Contextual inferences over speakers' pragmatic intentions: Preschoolers' comprehension of contrastive prosody

Chigusa Kurumada
kurumada@stanford.edu
Department of Linguistics
Stanford University

Abstract

We investigate pre-schoolers' ability in drawing pragmatic inferences based on prosodic information. Previous work has found that young children are generally oblivious to intonational meaning of utterances. In particular, the ability to comprehend contrastive prosody develops late during language acquisition (after the age of 6). In three experiments, we show that preschoolers can engage in prosody-based pragmatic inferences if the context provides supports for them. Furthermore, we find that preschoolers' interpretation of prosody involves complex counter-factual reasoning ('what the speaker would have said if she had intended another meaning'). The picture emerging from our studies contrasts with previous work: Through rich contextual inferences, four-year olds are able to bootstrap their interpretation of prosodic information, and achieve adult like performance in intonation interpretation.

Keywords: Prosody, language acquisition, contrastive accent, Principle of Contrast, rational inference

Introduction

In learning new words, young children can make use of pragmatic inference to bootstrap their knowledge about new word-object mapping. For example, in a situation where an adult utters "Give me the TOMA (nonce word)" [1] when a familiar object (e.g., a spoon) and an unfamiliar object (e.g., a whisk) are present in a visual field, a child as young as two years of age is likely to reach for the whisk. This is considered to be based on a cognitive bias for a unique object-label mapping (e.g., Markman and Wachtel (1988)) or the inference that the mother should have used the familiar word (spoon) if she had intended to refer to it (e.g., Clark (1990)).

Such pragmatic dispositions provide immense leverage in word learning because there is inherent uncertainty associated with mappings between speakers' intentions, linguistic signals, and their referents (Frank, Goodman, & Tenenbaum, 2009). One way to systematically solve this puzzle is to estimate the probability assigned to a possible intention-signal mapping relative to other possible mappings warranted by the same context. For instance, the probability of the signal "Give me the TOMA" expressing the speaker's intention of picking out the non-spoon object is estimated in proportion to probabilities of (1) the signal being generated by the intention of picking out a spoon; and (2) other signals (including [a spoon]) being generated by the intention of picking out the target (non-spoon) object.

[1] Hereafter: double-quotation marks are used for quoting speech, with phonetic and prosodic specification. Capital letters represent prosodic emphasis. Square brackets ([ ]) are used for example words or sentences abstracted away from acoustic detail, e.g., [It is raining outside] can be said as, "It's RAINING outside!", "It IS raining outside!", et cetera.)

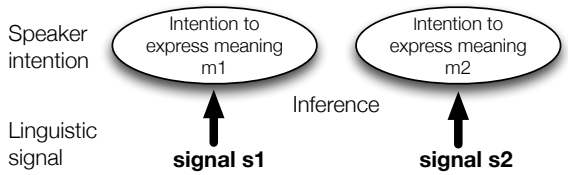

Figure 1: A schematic representation of a pragmatic model of intention-signal mapping

In the model illustrated in Figure 1, a speaker's intention (to express meaning m1) generates a particular linguistic signal (signal s1); If the speaker had meant to express meaning m2, she would have generated a different signal (signal s2). A word learner's job is to work *backwards* from the observed signal to infer the speaker's intention (as indicated with arrows) while updating her belief about the signal-intention mappings, including any associations newly introduced.

The current study extends this idea to a new domain: Young children's interpretation of contrastive prosody. Just as words are associated with speaker intentions, different prosodic representations are probabilistically mapped onto intentions that had generated them (Figure 2). Compared to words, however, prosodic signals are continuous and variable, which can make the mapping puzzle much harder to solve. Furthermore, the intentions that prosodic representations encode are often very abstract (e.g., contrastiveness) and are not always disambiguated in an observable context. In other words, signal-intention mappings for prosody include much more uncertainty (indicated by the thinner arrows in Figure 2) for listeners to overcome. The current study suggests that, despite this additional complexity, the rational inferences attested in word-learning provide leverage in young children's discovery of pragmatic functions of contrastive prosody as well.

Prosodic information is known to encode structural boundaries and phrasing but also speakers' intentions (Pierrehumbert & Hirschberg, 1990; Ladd, 2008; Büring, 2003). Much attention has been paid to how listeners interpret context-relevant contrast based on a low-high-low (an L+H*) pitch accent. (e.g., *KATIE* (L+H*) did not win a truck (but LAURA did); Ito & Speer, 2008). Previous work has generally agreed that inferences based on an L+H* accent present great difficulty to preschoolers, and even young school children fail to achieve adult-like performance in experimental settings (e.g., Solan, 1980; Cruttenden, 1985; Wells, Peppe,

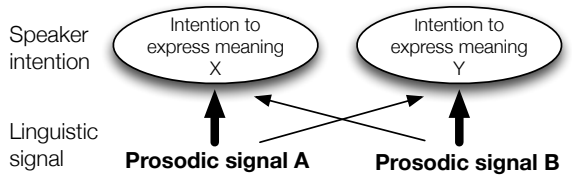

Figure 2: A schematic representation of a model for intention-signal mapping in prosodic interpretation

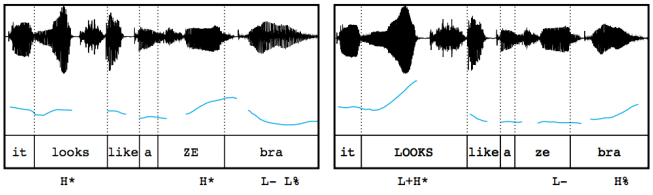

Figure 3: Waveforms (top) and pitch contours (bottom) of the utterance "It looks like a zebra". The affirmative interpretation *It is a zebra* is typically conveyed by the pattern on the left, while the negative interpretation *It is not a zebra* is conveyed by the pattern on the right.

& Goulandris, 2004; Sekerina & Trueswell, 2012). Since even young infants can use prosodic information for finding word boundaries or affective communication (Cutler & Swinney, 1987), the difficulty is not usually attributed to their sensitivity to prosodic information per se, but to limited cognitive resources and memory span (Speer & Ito, 2009). The current study shows a supportive discourse context allows children to comprehend contrastive prosody earlier than previously reported.

Furthermore, we demonstrate that acquisition of contrastive prosody is supported by the same pragmatic inference underlying the word-intention mappings described above. That is, upon receiving a signal, the listener works backward to inferentially identify the intention most likely to generate the particular signal observed. Crucially, a learner can bootstrap her knowledge about a new signal-intention mapping based on other mappings warranted in the same context.

In the three experiments reported below, 4-year-olds and adults were asked to interpret an English construction "It looks like an X", which can evoke different pragmatic meanings depending on its prosodic realization. A canonical accent placement (as illustrated in Figure 3, left panel, henceforth *noun-focus prosody*) typically elicits an affirmative interpretation (e.g. *It looks like a zebra and I think it is one*). When the verb "looks" is lengthened and emphasized with a contrastive accent (L+H*) and the utterance ends with a L-H% boundary tone (Figure 3, right, *verb-focus prosody*), it can trigger a negative interpretation (e.g. *It LOOKS like a zebra but its actually not one*; see also Dennison & Schafer, 2010).

The results show that, replicating the previous studies, preschoolers do not show adult-like understanding of contrastive prosody provided in an experimental setting (Experiment 1). However, the difficulty is alleviated when the prosodic input is preceded by a question that highlights what the alternative would be (Experiment 2). This suggests that preschoolers have prosodic representations while exhibiting difficulty in evoking a context-relevant alternative. Furthermore, children can use their knowledge about a construction (It's an X) that is more familiar to them to bootstrap their knowledge about contrastive inference (It LOOKS like a zebra...). These data together suggest that preschoolers use contextual information and pragmatic inferences to achieve adult-like performance in understanding contrastive prosody.

Experiment 1

In Experiment 1, a game-like task was used to elicit preschoolers' interpretations of the two prosodic contours: Noun-focus and Verb-focus prosody. This was done to replicate the past studies' finding that young children fail to derive contrastive inference based on the prosodic information.

Methods

Participants 12 children acquiring English as their first language (6 girls, 6 boys; mean age 4;1, age range 3;2 - 4;8) were recruited and tested at a local nursery school in Stanford, California. For a comparison, 20 adults were also tested in the same paradigm using Amazon Mechanical Turk. The adult participants were all self-reported native speakers of American English residing in the United States.

Stimuli Sixteen high-frequency animal names were embedded in the sentence frame [It looks like an X] (e.g., It looks like a zebra). Half of the items were produced with Noun-focus prosody (e.g., "It looks like a ZEBRA!") and the other half were produced with Verb-focus prosody (e.g., "It LOOKS like a zebra"). The pronunciation patterns were counter-balanced between two lists: items pronounced with Noun-focus prosody in List 1 were produced with Verb-focus prosody in List 2 (and vice versa).

Sixteen more animal terms were chosen to form pairs in which the animals resembled each other in visual features (e.g., a zebra and an okapi, Figure 4). In each pair, the target animal named in the input sentence ("it looks like a zebra") was the more common of the two and was more familiar to the children being tested. Hereafter, the target named in a sentence (e.g., a zebra) is referred to as the "mentioned" animal and the paired animal (e.g., an okapi) is referred to as the "unmentioned" animal. The two animals in each pair served as likely referents for one or the other of the two prosodic contours used in the task (e.g., a zebra for "It looks like a ZEBRA!" and an okapi for "It LOOKS like a zebra")

Procedure The experimenter began by introducing a puppet and telling the child that they would play a guessing game together. The game had two parts. The first part was a picture-naming phase, in which the child saw seven pictures on a computer screen and labeled them one by one. This was done to ensure that the names of the objects were familiar to the

(a) a sample picture for a guessing phase

(b) choice options based on a sentence: It looks like a zebra

Figure 4: Experimental setup: Participants heard the puppet's clue while looking at a picture like (a) and were subsequently asked to guess which of the two pictures (as in (b)) was hidden behind the barrier.

child. In the second part, the test phase, the child and the puppet took part in seven trials (two practice and five critical) of a two-alternative forced-choice task. In each trial, the child and puppet were presented with a picture partially occluded by a gray barrier (Figure 4a). The puppet was then allowed to peek behind the barrier and give the child a clue about what he saw. The puppet's clue took the form of the "it looks like X" construction, pronounced with either Noun-focus prosody or Verb-focus prosody. All the puppet's speech was vocalized during the task by an experimenter who was a native speaker of American English. Following the puppet's clue, the child was presented with two pictures - the mentioned and unmentioned (Figure 4-b) - and asked to point which animal was hidden by the barrier. When the child pointed to a picture, she got feedback about which animal was the target referent. After completing seven trials, the child named five more animals and participated in five more guessing game.

Results and Discussion

Figure 5 shows the proportion of mentioned animals chosen by the children and adult participants (e.g., choosing a zebra when the input sentence was [it looks like a zebra]). Adults responded to the stimuli in the expected ways: they reliably picked a mentioned animal based on the Noun-focus prosody (e.g., "It looks like a ZEBRA") and an unmentioned animal based on the Verb-focus prosody (e.g., "It LOOKS like a zebra...").

However, the four-year-olds did not differentiate the two patterns ($\chi^2(1) = 1.36,\ p > .24$). Overall, they showed a weak bias towards the picking an unmentioned animal (60% of all the responses), which might be due to their preference for a new, and often funnier looking, animal. Thus, replicating the previous findings, four-year-olds did not seem to make the contrastive inference based on the prosodic contour.

What makes the comprehension of contrastive prosody difficult for young children? Recall the model presented in Figure 2. In order to correctly interpret the prosodic contours, a listener needs to be aware that they are mapped onto two distinct speaker intentions. In particular, it is critical to understand that the two prosodic patterns signal two intentions (answers) relevant to a question at hand (e.g., Is the animal a zebra or not?) While this reasoning comes naturally to adult listeners, young children might need more contextual support for establishing these assumptions that are plugged into the interpretation of contrastive prosody. To test this prediction, in Experiment 2, additional discourse-contextual information was provided to ensure that the children have better access to the contextual alternatives.

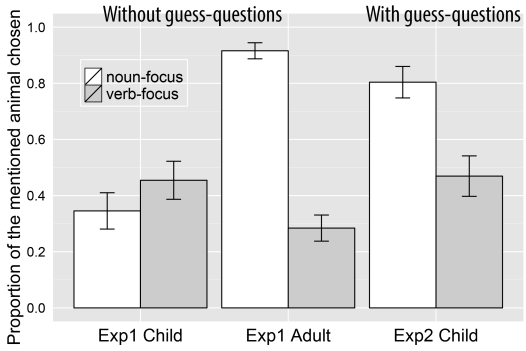

Figure 5: Proportions of the mentioned animal chosen in Experiment 1 (children and adults) and Experiment 2 (children). Error bars represent standard error of the mean.

Experiment 2

In Experiment 2, effects of an explicit guess-question are examined. The puppet asks the child to make a guess about the hidden animal, which establishes a question that needs to be answered (e.g., Is the hidden animal a zebra or not?) If this manipulation has a positive effect on the child's understanding of contrastive prosody, it would mean that the comprehension difficulty observed in Experiment 1 is at least partially attributed to their difficulty in detecting contextual alternatives.

Methods

Participants 12 children (7 girls, 5 boys; mean age 4;2, age range 3;6 - 4;6) were recruited and tested at the same nursery school as in Experiment 1.

Stimuli The stimuli were identical to those of Experiment 1.

Procedure The procedure was almost identical to that of Experiment 1 except that the puppet first pointed to the partially occluded picture and provided a guess-question: "What do you think is hiding behind the wall?" When the child did not give an answer, or the child's answer was unrelated to the trial item, the puppet followed up by saying, "I'm gonna guess it's an X (e.g., a zebra). But let me take a peek and give you a clue." This was done to provide an additional cue to ground the current "question under discussion" (Roberts, 2004), namely, whether the identity of the hidden animal was an X or not an X.

Results and Discussion

A mixed logit regression analysis with the full two (Noun-focus vs Verb-focus prosody) by two (Experiment 1 vs. Experiment 2) design was employed to predict children's likelihood of choosing a mentioned animal for each stimulus sentence (e.g., choosing a zebra when the input sentence was "it looks like a zebra"). The model reported here has a full factorial random effect structure justified by the data, which contains random by-subject and -item slopes. All the predictors were sum-coded and there was no sign of collinearity. The original model contained the item order as a fixed effect, but it was removed from the analysis that follows based on a null effect in model comparison.

Overall, children showed a marginal but non-significant preference for choosing the mentioned animal when they heard the Noun-focus prosody ($\beta = .62$, $p < .07$). Importantly, children were overall more likely to choose the mentioned animal in Experiment 2, where an explicit guess-question was present ($\beta = 1.43$, $p < .003$) (Figure 5). There was also a significant interaction term between the prosodic input and the conditions ($\beta = 2.41$, $p < .001$), such that children were more likely to choose a mentioned animal based on the Noun-focus prosody in Experiment 2. That is, the explicit guess-question about a target animal facilitated their comprehension of the pragmatic interpretations of the two prosodic patterns. An additional analysis revealed that there was also an effect of age: older children tended to choose mentioned animals across conditions and input patterns significantly more often ($\beta = .08$, $p < .04$).

How did the contextual support lead to adult-like judgement patterns? Two follow-up analyses were conducted to test if the presence and the types of guesses could predict children's choice behaviours. In Experiment 2, children were willing to make guesses 79% of the time, 53% of which included an animal mentioned in the input sentences. Consequently, the target animal was introduced to the discourse by the child 42% of the time, and by the puppet 58% of the time (e.g., "I'm gonna guess it's an X"). The children's responses to the puppet's guess-question were coded as binary predictors: (1) whether the child offered an animal name or not; and (2) whether the child made a correct guess. These predictors were included in two different models of children's choice of a mentioned animal in the Experiment 2. However, neither of these predictors was significant ($p > .8$ and $p > .7$ respectively). This suggests that the facilitative effect observed in Experiment 2 cannot be reduced to children's expectation about a particular animal. Whether or not the child guessed correctly at the outset, the explicit introduction of the animal name provided support for their prosodic interpretations.

Experiment 3

Experiment 3 tests a hypothesis based on the model of backward inferencing in prosodic comprehension. A structurally simpler, semantically less ambiguous, sentence "It's an X" was added to test if the presence of a familiar signal-intention mapping supports children's inferences about a less-familiar signal and its pragmatic meaning. A few novel features were added to Experiment 3. First, pre-recorded speech was used for the input to rigorously control the input children received. Also, physically manipulable props (a picture card, a cardboard box) replaced the computer screen for the stimuli presentation.

Methods

Participants 36 children acquiring English as their first language (24 girls, 12 boys; mean age 4;6, age range 3;8-5;2) were recruited and tested. They were randomly assigned to one of the three conditions described in Table 1. 60 adults were also tested on-line, using Amazon Mechanical Turk. 3 adult participants were excluded from the data because their participation time was two standard deviation below the mean.

Stimuli 16 high-frequency animal names were embedded in two sentence frames: [It looks like an X] and [It is an X]. Tokens of [It looks like an X] with Noun-focus and Verb-focus prosody, as well as tokens of [It is an X], were recorded by a female native speaker of American English for use in the presentation of each trial.

Procedure Participants took part in a two-alternative forced choice task similar to Experiments 1 and 2. It consisted of a total of 16 trials (two practice trials and 14 critical trials). As in Experiment 1, the child participant was first introduced to a puppet. A mini portable speaker was attached to the puppet in order to play the audio stimuli. The child first participated in a picture-naming task, in which they labeled eight animals one-by-one. Then child and puppet took part in a guessing game where first they were presented with a box and told that it contained many different pictures of animals. Then the puppet was allowed to peek inside the box and give the child a clue. Next, each child was presented with two pictures (e.g., a zebra and an okapi) and prompted to indicate which of the two pictures was hidden in the box. Then the experimenter took a picture card from the box and showed the child which animal the puppet had actually "seen". After the first eight trials, the child was given eight more pictures of animals to name, and participated in eight more test trials.

Manipulation Children are put into one of the three conditions: Prosory-only, Form-only, and Combined conditions. In the **Prosody-Only** condition, as in Experiment 1, the puppet used either a Noun-focus or Verb-focus contour with [It looks like an X] to give a hint and a warning respectively. Hence the Prosody-only condition is expected to replicate the results from Experiment 1. In the **Form-Only** condition, the puppet said [It's an X!] as a hint when the target animal was an X (e.g., "It's a ZEBRA" when the target picture depicted a zebra), compared to the puppet saying [It looks like an X] also with a focus on the final noun, as a warning when the picture was not an X (e.g., "It looks like a ZEBRA" when the target

Table 1: The between-subject manipulation of Experiment 3. The shaded cells indicate sentence patterns used for the warning function (identifying the hidden animal as not being the mentioned animal)

	Prosody-only X	Form-only	Combined
It's an X		"It's a ZEBRA"	"It's a ZEBRA"
Noun-focus prosody	"It looks like a ZEBRA"	"It looks like a ZEBRA"	
Verb-focus prosody	"It LOOKS like a zebra..."		"It LOOKS like a zebra..."

picture depicted an okapi). Notice that this manipulation is done based on the assumption that the Noun-focus prosody is in principle semantically ambiguous and it can be interpreted as *it is an X* or *It is not an X* depending on a speaker's preference and a context (Kurumada, Brown, & Tanenhaus, 2012). It is hypothesized that children can better distinguish the pragmatic intentions based on these formal cues due to their reliance on lexically encoded information over prosodically encoded information in online processing (Snedeker & Trueswell, 2003).

Finally, in the **Combined** condition, the puppet used [It's an X] for a hint with Noun-focus prosody, and Verb-focus prosody (e.g., "It LOOKS like an X") for a warning. Recall the word-learning situation with a spoon and a whisk. Presence of a familiar association (the word "spoon" and an intention to pick out a familiar object) results in higher confidence in a novel mapping compared to a situation in which there is no such familiar association. Experiment 3 tests if children can discover pragmatic meaning of contrastive prosody via a similar pragmatic inference: In the Combined condition, compared to the Prosody-Only condition, "It LOOKS like an x" becomes a more likely candidate for conveying the [it is not an X] meaning because speaker should otherwise have said "It's an X" if she had meant that.

Results and Discussion

All responses from the 14 critical trials were included in the analysis, as shown in Figure 6 for the children's response patterns. In the **Prosody-only** condition, which replicated Experiment 1, children's responses did not deviate from chance, and their judgments for each of the two prosodic patterns ("It looks like an X" and "It LOOKS like an X") did not differ significantly. In the **Form-only** condition, children showed more sensitivity to the contrast intended by the speaker ($p. < .3$): They showed more diverged responses for the two types of sentences intended for a hint and a warning presumably due to their confidence in the interpretation of "It's an X".

In the **Combined** condition, the children showed nearly categorical and opposing responses for the two types of prompts, reliably choosing the mentioned animal when they heard "It's an X" and the unmentioned one when they heard "It LOOKS like an X". The most interesting comparison can be made between the responses for the Verb-focus prosody in the Prosody-only and the Combined conditions. They are acoustically identical and yet interpreted differently depending on the other sentence type used for a hint function. The difference between the Form-only and the Combined condition suggests that children were indeed aware of the pragmatic function of the contrastive prosody used in the Verb-focus prosody.

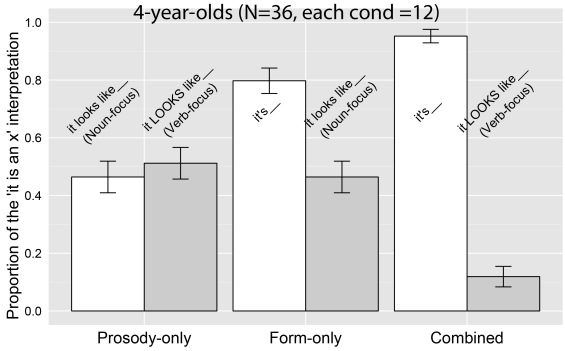

Figure 6: Proportions of an mentioned animal chosen by 4-year-olds in Experiment 3. Error bars represent standard error of the mean.

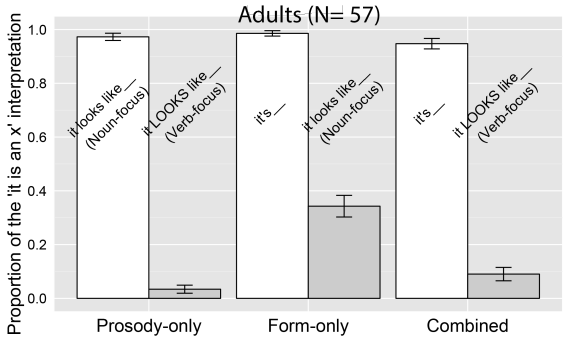

Figure 7: Proportions of an mentioned animal chosen by adults in Experiment 3

Figure 7 illustrates adults' responses in the three conditions. The most significant difference between the children's and adults' responses can be found in the Prosody-only condition. While children's responses for both of the prosodic patterns are at chance, adult listeners were almost categorically choosing a mentioned and an mentioned animals based on the Noun-focus and the Verb-focus contours respectively. The judgments were less categorical in the Form-only condition, which suggests that the children's and adults' response patterns were similar to each other in the Form-only condition as well as in the Combined condition.

General Discussion

The results of the three experiments indicate that discourse contexts provide strong support for preschoolers' comprehension of contrastive prosody. In particular, Experiment 2 confirmed that an explicit question in a preceding context helped children to be tuned into the prosodic differences. This was considered to be because the question made it easier for them to derive two distinct speaker intentions (i.e., It is an X and It is not an X). This is in line with previous findings in which preschoolers' difficulty in computing scalar implicature was alleviated by an explicit depiction of contextual alternatives (Barner, Brooks, & Bale, 2011).

Experiment 3 provided evidence that children engage in a rather complex probabilistic inferences when interpreting contrastive prosody: they interpret prosodic contours conditionally, depending on what other speech signals are used by the same speaker. When the speaker uses a more familiar, and semantically less ambiguous, sentence (i.e., It's an X), they can effectively infer that the prosodic prominence on LOOKS signals a distinct speaker intention (i.e., It is not an X).

Previous studies have viewed the interpretation of contrastive prosody as part of children's domain-specific knowledge about mappings between specific patterns of acoustic signals (i.e., L+H*) and pragmatic meanings. However, that approach cannot explain how hearing other forms (e.g., "It's an X") in the same context affects children's understanding of contrastive prosody. The current results suggest that children are trying to solve a bigger inference problem, where they cope with uncertainty regarding different speech signals, and estimate the likelihood with which prosodic signals are mapped onto different meanings.

These results highlight the possibility that such contextual inferences allow children to process pragmatic interpretations of prosody even before they acquire fully-fledged understanding of the prosody-pragmatics interface. As we saw in Experiment 1 and 3, four-year-olds do not yet exhibit adult-like knowledge about contrastive prosody. In other words, they do not reliably call to mind a contrast set based solely on prosodic minimal pairs (e.g., It looks like an X vs. It LOOKS like an x) and make an inference about a speaker's intentions. Nevertheless, with more contextual and linguistic information, they engage in inferences that result in adult-like responses. The role of such contextually-supported inferences has been discussed almost exclusively in word-learning while its full implications for language acquisition remain to be understood. The current results suggest that a similar model can explain pre-schoolers' intonational interpretation. A contrastive meaning of prosody LOOKS unattainable for those young children, but it is not in a context.

Acknowledgments

Thanks to Sarah Bibyk, Meredith Brown, Marisa Casillas, Eve V. Clark, Christine Gunlogson, T. Florian Jaeger, Molly Lewis, and Michael K. Tanenhaus for valuable discussion.

References

Barner, D., Brooks, N., & Bale, A. (2011). Accessing the unsaid: the role of scalar alternatives in childrens pragmatic inference. *Cognition*, *118*(1), 84–93.

Büring, D. (2003). On d-trees, beans, and b-accents. *Linguistics & Philosophy*, *26*(5), 511-545.

Clark, E. V. (1990). On the pragmatics of contrast. *Journal of Child Language*, *17*(02), 417–431.

Cruttenden, A. (1985). Intonation comprehension in ten-year-olds. *Journal of Child Language*, *12*, 643–661.

Cutler, A., & Swinney, D. A. (1987). Prosody and the development of comprehension. *Journal of Child Language*, *14*(01), 145-167.

Dennison, H. Y., & Schafer, A. J. (2010). Online construction of implicature through contrastive prosody. In *Speech prosody 2010 conference.*

Frank, M. C., Goodman, N. D., & Tenenbaum, J. B. (2009). Using speakers referential intentions to model early cross-situational word learning. *Psychological Science*, *20*(5), 578–585.

Ito, K., & Speer, S. R. (2008). Anticipatory effects of intonation: Eye movements during instructed visual search. *Journal of Memory and Language*, *58*(2), 541–573.

Kurumada, C., Brown, M., & Tanenhaus, M. K. (2012). Prosody and pragmatic inference: It looks like speech adaptation. In *Proceedings of the 34th annual conference of the cognitive science society.*

Ladd, D. R. (2008). *Intonational phonology* (2nd ed.). Cambridge University Press.

Markman, E. M., & Wachtel, G. F. (1988). Children's use of mutual exclusivity to constrain the meanings of words. *Cognitive Psychology*, *20*(2), 121–157.

Pierrehumbert, J., & Hirschberg, J. (1990). The meaning of intonational contours in the interpretation of discourse. *Intentions in Communication*, 271 – 311.

Roberts, C. (2004). Discourse context in dynamic interpretation. In L. Horn & G. Ward (Eds.), *Handbook of contemporary pragmatic theory* (pp. 197–220). Blackwell.

Sekerina, I. A., & Trueswell, J. C. (2012). Interactive processing of contrastive expressions by russian children. *First Language*, *32*(1-2), 63-87.

Snedeker, J., & Trueswell, J. (2003). Memory and language using prosody to avoid ambiguity : Effects of speaker awareness and referential context. *Journal of Memory and Language*, *48*(1), 103–130.

Solan, L. (1980). Contrastive stress and children's interpretation of pronouns. *J Speech Hear Res*, *23*(3), 688-698.

Speer, S. R., & Ito, K. (2009). Prosody in first language acquisition acquiring intonation as a tool to organize information in conversation. *Language and Linguistics Compass*, *3*(1), 90–110.

Wells, B., Peppe, S., & Goulandris, N. (2004). Intonation development from five to thirteen. *Journal of Child Language*, *31*(04), 749-778.