DIFFERENCES IN ADULT SPEECH: DOES BOY-DIRECTED AND GIRL-DIRECTED SPEECH EXIST

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ABSTRACT

It has been demonstrated that boys and girls speak differently on a phonetic level; however, the question of whether this is directly a result of the input they receive from adults is yet to be determined. The current study aims to explore potential differences in how adults speak to boy versus girl children. Forty university students participated in a speech production study in which they were asked to read a short passage to different gendered images of babies. Acoustic analysis was conducted on their recorded speech, with measures including the centroid frequency of the sound /s/, as well as f0 and intensity of the read passages. No robust differences were found in any of the acoustic parameters examined, suggesting that the ways adults converse with boy versus girl babies may not be substantially different.

Keywords: gendered speech production, acoustics, phonetics

1. INTRODUCTION

Speech production between males and females has been shown to differ in several aspects, resulting in gendered patterns in adult speech. Differences exist in the distinct stylistic choices that males and females use in speech such that females tend to use more affiliative speech and less assertive speech [1] and use more intensifiers on average [2] than men. In addition, women are more tentative (more uncertain) when discussing stereotypically masculine topics in intergroup contexts and vice versa [3]. Further, females tend to have a higher pitched and breathier voice [4, 5], greater speech intelligibility [6] and larger acoustic vowel space size than men [7]. Moreover, females have been found to produce clearer speech [8] which is exemplified through making greater vowel acoustic changes such as hyperarticulated vowels [9] and have a slower articulation rate compared to males [10]. A large part of these differences are due to anatomical differences which include males having a longer vocal tract [4] and having larger and thicker vocal folds than women, resulting in a lower pitch in males [7]. In addition, adult females were shown to produce a more anterior variant of /s/ [11] and longer closure time for stop consonants than males in German [12] and some varieties of English [13, 14]. In Contrast, males have longer closure time for aspirated consonants in Korean [15].

Similar gendered patterns have also been observed in the speech of young English-speaking children. Children have been shown to speak with distinctive speech styles depending on their gender in various languages [16, 17] and that boys and girls have different average pitch values [18]. Further, girls aged 6-14 showed longer closure time for stop consonants [14] as well as a more anterior variant of /s/ than same aged boys [11] in English. However, boys have a longer closure time for aspirated consonants than girls in Korean [19].

One potential mechanism that may account for the early emergence of gendered speech in children is through role modelling or imitation of the same-sex adults in their environment. As mentioned previously, men and women exhibit different ranges of pitch which children are able to recognize and imitate. According to [20], when imitating different genders, both boys and girls, aged 6-10 years old, raised their pitch for females and lowered their pitch for males. Importantly, adults were shown to be able to identify the gender of children as young as 2.5 years of age above chance based on the child's speech [21]. The fact that gender-specific speech patterns can be detected before puberty suggests that gendered speech is not solely due to sex dimorphism, and instead is learned through social learning such as role modelling or imitation [22].

Another possible mechanism contributing to these gendered differences in children's speech may be due to different input that they receive depending on their gender. That is, adults may alter their speech based on the sex of the child they are speaking to. Adults have been shown to accommodate their conversational partners to facilitate speech communication with people of varying gender [23], age [24], attractiveness [25] and language background [26]. In particular, they modify their speech style when addressing young children, such as using shorter and simpler words and speaking with a clearer and higher pitch as compared to their speech to other adults [27].

Moreover, the type and style of conversations of mothers and fathers varies based on their child's gender [28]. Mothers talk to their daughters more than their sons [29] as well as ask more questions to their daughters than their sons [30]. Further, adults utilize different types of words with male versus female children. For example, parents use more spatial words (describing the size, shape and spatial properties of spaces and objects) when talking to boys than when talking to girls [31].

With specific regard to phonetic details of individual speech sounds that adults produce when speaking to children, evidence is sparse. One notable study is Foulkes and Docherty's study [32]. This study found differences in /t/ production in mothers when speaking to boys or girls. More specifically, they discovered that mothers of boys equally used standard (plain) and nonstandard (laryngealized) variants of /t/ in word-medial position whereas mothers of girls used plain [t] twice as frequently as the laryngealized form in word-medial positions in their speech [32]. That is, mothers use the standard production of /t/ more frequently with their daughters than with their sons. Although Foulkes and Docherty [32] were able to find this gender specific speaking pattern in mothers, other evidence surrounding these patterns in relation to phonetic level differences is lacking. Thus, it still remains a question as to whether differences in input between boys and girls at a phonetic level are a true mechanism of the emergence of gendered speech patterns that emerge in childhood.

The purpose of the current study seeks to further investigate whether adults alter their speech depending on whether they are conversing with boy or girl children. Specifically, this study aims to examine the phonetic details in adult speech focusing on their voice characteristics and the sound of /s/, the two aspects of speech that young children have shown early gender-specific patterns.

2. METHODS

2.1. Study design

University students (N = 40, Females = 26) were recruited through the Psychology subject pool to participate in a speech production study. Participants were asked to read the shortened version of "The North Wind and the Sun" passage [33] to photos of babies of different genders aged one to two years old. The photos were edited such that pairs of baby girls and boys shared the same face to eliminate any confounds of facial features. There are a total of three sets of baby photos (n = 6) presented in randomized order to each participant. Participants were given a scenario in which they imagined themselves as a volunteer at a fictional dayhome and were asked to read passages to the babies at that dayhome.

During the task, each baby was introduced by a name that clearly indicated their gender as well as a sentence describing their gendered play behaviour. For example, "This is Sophia, she really likes to play with dolls." Participants were then asked to greet each baby by name and read them the passage from an illustrated booklet. Their speech was recorded for later acoustic analysis. Finally, participants filled out two questionnaires, one of which assessed basic demographic information and experience with children. The other questionnaire used in [34] was adopted to gather information on participants' communication and interaction style with children.

It should be noted that similar studies were conducted using photos of older-aged children; however, for the purpose of this paper, only the results of the babies will be reported.

2.2. Procedure analyses

Speech data from the 40 participants was analyzed using Praat [35]. Three acoustic parameters were measured: the centroid frequency of the sound /s/ in 9 tokens that began with /s/, the average f0 and the intensity. Each instance of /s/ in word initial position included in the passage was annotated and centroid frequency (m1, the first spectral moment in moments analysis, [36]) values of the /s/ snippet were calculated from the middle 40-ms window extracted from the frication portion of the /s/ sound. In addition, average f0 and RMS intensity of the reading passages as well as the greetings were also measured. It is to be noted that some adults produce /s/ with a [ʃ] variant in words such as "stronger", and those instances were eliminated from further analysis.

3. RESULTS

Analysis of the m1 values of /s/ were performed with a mixed effects Bayesian model using the "brms" package in R [37]. This model estimates the probability of m1 differences when individual adults are addressing male or female babies where the dependent variable is the m1 values, and the fixed effects are speaker gender (male vs. female), baby gender (male vs. female), the interaction between baby gender and speaker gender and presentation order of the photos (1st to 6th presentation).

The model in the analysis has random slopes for baby gender and presentation order that vary with individual speakers, as well as random slopes for speaker gender and baby gender that vary with individual words. The model also has a random

intercept of face ID (baby faces 1-3), participant ID and individual words.

(1) brm(m1 ~ babyGender * speakerGender + babyPresOrder + (1+babyPresOrder+babyGender|ParticipantID) + (1|faceID) + (1+babyGender+speakerGender|word)

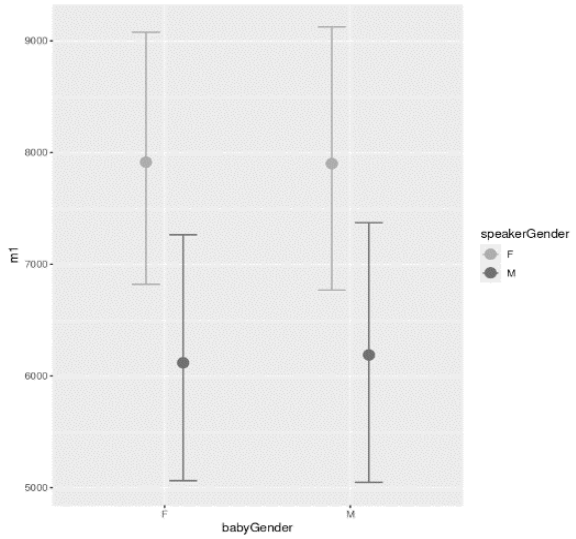

Figure 1: Conditional effects plot from the mixed effects Bayesian model output which reflects m1 values for male and female speakers when they are addressing either male or female babies.

This model ran using 4 chains and 2000 iterations. It converged well with all R^s equalling 1.00. A posterior predictive check (pp_check) was assessed as well, which showed that the model fits well with the data (figure 2).

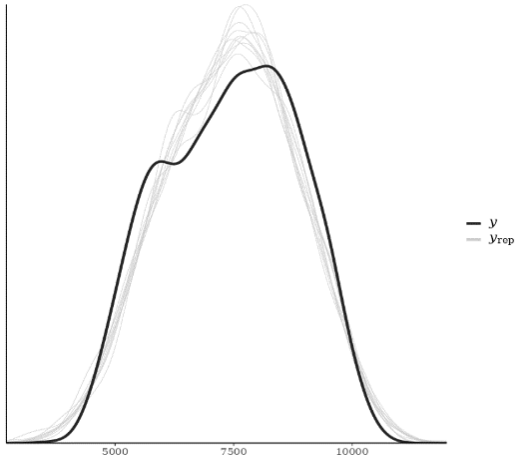

Figure 2. A posterior predictive check of the model where the light grey line represents predicted data, and the dark grey line indicates actual data. M1 values are represented on the x axis.

Population level effects are reported in table 1 which show that baby gender was not significant (-15.04, 95% CI: -353.31, 394.14). Significance is determined in Bayesian statistics through the credible intervals. When the upper and lower credible intervals are either both positive or both negative (i.e. do not cross zero), then the variable in the model is said to be significant [38]. Speaker gender was the only significant factor in this model as the credible intervals do not cross zero. Similar Bayesian models (4 chains, 2000 iterations) were constructed to analyze pitch and intensity of each greeting and passage respectively, in which all R^s converged at less than 1.02. Results did not meet significance for passage pitch (-0.30, 95% CI: -1.20, 0.59) or passage intensity (-0.02, 95% CI: -.017, 0.12) when examining the effect of baby gender. However, baby gender was significant for greeting pitch (5.90, 95% CI: 0.68, 11.09) and greeting intensity (0.84, 95% CI: 0.27, 1.41), suggesting that there may be a difference in how adults greet male babies versus female babies. Despite this significance, the effect size is small and therefore is not substantial evidence for concretely saying adults speak to male versus female babies differently.

Parameter	Estimate	Est. error	Lower 95% CI	Upper 95% CI
Intercept	7940.23	545.57	6842.33	9097.02
Baby gender (M)	-15.04	182.12	-353.31	394.14
Speaker gender (M)	-1799.08	306.97	-2384.12	-1187.98
Presentation order	-3.65	9.96	-23.36	15.46
Interaction	81.62	70.41	-53.24	219.13

Table 1: Population level effects of the current model that assessed baby gender, speaker gender, the interaction between speaker gender and baby gender and presentation order.

4. Discussion

The current study aims to investigate whether adults speak differently to boy babies than they do to girl babies, and whether those differences, if they exist, could be detected at a phonetic level. The results of this study show no robust differences in the acoustic parameters measured in adult speech to babies. Several elements in the current study may provide an explanation for this outcome. First, the repetition within the study may have induced a fatigue effect that could have diminished any results, had there been any evidence in the acoustic recordings. Second, the study was not conducted in a naturalistic environment with adults interacting with real babies. Due to the recent pandemic, we were not able to recruit parent and baby participants and conduct testing in their homes. The alternative design of reading to baby photos in a lab setting is not an authentic interaction. The artificial interaction with children may have prevented us from finding the potential gendered differences in adult speech when they address babies of different genders.

Similar findings were reported by a recent study [29] that compared the ways of word and utterance use in which mothers and fathers talked to babies aged 6-18 months old in their homes. They found no difference in the use of noun type, noun token, and utterance type when examining the speech produced by mothers and fathers when speaking to boys versus girls. These findings collectively suggest that adults may not produce sounds and words in substantially different ways when speaking to baby boys versus. baby girls. It remains a possibility that such input differences could occur later in a child's development after they become a true conversational partner. Ongoing research in our lab is currently testing this hypothesis.

5. Conclusion

Multiple mechanisms may exist for the emergence of gendered speech patterns in childhood. This study aimed to explore one such mechanism, namely, whether there are any input differences at the phonetic level when adults address children of different genders. That is, whether girl-directed vs. boy-directed speech exists. Although no substantial support for this stance has been found in the current study, further research is ongoing to investigate the extent to which adults may modify their speech depending on a child's gender. Thus far, there is inconclusive evidence suggesting phonetic differences in speech when adults address boy vs girl children. Further investigation surrounding this topic would be beneficial to allow for more definitive conclusions.

6. References

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