UNIVERSITY OF ALBERTA

Effects of Utterance Position and Familiarity on Mothers' Production of Labels: An Acoustic Analysis of Child-Directed Speech

BY

Megan Galloway

A THESIS

SUBMITTED TO THE FACULTY OF ARTS

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

BACHELOR OF ARTS

DEPARTMENT OF LINGUISTICS

EDMONTON, ALBERTA

June, 2019

UNIVERSITY OF ALBERTA FACULTY OF ARTS

The undersigned certify that they have read and recommend to the Faculty of Arts for acceptance, a thesis entitled ‘Effects of Utterance Position and Familiarity on Mothers’ Production of Labels: An Acoustic Analysis of Child-Directed Speech’, submitted by Megan Galloway in partial fulfillment of the requirements for the degree of Bachelor of Arts.

….....

Honours Thesis Supervisor

….....

For the Department

ABSTRACT

Research on child-directed speech (CDS) has hosted a debate surrounding the reason caretakers use certain acoustic-prosodic characteristics when speaking to children. This study seeks to investigate the purpose of two of these CDS characteristics: higher mean pitch (Hz) and wider pitch range (pitch difference calculated by low Hz subtracted from high Hz) than adult-directed speech (ADS). The present study does so by comparing label productions of familiar and novel words in different utterance positions to children vs. adults. If mothers make acoustic modifications to novel labels only in salient utterance positions, and only in CDS, it would suggest that these modifications are a product of didactic intent. Results found that mothers did make modifications to mean pitch depending on familiarity and utterance position (initial and medial, but not final), but this was found in both CDS and adult-directed speech (ADS). Additionally, there were no significant results for pitch range. Overall, our results suggested that, rather than didactic intent, higher mean pitch and wider pitch range typically found in CDS are due to positive affect, attention-elicitation, or some other factor.

ACKNOWLEDGEMENTS

Thank you to my friends an family who supported me in this endeavour. Thank you to the department for its dedication to the honors program and all of its professors for fostering my passion for this field. Most importantly, an especially huge thanks to the amazing Dr. Stephanie Archer for all of her help and support during the supevision of this project.

TABLE OF CONTENTS

TABLES AND FIGURES

SECTION I. INTRODUCTION

Across a wide variety of languages, research on child-directed speech (CDS) has found a prosodically distinct register for speaking to children (Fernald et al., 1989). CDS is the unique way in which adults speak to children, as compared to the way they would normally speak to other adults, known as adult-directed speech (ADS). Among many of these languages, research has also revealed a consistent pattern of specific speech characteristics in CDS that set the register apart from ADS, including higher pitch (f_0), f_0-range, wider vowel peripherality, shorter utterances, and longer pauses, than in ADS (Fernald et al.,1989; Wang, Seidl & Cristia, 2015). Further, previous literature has exemplified children's preference for listening to CDS over ADS (Cooper & Aslin, 1990; Fernald 1985). Children even prefer listening to CDS over ADS in languages other than their native language, strengthening the claim that child preference for CDS characteristics may be universal (Werker, Pegg, & McLeod, 1994). The existence of a robust cross-linguistic pattern in CDS characteristics and child preference for speech with these characteristics, raises questions about the reason CDS uses these specific characteristics and, more importantly, why we use CDS at all.

Much of the speculation around the purpose of CDS has centered around whether or not CDS facilitates child first language acquisition. Findings appear to support that many CDS characteristics may impact ease of perception. Some characteristics, such as vowel hyperarticulation and slow rate of speech, appear to be correlated with perceptual ease, as these factors have been found to positively affect word recognition and segmentation (Song, Demuth & Morgan, 2010). Ma, Golinkoff, Houston and Hirsh-Pasek (2011) found that 21-month-olds appeared to learn object-label associations in CDS, but not ADS, and went further to conclude that this effect was associated with label-learning, not just attention. Graf Estes and Hurley (2013) also found evidence supporting that children learned object-label associations when presented in CDS, but not when presented in ADS. Their findings also suggest that prosody variability may be a key characteristic of CDS because children appeared to not learn object-label associations when presented in CDS with no prosodic variation between tokens, but did when variability was included.

If CDS characteristics may facilitate perception and learning, do caretakers modify CDS for the purpose of teaching children? This study is exploring what kinds of acoustic modifications mothers make to their speech and what factors affect those modifications. Research suggests that where a word is within an utterance (utterance position) may impact the production of labels in CDS. For example, intonational attributes such as duration and pitch are impacted by the location of the target word in the utterance (Eady & Cooper, 1986). Aslin (1993) found that mothers tend to place target words in utterance-final position, even when doing so violates grammaticality, concluding that mothers appear to knowingly take advantage of final boundary strengthening. He explains that there are potential benefits to placing target words in utterance-final and also utterance-initial position due to reduction of segmentation problems and the added advantage of recency or primacy effects. Additionally, Fernald and Mazzie (1991) found a consistent pattern of mothers placing target words with pitch peaks in utterance-final position and that prosodic emphasis was more variable in ADS than CDS. Kondaurova and Bergeson (2011) found that pitch (including mean pitch and pitch range), pause, and duration cues in CDS were more exaggerated in utterance final position than utterance initial position.

Target words and the prosodic characteristics assigned to them by the speaker may further be distinguished by whether or not the listener is familiar with the word. That is, whether the speaker thinks the listener is familiar with the word, or not. This does not have to do with how familiar the listener actually is with the word, only the judgement of the speaker. In ADS, words that are 'new' to the speaker are emphasized through longer duration and higher fø than familiar words (Brown, 1983). Moreover, studies support that adults do make use of this modification. Adults have been shown to experience improved comprehension if the 'appropriate' intonation is used to mark given and new information (Bock & Mazzella, 1983). Seeing as young children encounter many novel labels every day, more so than adults, it is appropriate to ponder if these facilitating effects also occur in children. The difference is that, rather than the novel words being new to the speaker, we are focusing on how new a word is to a listener affects production from the speaker. Previous literature shows that children as young as 7.5-months-old have the ability to segment words that they have been familiarized with from fluent speech (Jusczyk & Aslin, 1995).

Novel labels may be given focus in CDS, as the speaker may want to highlight this word compared to other words that the child already knows. In CDS, focused words tend to appear on pitch peaks, perhaps making the word more salient (Fernald & Mazzie, 1991).

The current study seeks to gain a better understanding of how mothers produce familiar versus novel labels in different utterance positions to children between 18 and 25 months of age. Typically developing children in this age range are not prelinguistic and have already experienced their word spurt (Nazzi & Bertoncini, 2003). Children of this age also tend to have stories read to them often, matching the sort of stimulus used in this study. What impact child age has on CDS is still being investigated. Some claim that speakers modify acoustic characteristics of CDS based on child age, as their linguistic abilities and needs are changing (Benders, 2013). More specifically, some studies suggest that younger infants' preferences are driven by prosodic characteristics of pitch and duration, while older infants' preference for CDS may wane then increase again being driven by structural components instead (Newman & Hussain, 2006). However, it is still not quite clear how child age and CDS interact.

Knowing that the use of certain acoustic modifications related to utterance position and familiarity have the potential to facilitate comprehension and learning, it is possible that mothers make these adjustments in CDS when producing a label that they want their child to learn. This study seeks to answer: What is the effect of utterance position and familiarity on maternal production of labels to children in CDS vs. ADS in terms of two acoustic correlates (mean pitch and pitch range)? In a more recent study looking at the relationship between acoustic characteristics of CDS and utterance position, Wang, Seidl and Cristia (2015) found no support for acoustic CDS-ADS differences being modulated by utterance position. Although, their study only looked at medial and final position and the speech was spontaneous. In the current study, we will also look also at initial position because it is a boundary position. We will also not be looking at spontaneous speech, so we will be able to explore what happens when the position of the target word is set. Although the target words will not be produced in isolation, the acoustic analyses will look only at the target word. Graf Estes and Hurley (2013) found that CDS labels appear to facilitate learning even when presented in isolation, suggesting that there is enough CDS-specific acoustic-prosodic information

contained in the target word itself to facilitate object-label association learning. Also, each target word will be repeated minimally six times during the procedure, so, if variability is a key factor in child learning of object-label associations in CDS, we should see large variability between tokens in the CDS condition.

By exploring this research question, we can learn more about the reason(s) caretakers use certain characteristics in CDS. The present study is working on the idea that mothers make acoustic modifications to labels based on if the label is new to the child (familiarity) and if the label is in a salient position within the utterance (utterance position). If caretakers make use of these features, it would support that the higher mean pitch and wider pitch range acoustic typically found in CDS may be a product of didactic intent. If caretakers do not make use of these features, it would support that these acoustic characteristics of CDS may be a product of attention-elicitation/maintenance or positive affect. In order to investigate the research question, we created three hypotheses based on previous research. Hypothesis 1: All target words will show higher pitch and wider pitch range in CDS versus ADS. We are looking to recreate the general CDS-ADS differences found in previous literature. Hypothesis 2: Novel labels will have higher pitch and wider pitch range in CDS, but not ADS. Novel labels should have more exaggerated acoustic characteristics than familiar labels if mothers are trying to teach them to their children, and these acoustic modifications are expected only in CDS, not ADS. Hypothesis 3a: The familiarity of labels will affect the acoustic characteristics of label production in different utterance positions in CDS, not ADS. Hypothesis 3b: The effect of familiarity in CDS will be on boundary positions (initial and/or final), but not medial. The last two hypotheses (3a/b) expect that acoustic modifications to labels based on familiarity in CDS will be present in salient positions, and mothers will not make such modifications when the target word is not in a salient position.

SECTION II. METHODS

2.0 Participants

Nineteen mothers of 18-25-month-olds (M = 21.27, SD = 2.07, range = 18.39-25.11, 9 girls) were recruited by the research group Warwick Research with Kids (Wa.R.Ks) at the University of Warwick. Additional mother-child dyads were excluded due to atypical development (n=1) and recording issues (n=3). Dialects varied within British English, with most being from the West Midlands, and all mothers were either native speakers or highly proficient in English. All mothers were briefed and consented to the study.

2.1 Stimuli

Stimuli consisted of six drawings of actual creatures (chicken , monkey, tiger, elephant, turtle, butterfly) and six novel creatures phonologically similar to the actual creature (jidam /ʒɪdəm/, nambee /næmbi/, paber /peɪbə/, hawtherand /hɔwθəɻænd/, gorble /gɔ:bəl/, kaffelsay /kæfəlseɪ/) (see table 1.). The actual creatures were chosen from the Oxford Communicative Development Index (CDI). Each familiar creature was paired with a novel creature whose label was specifically created to match the prosodic pattern of its actual creature counterpart. A 'story card' was made for each creature that included six sentences and a drawn picture of the creature. Illustrations were created for novel creatures that shared prototypical features of their actual counterpart, but were different enough in appearance to be obviously distinct (see figure 1.). Each story passage was meant to consist of two sentences with the target word (beginning with the determiner + <creature>; i.e., "the <creature>...") in utterance-initial position, two in utterance-medial position, and two in utterance-final position, in no specific order, and one question at the end of the story (see appendix A.). However, the story material for 'monkey' unintentionally included three utterance-initial sentences and only one utterance-medial sentence. 'Info cards' for each creature provided the mothers with basic information about the animals and were used to familiarize the mothers with the novel creatures and ensure uniform pronunciation across participants.

Stimuli were chosen from the list of actual-novel pairs for each participant based on familiarity ratings given to the mothers beforehand. The three actual creatures that the mother rated the child to be most familiar with were used, along with those creature's novel counterparts. This was done to ensure that the mothers judged the actual creatures to be familiar to the children, as a main focus of this study is to contrast the productions of familiar versus unfamiliar labels.

Actual Creature	Novel Creature
Monkey	Nambee
Chicken	Jidam
Elephant	Hawtherand
Butterfly	Kaffelsay
Tiger	Paber
Turtle	Gorble

Table 1. The six actual-novel creature pairs used in the experimental procedure of the larger study.

Figure 1. An example of the pictures used for an actual-novel creature pair used in this procedure, as displayed on 'info cards' and 'story cards': (Left) The picture used for 'monkey' and (right) the picture used for 'nambee'.

Two familiar-novel creature pairs were chosen to be analyzed. In order to maximize the amount of useable data and participant overlap, this decision was based on those two pairs having been used with many participants: Monkey/nambee (n = 11) and chicken/jidam (n = 11). Five of the participants

overlapped between the two familiar/novel creature pairs, leaving the total number of participants at 16 (Male = 8, Female = 8, Mean age = 21.27, Age range = 18.39-25.11) (see table 2.). Two participants' data for chicken/jidam was excluded due to missing audio files (n = 2), as well as one overlapping participant and an additional one for monkey/nambee (n = 2). Participant 123's audio file for monkey/nambee in ADS was also missing.

Participant Number	Register Condition Used First	Stimuli Pairs Used	ADS Condition Read Alone or With Adult
102	CDS	Monkey/Nambee, Chicken/Jidam	alone
105	CDS	Monkey/Nambee, Chicken/Jidam	with adult
106	CDS	Chicken/Jidam	N/A
107	ADS	Monkey/Nambee	with adult
108	ADS	Monkey/Nambee	with adult
109	CDS	Chicken/Jidam	alone
110	CDS	Monkey/Nambee, Chicken/Jidam	alone
112	ADS	Monkey/Nambee	alone
113	CDS	Monkey/Nambee, Chicken/Jidam	alone
114	CDS	Chicken/Jidam	alone
117	CDS	Monkey/Nambee, Chicken/Jidam	alone
119	ADS	Monkey/Nambee, Chicken/Jidam	with adult
121	CDS	Chicken/Jidam	with adult
122	CDS	Chicken/Jidam	alone
123	ADS	Monkey/Nambee, Chicken/Jidam	alone
124	ADS	Monkey/Nambee	alone

Table 2. Information for participants used in statistical analysis.

2.2 Procedure

Participants were sent a modified Oxford CDI to complete online before visiting the laboratory. Separate from the CDI was a mini-questionnaire in which mothers were asked to rate the familiarity of the actual creatures (chicken, monkey, tiger, elephant, turtle, butterfly) on a 5-point scale (1 = child doesn't know, 2 = parent doesn't know if child knows, 3 = child somewhat knows, 4 = child knows, 5 = child

knows well). Mother reports of the creature survey allowed the researchers to have stimuli prepared for the three most familiar creatures and their matched novel counterparts chosen for the participant ('story cards' and 'info cards'). The 'story cards' and 'info cards' were ordered in pairs, meaning that the novel and actual creature pairs were kept together.

Mothers were briefed on the task procedure prior to the experiment. The mothers were told that they would be audio recorded to investigate cross-dialectal differences in CDS. Note that this cross-dialect aspect is the focus of the larger study for which this procedure was created, but that study has not yet been completed. Next, the 'info cards' for the three relevant creature pairs for that participant were handed to the mothers one-by-one. These cards were intended to give the mothers background information about the creature, in order to make the novel creatures slightly more familiar to them than to their child. This step was also used ensure uniform pronunciation of the novel creature label in the story reading task. To do so, the researcher introduced each card to the mother by clearly demonstrating the pronunciation of the label. The mothers then read the cards silently.

Mother and child dyads were brought to a dimly lit, sound attenuated room where a researcher fastened a lapel microphone to the opposite shoulder to where the mother would would usually hold her child, and began recording. The set-up of the room included multiple options for seating (a chair, a bean bag cushion, an infant pad, and a children's chair). The experiment was split into two conditions: child-directed and an adult-directed phase, which would alternate in order to counterbalance. The order of presentation for novel and actual creatures was also counterbalanced. During the child-directed phase, the mothers were instructed to read the passages on the 'story cards' aloud to their child and to *actively* engage with them. The mothers were allowed to stop and make casual comments to their child if they wished, as there was no set time limit. The researchers then left the mother alone in the room with their child and were told that the researcher(s) could not hear them, as to not make them self-conscious. During the adult-directed phase, the mothers were instructed to read the same passages aloud specifically in the manner that they would normally speak to an adult. The mothers were given the option to keep their child in the room and read to an

adult (a researcher) or read alone in the room with their child absent. Once both phases had finished, the researcher would debrief the participants and give them a certificate and a gift for the child.

SECTION III. RESULTS

3.0 Data Analyses

Each creature's recording for both register conditions (CDS and ADS) was analysed in Praat (Boersma & Weenink, 2019). Each production of the creature label read from the six sentences on the 'story cards' was annotated and recorded for mean pitch (Hz), high pitch (Hz), low pitch (Hz), duration (sec), and coded for utterance position. Acoustic measurement analyzed anyally (as opposed to scripted). The production read from the question on the 'story card' and any spontaneous productions were not analysed. A production of a creature label (a token) was excluded for pitch analyses if there was disturbances during the recording, such as child noises and noises from toys (if these 'noises' interfered with the analyses of the target words). Additionally, some data was missing due to omissions from the mothers. With the data from the mothers' recordings of the two familiar-novel pairs we had 528 potential tokens. After excluded/missing data, we ended up with 479 usable tokens for analysis. Statistical analysis focused only on two acoustic correlates: mean pitch and pitch range. Pitch range is the difference from the maximum frequency in Hertz (Hz) to the minimum frequency (Hz). This was calculated by subtracting low pitch from high pitch. As mentioned before, only monkey/nambee and chicken/jidam were chosen for statistical analysis. Statistical analysis was run using SPSS (IBM SPSS, 2019).

3.1 Register

3.1.0 Mean pitch (f_0)

We first wanted to look at whether our data replicates expected acoustic CDS-ADS differences in terms of mean pitch. A one-way ANOVA with between subjects *register* (CDS, ADS) tested mean pitch in Hertz (Hz). There was a significant difference of mean pitch between registers, $F(1, 93)= 6.491$, $p = .012$, $\eta_p^2 =.065$. Mean pitch was higher for CDS (M = 218.3, SD = 35.3) than ADS (M = 197.3, SD = 44.5) (see fig. 2).

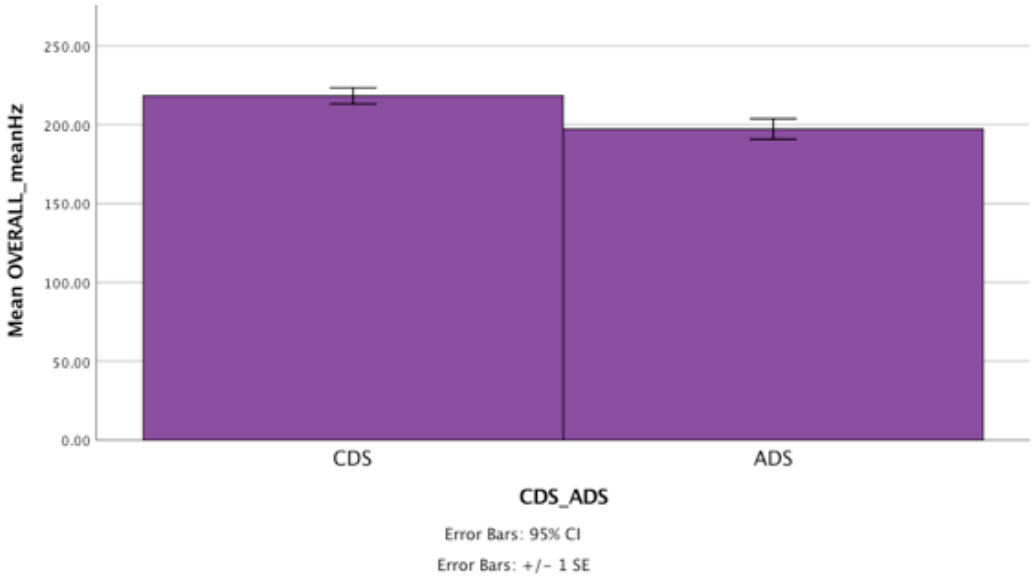

Figure 2. A bar graph showing the significant ($p<.05$) difference of mean pitch (Hz) between registers (CDS, ADS).

3.1.1 *Pitch range (maximum f_0 - minimum f_0)*

We also wanted to investigate CDS-ADS differences in terms of pitch range. Another one-way ANOVA with between subjects *register* (CDS, ADS) testing pitch range in Hertz (Hz) found no significant difference between registers, $F(1, 93)= 1.324$, $p = .253$.

3.2 Familiarity

3.2.0 Mean pitch (f_0)

We wanted to look at the effect of label familiarity (familiar and novel creature labels) on mean pitch in CDS and ADS. A repeated measures omnibus 2x2 ANOVA with within-subjects *familiarity* (novel, familiar) and between-subjects[1] *register* (CDS,ADS) tested mean pitch (Hz). There was a significant main effect of *familiarity*, $F(1, 92) = 18.518$, $p < .0001$; $\eta_p^2 = 0.168$. However, there was no interaction between *register* (CDS, ADS) and *familiarity* (familiar, novel), $F(1, 92) = 1.38$, $p = .244$. Familiar labels were higher

[1] CDS and ADS register were analyzed as between-subjects.

in mean pitch (M = 216.0 Hz; SD = 47.8 Hz) than novel labels (M = 200.1 Hz; SD = 41.9 Hz) with a medium effect size (see fig. 3).

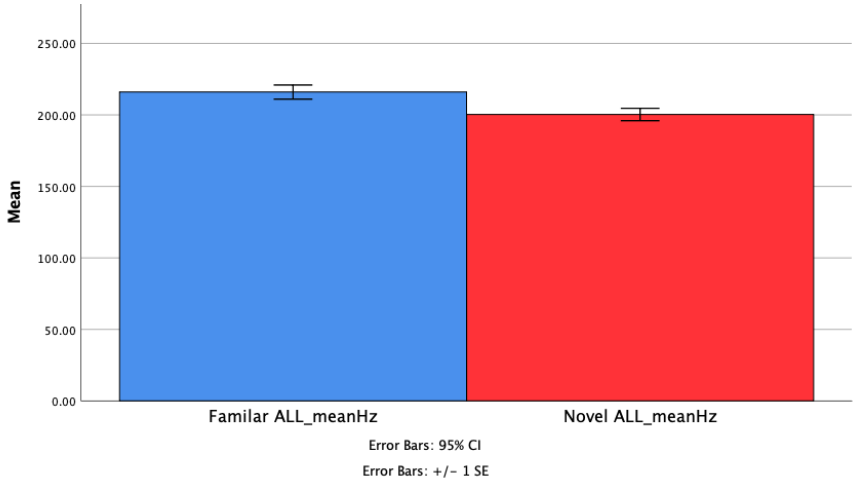

Figure 3. A significant difference in mean pitch (Hz) ($p < .05$) between all familiar and all novel labels in combined CDS/ADS

3.2.1 Pitch range (maximum f_0 - minimum f_0)

In order to determine if pitch range was impacted by familiarity, we used a similar 2x2 ANOVA as with the mean pitch. We analyzed these data using the pitch range (maximum f_0 - minimum f_0) as a dependent variable. There was no significant main effect between *familiarity* (familiar: M = 145.0 Hz; SD = .93.3 Hz and novel: M = 133.3 Hz; SD = .110.8; $F(1,92) = .819$, $p = .368$), nor was there a significant interaction ($F(1,92) = .516$, $p = .474$).

3.3 Utterance Position

Exploring the effects of utterance position and its potential interplay with familiarity on acoustic characteristics of CDS, we first ran a similar repeated measures 2x2x3 ANOVA using *familiarity* (familiar, novel), *utterance position* (initial,medial, final), and *register* (CDS,ADS) on the dependent variable mean pitch (Hz). There was a significant main effect for *familiarity,* $F(1, 88)= 18.472$, $p < .0001$, $\eta_p^2 = 0.173$. Additionally, a marginally significant interaction was found between *familiarity x utterance position* on mean pitch, $F(2, 88)= 2.759$, $p = .069$, $\eta_p^2 = 0.059$, though no interaction between *familiarity* x *utterance*

position x register, F(2, 88)= .156, p = .856, nor between *familiarity* x *register*, F(1,88) = 1.424, p = .236.

To tease apart the *familiarity* x *utterance position* interaction, we split utterance position for each familiar comparison using a pairwise t-test. We found a significant difference between familiar (M = 257.21, SD = 38.08) and novel (M = 230.04, SD = 28.51) labels in initial position (t(31) = 4.079, p<.0001, *d* = .72), a significant difference between familiar (M = 202.41, SD = 32.78) and novel (M = 190.02, SD = 28.90) labels in medial position (t(30) = 2.265, p=.03, *d* = .41), and no significant difference between familiar (M = 187.05, SD = 40.59) and novel (M = 179.6, SD = 48.04) labels in final position (t(30) = 1.142, p = .263) (see fig. 4, appendix D.)

There were no significant differences of pitch range between *familiarity* (familiar, novel) x *utterance position* (initial, medial, final) x and *register* (CDS, ADS). There was no significant main effect of *familiarity*, F(1, 88) = .747, p = .390. There was no significant interaction between *familiarity* x *register*, F(1, 88) = .490, p = .486, no significant interaction between *familiarity* x *utterance* position, F(1, 88) = .118, p = .888, and no significant interaction between *familiarity* x *utterance position* x *register*, F(1, 88) = .232, p = .725.

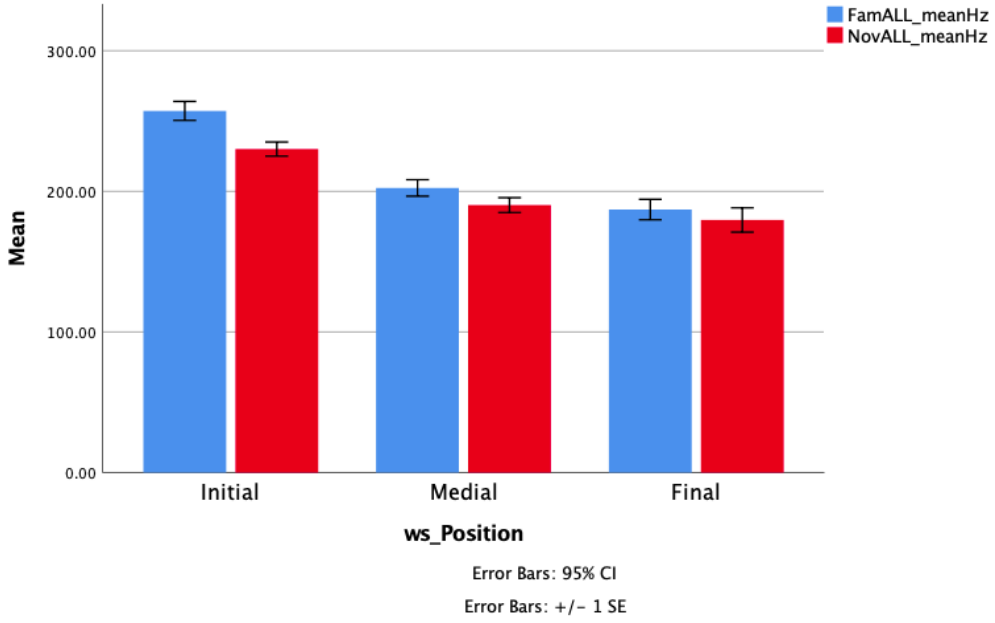

Figure 4. A bar chart showing the differences of mean pitch (Hz) between familiar and novel labels in initial, medial, and final position. Differences in initial and medial positions are significant (p<.05).

3.4 Other Factors

We wanted to rule out certain confounding variables in our results. To do so, we looked at two experimental factors that could have had an influence: the order that the mother experienced the register conditions (CDS first or ADS first) and whether the mother read to themself or to another adult in the ADS condition. The order of register may have influenced outcomes if the CDS condition came first, making it difficult for the mother to switch completely into ADS afterward. Whether the mother read to themself or to another adult in the ADS condition may have had an effect if the mother was unable to produce genuine ADS without a real adult listener present.

3.4.0 Order of register (CDS first or ADS first)

In order to determine if the *order of register* (CDS first, ADS first) had any effect on mean pitch (Hz) in ADS, we ran one-way ANOVA. We found no significant effect of *order of register* on mean pitch, $F(1,45)= 1.755$, $p = .192$. However, a similar one-way ANOVA looking at pitch range in ADS found a significant effect of *register condition order* in ADS, $F(1, 45)= 10.901$, $p = .002$, $\eta_p^2 .195$. Pitch range was higher for CDS first participants ($M = 157.81$, $SD = 86.39$) than ADS first participants ($M = 82.63$, $SD = 54.34$) in the CDS condition. It should be noted that there is an unbalanced number of participants between CDS ($n = 10$) and ADS first ($n = 6$). This factor was counterbalanced in the larger study, but not for the participants for the familiar-novel pairs chosen for our analyses. Therefore, further investigation would be needed to properly determine the effect of *register condition order*.

3.4.1 Read to Self vs. Read to Adult

Another 2x2 ANOVA was used to investigate the impact, or lack thereof, of whether the mother read to themself or to another adult in the ADS condition. There was a main effect of *read to self vs. read to adult* on mean pitch, $F(1, 42)= 5.124$, $p =.029$, $\eta_p^2 = .109$. However, there was no significant interaction between who they read to and mean pitch, $F(1, 42)= .842$, $p = .364$ (see figure 5.). As for pitch range, a 2x2

ANOVA determined that there was no significant main effect on *familiarity*, F(1, 42)= .001, p = .981, and no significant interaction between *familiarity* x *read to self vs. read to adult*, F(1, 42)= .827, p = .368.

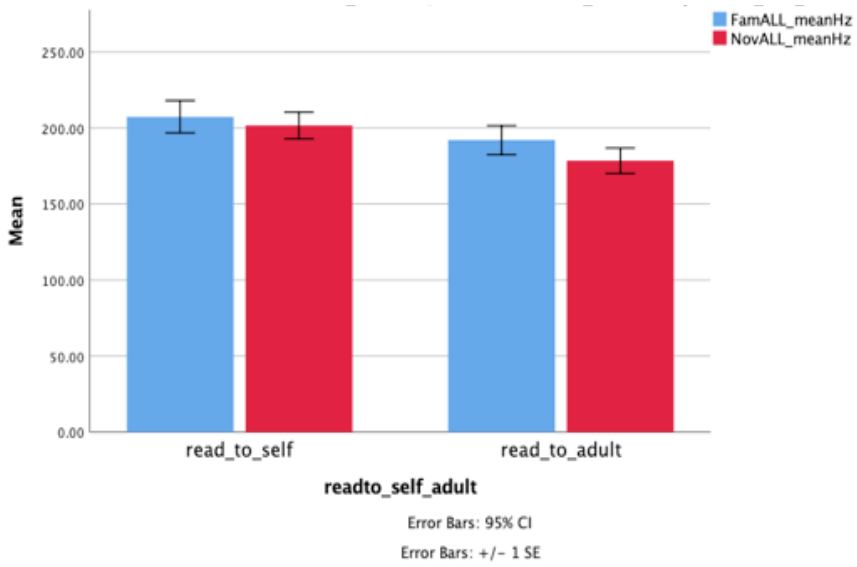

Figure 5. A bar chart showing mean pitch (Hz) differences between familiar and novel labels when mothers read to themselves and read to another adult (both registers).

SECTION IV. DISCUSSION

The most important findings of this study were that familiar labels had significantly higher mean pitch than familiar labels and this difference had a significant interaction with utterance position in initial and medial position, but not final. To our surprise, these effects were not CDS- specific, as there were no significant interactions with register. Also, there appeared to be no significant effect of familiarity and/or utterance position on pitch range.

Hypothesis 1 predicted that all target words (familiar and novel labels) would show higher pitch and wider pitch range in CDS versus ADS. We found that mean pitch was significantly higher in CDS than in ADS, as predicted by previous literature. However, there was no significant difference of pitch range between the registers. This was surprising seeing as wider pitch range than ADS is a fairly widely attested characteristic of CDS (Fernald et al.,1989). As for the lack of differences between registers, this could be a result of the nature of the stimuli. The sentences on the 'story cards' tell a childlike story in a childlike manner. It is difficult to produce childlike content without using any CDS characteristics. It is also important to remember that mothers have British English dialects. The larger study by Archer, Tsang, Duffy, & Kita (In progress) is investigating cross-dialectal differences in CDS, based on the hypothesis that British English CDS may be less exaggerated than dialects of North American English, specifically Canadian English. Much of previous research on this subject focuses on American English, but there can be significant cross-dialectal and cross-linguistic variance in CDS. Floccia et al. (2016) found evidence suggesting that British English-learning infants (exposed to British English CDS) may develop the ability to segment unfamiliar words from speech later than infants exposed to American English CDS. Studies investigating cross-dialectal differences of CDS characteristics have found that, compared to British English CDS, American English CDS shows more extreme prosodic differences between target words and other utterance information, more target words appearing in utterance-final position, and significantly greater pitch variation (DePaolis, Keren-Portnoy, & Vihman, 2010; White, 2012). Therefore, it is possible that these results are contrary to previous findings because British English CDS characteristics differ from those

of American English CDS in terms of the factors investigated in this study. Though, further research is needed to establish how these differences would affect familiarity and utterance position effects.

Our second hypothesis predicted that novel labels would have higher pitch and wider pitch range in CDS, but not in ADS. Contra expectations, this study found that mean pitch was higher and pitch range was wider for familiar labels than novel labels, but this effect was only significant for mean pitch. Furthermore, this effect was observed in both CDS and ADS, as there was no significant interaction between familiarity and register. We expected that ADS would have relatively the same production for both familiarities if acoustic characteristics that set CDS apart from ADS were a product of didactic intent. Unexpected results pertaining to familiarity may be due to the nature of the novel labels. It is possible that the mothers acknowledged that labels 'nambee' and 'jidam', though definitely novel, will never be of use to their child after the procedure. 'Monkey' and 'chicken', on the other hand, will be useful for their child for the rest of their life. Therefore, the mothers may not have given the novel labels the kind of acoustic modifications typically assigned in CDS because they didn't feel it was important for their child to learn them. Had the novel labels been real labels that the child was unfamiliar with, perhaps results would have been in accordance with previous findings. As long as the mother judges that the labels are unfamiliar to their child *and* that the label is of value to teach to their child, they should produce it as such. If this really is the case, results may actually be showing effects of labels that mothers find important to their child versus labels that are of no use for their child to know. Additionally, we must acknowledge that not all differences between the familiar and novel labels may be a product of the speaker's judgments on the listener's familiarity with the label. Perhaps the mothers' own familiarity with the labels also impacted their productions. Even though the mothers had been 'familiarized' with the novel creature-label associations through the background information on the 'info cards' and the novel labels are *more* familiar to them than to their children, the novel labels are still quite new to the mothers. Research has shown that words that are novel to speakers have longer duration and higher pitch than familiar words in ADS (Brown, 1983). Thus, we cannot ignore that the novelty of the novel labels to the mothers themselves may have impacted production. Also, in the ADS condition, the mothers who read to a researcher may have produced the novel labels differently

because they knew that the researcher knew the novel labels. If there is any modification due to didactic intent in ADS for novel labels, mothers likely would not have made use of it to the very people who taught them the labels.

Focusing on utterance position, hypothesis 3a predicted that the familiarity of labels would affect the acoustic characteristics of label production in different utterance positions in CDS, but not ADS. Only a marginally significant interaction of mean pitch was found between utterance position and familiarity. Teasing this apart, we found a significant difference of mean pitch between familiar and novel labels for initial and medial position, but not for final. There was no significant evidence that there was any effect on pitch range. Initial tokens had the highest mean pitch, followed by medial, and then final (see appendix D.). This was true in both CDS and ADS and is in line with normal pitch declination found in declarative English sentences, where pitch falls gradually across the utterance (Cooper & Sorensen, 1981). The mothers appear to have adhered to regular constraints on pitch regarding utterance position. Furthermore, hypothesis 3b stated that the effect of familiarity in CDS will be on boundary positions (initial and/or final), but not medial. This was partially supported in that familiarity showed a significant difference of mean pitch in initial position, possibly subjecting the labels to boundary strengthening effects, but there was no difference in final position. To our surprise, medial position, a non-boundary position, also showed a significant difference of mean pitch between familiar and novel labels. Aslin (1993) found that mothers take advantage of boundary strengthening effects of initial and final position, making them more salient positions. Therefore, we thought that novel labels would perhaps be produced differently in these positions if mothers were trying to teach them to their children versus familiar labels. It is especially surprising that the only position not affected was final position, seeing as previous research found that target words tend to be placed in final position in CDS (Fernald & Mazzie, 1991). Further, the lack of interaction with register suggests that these effects are not CDS-specific. These results are still of interest because the interaction between familiarity and initial position may mean that mothers modify the production of labels as a means of focusing novel words in certain utterance positions. However, this does not depend on whether speech is directed toward a child or another adult.

We must also acknowledge that certain methodological decisions may have impacted results. Firstly, although read to self versus read to adult in ADS was ruled out as being major factor in results, we did find a significant effect of order of condition on pitch range (but not mean pitch). This may explain why we did not find any other significant results for pitch range, even at the level of CDS-ADS differences. We must bear in mind that there was an effect of a confounding variable on one of our acoustic measures, even if data were unbalanced. Also, we did not look at how the order of utterance position may impact label production. For all creatures, the first sentence read from the 'story cards' had the target word in utterance initial position. It is possible that the first mention of the creature may be different, possibly more exaggerated, than subsequent mentions. Since the target word was never mentioned first in medial or final position, we cannot be sure what effect this would have. Fernald and Mazzie (1991) found that mothers prosodically exaggerated target words even upon second mention, but these results were from spontaneous speech and the effect on third and subsequent mentions were not described.

Regarding analysis, we only analyzed the target word, not the rest of the utterances. Pitch was not analyzed related to other words in the utterances, only to other target words. We do not know how much prosodic emphasis was given to the label versus other words. Looking at the stimuli, there were many words that could have potentially been given prosodic focus other than the target words, especially in final and medial position sentences. Therefore, it is possible that on some occasions, prosodic emphasis was given not to the target word, but to another word in the utterance. Given the time, we would have looked at this further for each sentence. However, for the sentence stimuli, we have indicated other words that could have been prosodically focused over the target word (see Appendix A). Also due to time constraints, we were unable to fix unusual pitch segments found in chicken/jidam tokens, so these tokens were included in analyses. Chicken/jidam seems to have elicited creaky voice in a lot of participants, especially in final position, leading to some very low pitch measures. Because the lower threshold for pitch was set at 75 Hz on Praat, pitch correlates below that were shown as being extremely high instead. Therefore, these tokens have unusually high maximum pitch (in the ~600-900 Hz range) and this would also effect mean pitch and pitch range. We did not have the time to go through all chicken/jidam tokens in Praat with a lower pitch

threshold, but we acknowledge that this affects our results.

In general, our results do not support that acoustic characteristics of CDS are a result of didactic intent, as our measures (mean pitch and pitch range) did not seem to change only in CDS when target words are novel and/or when they are in more salient positions. Instead, it is possible that the mean pitch and pitch range characteristics of CDS are a product of trying to elicit and maintain attention or positive affect. However, this does not necessarily rule out that other acoustic characteristics of CDS are a product of didactic intent. Based on comparing CDS to other registers such as pet-directed speech and foreigner-directed speech, there is evidence that hyperticulation of vowels found in CDS may be due to didactic intent, but not pitch (Burnham, Kitamura & Vollmer-Conna, 2002; Uther, Knoll & Burnham, 2007). We should also not rule out that some acoustic-prosodic modifications in CDS may be a product of didactic intent to children of other ages. It is possible that children of this age have different preferences and/or rely on different cues than younger children and mothers modify their CDS accordingly. Therefore, the results found in this study are only generalizable to children of 18 to 25 months of age.

SECTION V. CONCLUSION

Overall, our results support that how familiar the listener is with a label and the position of the label within the utterance may impact mean pitch (Hz) in production of that label. However, these effects were found to be present in both registers (CDS and ADS). Familiar labels were found to be significantly higher in mean pitch than novel labels and this effect interacted with utterance position in initial and medial position. Certain methodological decisions may be the reason for lack of register differences, lack of significant pitch range results, and unexpected mean pitch differences between familiar and novel labels. Further research is needed to determine the exact role of familiarity and utterance position on acoustic modifications of labels in CDS. In the future, studies should continue to investigate the interaction of these factors in non-spontaneous CDS, but with better controlled methods and analyses. Further, future research should be conducted in other dialects and languages, on other ages of children, and for other measures, to fully understand the scope of CDS. In conclusion, the present study's results support that the acoustic-prosodic characteristics of CDS are not a product of didactic intent.

REFERENCES

Aslin, R. N. (1993). Segmentation of fluent speech into words: Learning models and the role of maternal input. In Developmental neurocognition: Speech and face processing in the first year of life (pp. 305-315). Springer, Dordrecht.

Archer, S. Tsang, C., Duffy, H. & Kita, S., (In progress). Cross-cultural differences in the production of child directed speech.

Benders, T. (2013). Mommy is only happy! Dutch mothers' realisation of speech sounds in infant-directed speech expresses emotion, not didactic intent. *Infant Behavior and Development*, 36(4), 847-862.

Bock, J. K., & Mazzella, J. R. (1983). Intonational marking of given and new information: Some consequences for comprehension. *Memory & Cognition*, 11(1), 64-76.

Boersma, Paul & Weenink, David (2019). Praat: doing phonetics by computer [Computer program]. Version 6.0.50, retrieved 31 March 2019 from http://www.praat.org/

Brown, G. (1983). Prosodic structure and the given/new distinction. In *Prosody: Models and measurements* (pp. 67-77). Springer, Berlin, Heidelberg.

Burnham, D., Kitamura, C., & Vollmer-Conna, U. (2002). What's new, pussycat? On talking to babies and animals. *Science*, 296(5572), 1435-1435.

Cooper, W. E., & Sorensen, J. M. (1981). Fundamental frequency in sentence production. New York: Springer-Verlag.

Cooper, R. P., & Aslin, R. N. (1990). Preference for infant‐directed speech in the first month after birth. *Child development*, 61(5), 1584-1595.

DePaolis, R. A., Keren-Portnoy, T., & Vihman, M. M. (2010). A comparison of US and UK kids. In Talk presented at Child Phonology conference, Memphis.

Eady, S. J., & Cooper, W. E. (1986). Speech intonation and focus location in matched statements and questions. *The Journal of the Acoustical Society of America*, 80(2), 402-415.

Fernald, A. (1985). Four-month-old infants prefer to listen to motherese. *Infant behavior and development*, 8(2), 181-195.

Fernald, A., Taeschner, T., Dunn, J., Papousek, M., de Boysson-Bardies, B., & Fukui, I. (1989). A cross-language study of prosodic modifications in mothers' and fathers' speech to preverbal infants. *Journal of child language*, *16*(3), 477-501.

Fernald, A., & Mazzie, C. (1991). Prosody and focus in speech to infants and adults. *Developmental psychology*, 27(2), 209.

Floccia, C., Keren-Portnoy, T., DePaolis, R., Duffy, H., Delle Luche, C., Durrant, S. & Vihman, M. (2016). British English infants segment words only with exaggerated infant-directed speech stimuli. *Cognition*, 148, 1-9.

Graf Estes, K., & Hurley, K. (2013). Infant‐directed prosody helps infants map sounds to meanings. *Infancy*, 18(5), 797-824.

IBM Corp. Released 2019. IBM SPSS Statistics for Macintosh, Version 25.0. Armonk, NY: IBM Corp.

Jusczyk, P. W., & Aslin, R. N. (1995). Infants′ detection of the sound patterns of words in fluent speech. Cognitive psychology, 29(1), 1-23.

Kondaurova, M. V., & Bergeson, T. R. (2011). The effects of age and infant hearing status on maternal use of prosodic cues for clause boundaries in speech. *Journal of Speech, Language, and Hearing Research*.

Ma, W., Golinkoff, R. M., Houston, D. M., & Hirsh-Pasek, K. (2011). Word learning in infant-and adult-directed speech. *Language Learning and Development*, 7(3), 185-201.

Nazzi, T., & Bertoncini, J. (2003). Before and after the vocabulary spurt: Two modes of word acquisition?. *Developmental Science*, 6(2), 136-142.

Newman, R. S., & Hussain, I. (2006). Changes in preference for infant‐directed speech in low and moderate noise by 4.5‐to 13‐month‐olds. *Infancy*, 10(1), 61-76.

Song, J. Y., Demuth, K., & Morgan, J. (2010). Effects of the acoustic properties of infant-directed speech on infant word recognition. *The Journal of the Acoustical Society of America*, 128(1), 389-400.

Uther, M., Knoll, M. A., & Burnham, D. (2007). Do you speak E-NG-LI-SH? A comparison of foreigner-and infant-directed speech. *Speech communication*, 49(1), 2-7.

Wang, Y., Seidl, A., & Cristia, A. (2015). Acoustic-phonetic differences between infant-and adult-directed speech: the role of stress and utterance position. *Journal of child language*,*42*(4), 821-842.

Werker, J. F., Pegg, J. E., & McLeod, P. J. (1994). A cross-language investigation of infant preference for infant-directed communication. *Infant Behavior and Development*, 17(3), 323-333.

White, L. (2012). American vs. British infant-directed speech: Cultural differences and developmental consequences (Unpublished MA thesis). University of York, UK.

APPENDICES

APPENDIX A. The six sentences read from the 'story cards' of each creature and words other than the target word (the creature label) within each sentence that could possibly have been prosodically focused.

Creature	**Sentence Number and Target Word Position**	**Sentence: Target Word and other potentially focused words**
Monkey	Sentence 1 (initial)	The monkey loved to explore the jungle branches.
	Sentence 2 (final)	One day, a small horse walked up to the curious monkey.
	Sentence 3 (initial)	The monkey was excited to meet a new donkey friend.
	Sentence 4 (final)	"Where did you come from?", asked the monkey.
	Sentence 5 (initial)	The monkey thought the donkey had come a long way and must be hungry.
	Sentence 6 (medial)	Climbing up a nearby tree, the helpful monkey gathered some bananas for his new friend.
Nambee	Sentence 1(initial)	The nambee loved to explore the jungle branches.
	Sentence 2 (medial)	One day, the friendly nambee met an old friend.
	Sentence 3 (initial)	The nambee was happy to chat with his donkey chum.
	Sentence 4 (medial)	He had been on a long journey and told the nambee all about it.
	Sentence 5 (final)	"Where did you come from?", asked the nambee.
	Sentence 6 (final)	The friends talked and laughed until the donkey went to sleep- as well as the tired nambee.
Chicken	Sentence 1 (initial)	A chicken lives on a big farm near the river.
	Sentence 2 (medial)	One day, this chicken went for a walk to meet her friends.
	Sentence 3 (final)	A cow and sheep were playing and called to the chicken.
	Sentence 4 (medial)	The cow told the chicken that she was her favourite friend and gave her a sticker as a gift.
	Sentence 5 (initial)	The chicken was so happy that she took her sticker back to her coop.
	Sentence 6 (final)	When the sun went down and she was tucked into bed, there slept a very contented chicken.

Jidam	Sentence 1 (initial)	The jidam lives on a big farm near the river.
	Sentence 2 (medial)	One cloudy day, this jidam went to meet his friends.
	Sentence 3 (final)	The horse and pig laughed and joked with the jidam.
	Sentence 4 (medial)	The pig gave the jidam a sticker for winning the best joke.
	Sentence 5 (initial)	The jidam was very proud and took his sticker back to his house.
	Sentence 6 (final)	That evening, nestled into bed and under the blankets, slept a very delighted jidam.

APPENDIX B. Descriptives

Table B1. Descriptives for all tokens split by register for mean pitch and pitch range.

Register	Measure	N	Mean (Hz)	Standard Deviation
CDS	Mean Pitch (Hz)	48	218.26	35.33
	Pitch Range (Hz)	48	148.56	81.83
ADS	Mean Pitch (Hz)	47	197.28	44.49
	Pitch Range (Hz)	47	129.02	83.69

Table B2. Descriptives for all tokens split by familiarity for mean pitch and pitch range.

Familiarity	N	Mean (Hz)	Standard Deviation
Familiar	94	216.00	47.82
	94	145.00	93.33
Novel	95	200.10	41.93
	95	133.32	110.77

Table B3. Descriptives for initial position for mean pitch (Hz) and pitch range (Hz) for all tokens split by familiarity and utterance position.

Familiarity	Measure	N	Mean (Hz)	Standard Deviation
Familiar	Mean Pitch (Hz)	32	257.21	38.08
	Pitch Range (Hz)	32	134.82	70.88
Novel	Mean Pitch (Hz)	32	230.04	28.51
	Pitch Range (Hz)	32	118.19	75.49

Table B4. Descriptives for medial position for mean pitch (Hz) and pitch range (Hz) for all tokens split by familiarity and utterance position.

Familiarity	Measure	N	Mean (Hz)	Standard Deviation
Familiar	Mean Pitch (Hz)	31	202.41	32.78
	Pitch Range (Hz)	31	120.83	80.84
Novel	Mean Pitch (Hz)	32	190.02	28.90
	Pitch Range (Hz)	32	117.69	100.77

Table B5. Descriptives for final position for mean pitch (Hz) and pitch range (Hz) for all tokens split by familiarity and utterance position.

Familiarity	Measure	N	Mean (Hz)	Standard Deviation
Familiar	Mean Pitch (Hz)	31	187.05	40.59
	Pitch Range (Hz)	31	179.68	115.40
Novel	Mean Pitch (Hz)	31	179.60	48.04
	Pitch Range (Hz)	31	165.06	143.24

Table B6. Descriptive statistics for order of register condition (CDS first vs. ADS first) in the ADS condition**.**

Order of Register Condition	Measure	N	Mean (Hz)	Standard Deviation
CDS First	Mean Pitch (Hz)	29	204.00	47.84
	Pitch Range (Hz)	29	157.81	86.39
ADS First	Mean Pitch (Hz)	18	186.46	37.21
	Pitch Range (Hz)	18	82.63	54.34

APPENDIX C. Descriptive statistics for utterance position and familiarity.

Table C1. Descriptives for tokens where adults read to themselves during ADS condition.

Measure	Familiarity	N	Mean (Hz)	Standard Deviation
Mean Hz	Familiar	27	207.38	55.14
	Novel	27	201.64	45.72
Pitch Range	Familiar	27	145.24	91.58
	Novel	27	164.86	146.26

Table C2. Descriptives for tokens where adults read to another adult during ADS condition.

Measure	Familiarity	N	Mean (Hz)	Standard Deviation
Mean Hz	Familiar	17	192.02	39.36
	Novel	17	178.45	34.64
Pitch Range	Familiar	17	100.24	79.68
	Novel	17	81.64	63.44