compares negative-declarative to the baseline non-subjective-declarative, which is again negative and compelling as anticipated. The fixed effect $b_{modifier_typegradPsubjPpos}$ found the opposite, and the positive-declarative condition had higher ratings than the baseline non-subjective-declarative, which we expected from a literal compliment. The effect $b_{intonationsarcastic:modifier_typegradPsubjPneg}$ compares negative-declarative to negative-sarcastic and finds higher ratings for the latter. Finally, $b_{intonationsarcastic:modifier_typegradPsubjPpos}$ provides evidence that positive-sarcastic was rated lower than positive-declarative, although again, this difference was not compelling ($pd = .81$). The other comparisons were all compelling with their probabilities of direction approaching 1.

4.2 Children

Data collection for children is still in progress. The results shown in Figure 8 are preliminary results from 38 children.

Figure 8: Children Responses



5. Discussion

This study intended to (1) investigate the interactions of prosody and adjectives in detecting non-literal content, (2) compare adults' and children's level of sensitivity to these cues, and (3) understand the role of the sarcastic intonation in lexical semantics.

5.1 Adults

Overall, results from adults aligned with predicted responses. Looking at the results to speaker approval, adults responded generally as expected. For the positive-declarative condition, participants correctly assumed that the speaker approved of the referent and had little reason to believe otherwise. For the positive-sarcastic condition, while approval levels did not drop as significantly as anticipated, there was an obvious decrease in comparison to the positive-declarative condition. This suggests that there is an interaction between the sarcastic intonation and the positive subjective gradable adjective such that an inverse meaning is gleaned. In the negative-declarative condition and negative-sarcastic condition, participants correctly determined that the speaker disliked the target referent and speaker approval levels were low. For the non-subjective-declarative condition, we anticipated responses would be at chance level given the target utterance did not specify anything about personal preference. However, speaker approval was similarly low to the non-subjective-sarcastic condition. We believe such low approval ratings were the result of the target utterance flouting the maxim of relevance. When a speaker answers irrelevantly and non-subjectively to a subjective question, it invites the implicature that the speaker did not like the referent and thus chose to avoid the question entirely. The sarcastic intonation enhanced this effect. The question of speaker sincerity was used to gauge whether the speaker meant what they said. Adult participants once again responded in

tandem with the predicted results. We anticipated that adults would have no reason to question the sincerity of the speaker for all conditions except the positive-sarcastic condition and adults believed that the speaker was least likely to be sincere in the positive-sarcastic condition. While there was no difference in response when the intonation was changed for the non-subjective conditions, participants were less likely to say the speaker was being sincere in the sarcastic conditions for the gradable, subjective adjectives. This effect was expected for the positive adjective and shows the sarcastic intonation is interacting semantically. However, this difference was unexpected for the negative adjectives and it is unclear what participants are viewing as insincere.

Lastly, participants were also asked how nice or mean the speaker was trying to be, directly investigating the speaker's intentions and attitude. The speaker was noted to be most nice in the positive-declarative condition and the least nice in the negative-declarative condition, both as expected. The non-subjective conditions demonstrated higher nice ratings than the negative conditions and were not comparable to the positive-declarative condition. The positive-sarcastic condition showed lower nice ratings than the positive-declarative condition, but still remained higher than any of the other conditions. Comparing distributions of responses across positive and negative conditions, we recognize that there is no complete leftward shift as expected from the role of the sarcastic intonation. Instead, there were more participants who viewed speaker attitude as mean while the rest continued to view the attitude as nice. We hypothesize that this is because the intent of sarcasm varies. It can be malicious or simply made in jest and it is difficult to determine the speaker's intentions from the scenarios they listened to. So even if adults are recognizing the sarcastic intent, it is possible that a non-literal criticism does not signify a mean attitude as strongly as a literal criticism. It is also possible that use of the

sarcastic prosody in certain trials did not cue disapproval and a contradiction of the positive adjective, but rather emphasis or reinforcement of the positive adjective, hence the U-shaped distribution of speaker attitude ratings. Overall, these results demonstrate that adults are sensitive to differences in prosody and recognize the presence of the sarcastic intonation. They are able to distinguish between literal compliments, literal criticisms, and non-literal criticisms. They also suggest that there is a clear interaction between the sarcastic intonation and the positive gradable subjective adjective that alters the truth value of the speaker's perspective.

5.2 Children

Previous literature has cited that children become sensitive to non-literal content around the ages of five to six. Babies are adept at distinguishing differences in prosody, but it still remains unclear if children can go so far as to infer speaker intentions, or at least at the level of adults. We thus hypothesized that children could pick up on differences in the prosody although not as significantly as adults did. Results, while preliminary, demonstrated that children patterned similarly to adults. Children correctly attributed speaker approval across all conditions. They believed the speaker liked the referent most in the positive-declarative condition. This rating dropped for the positive-sarcastic condition, although not as significantly as adults. Children believed the speaker liked the referent least in the negative conditions. They were at chance for the non-subjective-declarative condition and similar to the adults, this approval rating decreased for the non-subjective-sarcastic condition.

Similar to adults, for children, the sarcastic intonation emphasizes disapproval for the non-subjective adjective. We also believe that children's tendency to grade the non-subjective adjective higher than adults parallels their emerging ability to calculate implicatures. Children

behaved differently from adults primarily when it came to the question of speaker belief. They believed the speaker was being least sincere when using the negative adjective, as opposed to adults who said the speaker was being least sincere in the positive-sarcastic condition.

Speaker sincerity was actually regarded as the highest in the positive adjective conditions, in contrast with the adults. We suspect this may be because of several reasons. One, we noticed that some children struggled with understanding the question about sincerity, especially as they failed and doubled-down on the control. Two, it is possible children were reluctant to view the speaker as mean so they were more likely to say the speaker was insincere for the negative adjectives. These findings suggest that children likely did not notice a significant difference between the two prosodies, especially in terms of recognizing speaker intention.

As for the niceness rating, children tended to rate speaker niceness much higher than adults did for all conditions. However, the positive-sarcastic condition had a slightly lower niceness rating than the positive-declarative condition. This suggests that children may have found the sarcastic intonation to be meaner than the declarative intonation, but not significantly. Overall, it appears that children recognize the differences in intonation but are unaware what it signals in terms of speaker intention. They are reluctant to say that the change in intonation suggests an inverse interpretation for the positive subjective adjective. They rely on the literal semantic meaning of the adjective over any prosodic change. This may be because they are not familiar enough with sarcasm or its cues at this age. These results contrast with the findings of Capelli, Nakagawa & Madden (1990), who found that children would prioritize the intonation over semantic contradiction. However, this can be attributed to the fact that the scenarios children listened to in this study did not provide the expectations for situational irony—in that there was no certainty of the subject's success or failure—only expectations of a particular

character. In which case, children may be exhibiting the same interpretation of some adults where the “sarcastic” intonation does not signal a negative attitude but rather emphasis of the positive attitude. This suggests that children may require contrasting context with the sarcastic intonation to interpret sarcasm.

5.3 General

In this study, we controlled for the different lexical semantics of these adjectives and studied their individual effect on the listener’s comprehension. We propose that intonation introduces speaker negation and interacts compositionally with lexical meaning. With negative subjective adjectives, the negation is additive: it conveys negative speaker perspective on top of negative valenced meaning. When a speaker says, “You made a yucky cake” declaratively or sarcastically, the listener understands that the speaker believes the cake was yucky both ways. There is no interaction between the prosody and the speaker belief, and with the negative perspective introduced, we do not see the effect because of the existing negative perspective.

With positive subjective adjectives, the negation cannot add to the lexical meaning, but it still conveys a negative speaker perspective, which gives rise to sarcasm. For example, when a speaker says, “You made a yummy cake” with declarative prosody, the listener understands that the speaker believes the cake was yummy. But when a speaker sarcastically says, “You made a yummy cake”, the listener can interpret it such that the speaker does not believe the cake was yummy. The intonation interacts with the predicate of personal taste by overriding the positive valence with the negative speaker perspective.

It would appear that the sarcastic intonation would not affect the non-subjective non-gradable adjective because it is not a predicate of personal taste, but this is not the case. When a speaker normally says, “You made a lemon cake”, the listener understands that the speaker believes the cake was lemon and also that the cake was indeed lemon. The use of a non-subjective adjective indicates an objective truth of the event. When a speaker sarcastically says, “You made a lemon cake,” the listener is more likely to think that the speaker believes the cake was lemon and that the cake was lemon, but also that the speaker does not approve of the lemon. We can infer two interpretations from this case: the speaker does not like lemon specifically or the speaker does not believe lemon is a suitable choice for the cake. This depends on what the listener considers the alternative utterances the speaker could’ve made. Regardless, in both suppositions, the sarcastic intonation interacts with the non-subjective adjective and introduces a negative speaker perspective directed toward the modifier specifically.

In the case of the gradable, subjective adjectives, the negation appears to scope over the speaker belief of the utterance to introduce a negative speaker perspective. For the negative subjective adjective, the utterance already carries a negative speaker perspective, so the sarcastic intonation's effect is merely additive. In the case of the positive subjective adjective, the intonation overrides the positive perspective and alters the utterance such that the speaker does not believe the cake was yummy. Alternatively, it can also be said that the speaker believed that the cake was “NOT yummy”, where the negation falls over the adjective. We propose that this ambiguity is similar to the case of Neg-raising, in which negation is raised from the subordinate clause to the main clause. For example, the utterance “I don’t think that’s correct” can also be interpreted as “I think that’s not correct” even though the negation scopes differently.

The utterances we are investigating are direct answers to questions of opinion, so there is an underlying non-factive verb attached to and extended over the statements. This is more obviously seen in cases of the subjective adjective, where it is read as “I THINK you made a yummy/yucky cake”. Either way, the negation is introduced in the case of the positive subjective adjective, the listener still gleans speaker disapproval. Unlike the gradable subjective adjectives, the non-subjective adjective does not inherently carry a speaker perspective. Therefore, it cannot be negated or overridden the way the positive subjective adjective is. Instead, we suggest that the negative speaker perspective introduced is acting more like a conjunction, such that when the sarcastic intonation is applied, the listener interprets the utterance as: “You made a lemon cake AND I do not approve of it being lemon.”

Given the sarcastic intonation’s interactions with all the adjective types and its scope, we propose that the sarcastic intonation conveys a negative perspective as a Conventional Implicature, similar to the rise-fall-rise intonation (Constant, 2012). Following previous definitions of CIs, the sarcastic intonation fulfills all three properties. One, it is tied to lexical meaning that is being carried by the intonation itself. Two, regardless of the adjective type it is being applied to, the sarcastic intonation consistently modifies speaker perspective and is a commitment on the part of the speaker. Three, the meaning of the sarcastic intonation—its ability to introduce negative speaker perspective—is evaluated independently from the main assertion. The sarcastic intonation acts as a morpheme that is in the structure and taking scope. It introduces a negative speaker perspective that is indefeasible and interacts differently based on the lexical content it is applied to.

5.4 Limitations & Future Directions

Despite promising results, we noticed item variability across trials that may have caused skewing. Scenarios were constructed as consistently as possible but there still existed variation in terms of expectations and familiarity, which may affect the way participants interpret the questions. For example, we noticed significant item variability with a scenario involving the target referent “novel”, where it was unclear what the valences of an “easy” or “tricky” novel were. In Table 6, it is clear that the approval ratings for the positive and negative adjectives for the referent “novel” were almost inverted. This may be a result of the way the scenario was framed and provided listeners with the wrong impression. Participants thus did not respond as expected to this trial and can be viewed as an outlier case.

Table 6: Speaker Approval Responses Across Trials

Speaker Approval				
	grad+subj+pos		grad+subj+neg	
referent	declarative	sarcastic	declarative	sarcastic
bouquet	85.00%	74.10%	3.80%	16.70%
cake	80.80%	79.20%	0.00%	4.80%
dish	85.70%	90.50%	0.00%	18.50%
gift	66.70%	53.80%	0.00%	9.50%
hole	85.00%	51.90%	3.80%	8.30%
novel	19.00%	19.00%	40.00%	18.50%
question	95.20%	45.00%	11.10%	15.40%
shirt	91.70%	66.70%	0.00%	5.00%
solution	100.00%	35.00%	11.10%	11.50%
story	88.50%	79.20%	4.80%	9.50%
tool	81.50%	61.50%	0.00%	4.80%
video	75.00%	33.30%	0.00%	15.00%

Additionally, we recognized that for some trials featuring the positive adjectives, participants were less likely to view the sarcastic intonation as a non-literal criticism. We specifically noticed this for the cases of “tasty dish” and “yummy cake”, where the sarcastic intonation respectively demonstrated an increase in approval or no significant difference (Table 6). While it is unclear exactly why this is occurring, we wonder if this is a result of the referent being a food item. Instead of interpreting the sarcastic intonation as disapproval and thus a criticism, participants appeared to view it as an emphasis on the positive adjective, which would explain the increase in approval rate. We also speculate whether the choice of verb in the target utterance affected the listener’s interpretation of compliment or criticism. For example, trials featured verbs “made” and “ordered,” but both carry varying degrees of personal connection. A criticism made towards something that someone “made” rather than “ordered” would likely be interpreted as meaner because there is a direct connection to it. Determining speaker approval for the non-subjective adjective could have also been biased because of the participant’s association with the word. For example, whether someone likes a “partial solution” or “spotted shirt” depends entirely on the speaker’s relationship with the item. As the participant is unaware of the speaker’s preferences, a forced choice response eliminates the potential ambiguity a participant may feel about those modifiers.

While this research investigated the relationship between adjective types and intonation, it was still a preliminary investigation into the functions of intonation and listener interpretation. Adults reliably distinguish non-literal criticisms, literal criticisms, and literal compliments, but we must investigate further to understand why they fail in certain circumstances. Children ages five and six also pattern similarly to adults but are much more inconsistent based on age. We suspect their individual exposure to sarcasm and verbal irony affects their interpretation, as well

as their knowledge of the adjectives used in the scenarios and of the questions being asked. While results for children are still promising, extending this study to an older age range of seven-to-eight-year-olds may demonstrate children's capabilities better. Overall, further research is still required to understand the extent of the sarcastic intonation and its interaction with lexical semantics.

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Appendix

A1. Scenarios & Target Utterances

Practice Trials:

P1. Alex lent his friend Kim a book that he really enjoyed. The book is a non-fiction book about US history. Kim likes books that are fictional and funny. While she was reading it, Kim was very bored. When she's finished reading it, Alex asks Kim what she thinks. Kim says: "I did not like that book."

P2. Megan invited her friend Greg to her piano recital. Greg doesn't know much about classical music. Greg finds himself really enjoying Megan's playing and the music. When the performance is over, Megan asks Greg what he thinks. Greg says: "I loved your recital."

Test Trials:

1. Mike made a cake for Lori's party. He used lemons from his garden to make it, and thinks it's going to be delicious. When Lori takes a bite, Mike asks Lori what she thinks. Lori says: You made a {yummy/yucky/lemon} cake.

2. Kim bought a gift for Dave's birthday. She searched long and hard to find something suitable. Kim thinks Dave is going to love it. When Dave opens the gift, Kim asks Dave what he thinks. Dave says: "You gave me an {awesome/awful/birthday} gift."

3. Lisa is putting together a bouquet of flowers for Matt's event. She has done this many times. She thinks it is going to look beautiful. When Matt comes around to see the bouquet, Lisa asks Matt what he thinks. Matt says: "You made a {pretty/messy/floral} bouquet."

4. Finn is sitting with his partner Mia in English class. He knows his teacher appreciates when students ask really good questions. He comes up with one he thinks will really impress his teacher. When he tells it to his partner, Finn asks Mia what she thinks. “Mia says: You asked a {clever/silly/review} question.”
5. Marc is at an Italian restaurant with his friend Katie. He heard that the restaurant had really good reviews. He ordered a popular dish for Katie. When she takes a bite of the dish, Marc asks Katie what she thinks. Katie says: “You ordered a {tasty/nasty/lobster} dish.”
6. Jane went shopping with her brother Andy. She picked out a trendy shirt. She thinks it looks really good when she tries it on. When she comes out of the dressing room, Jane asks Andy what he thinks. Andy says: “You picked a {lovely/ugly/spotted} shirt.”
7. Maddy was reading a story for her brother Chase at night. It is one of Maddy’s favorite books. Maddy thinks the author is really good at writing humor. When she’s finished with the story, Maddy asks Chase what he thinks. Chase says: “You read a {funny/boring/bedtime} story.”
8. Carl was working on a group project with Kayla in science class. He had a good idea for a device, so he put something together and brought it back to the group. He thinks it will be very helpful for their project. When he shows her his tool, Carl asks Kayla what she thinks. Kayla says: “You made a {useful/useless/wooden} tool.”
9. Tim was learning to make button holes for his sister Tara’s sweater. He watched a lot of YouTube tutorials before and thinks he is getting the hang of it. When he makes a hole in the fabric, Tim asks Tara what she thinks. Tara says: “You made a {careful/careless/half-inch} hole.”
10. Ruth was listening to Jason talk about his concerns. She likes to give people advice and thinks she can help solve their problems. When she offers him a quick fix for his issue, Ruth asks Jason what he thinks. Jason says: “You gave a {helpful/bossy/partial} solution.”

11. Anne was asked to choose the book for her friend Jake’s book club. Anne enjoys reading books that challenge her. She thinks everyone will like the novel that she’s picked. When she announces her choice for the week, Anne asks Jake what he thinks. Jake says: “You chose a/an {easy/tricky/fiction} novel.”

12. John was making a TikTok for his friend Jenny. John likes cracking jokes and making people laugh. He thinks he is very clever. When he publishes the video, John asks Jenny what she thinks. Jenny says: “You made a {witty/foolish/TikTok} video.”

A2. Scenario Video Files

Version A: <https://www.youtube.com/playlist?list=PL6GyAhe9rUH09I6q1ip6EyOO1d1c14L7k>

Version B: <https://www.youtube.com/playlist?list=PL6GyAhe9rUH0Zgdw6o5fhmjaovYyEYO1c>

Version C: <https://www.youtube.com/playlist?list=PL6GyAhe9rUH1dyohUzErf3RgZ8ui0XIjr>

Version D: <https://www.youtube.com/playlist?list=PL6GyAhe9rUH3kByS8NutPNqJLri1G3MrY>

Version E:

<https://www.youtube.com/playlist?list=PL6GyAhe9rUH17zzH4qqOZvXsOxpkY9v7G>

Version F:

<https://www.youtube.com/playlist?list=PL6GyAhe9rUH31OQvxxwk0wgoROCG-vH8H>