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ARTICLE

Revisiting frequencies of phonological sound classes in speech input: Change over time in child-directed speech

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Abstract

The purpose of the current study was to revisit a controversial topic: whether frequencies of phonological consonant and vowel classes differ in speech directed to children and to adults. In addition, the current study investigated whether the frequency of phonological consonant and vowel classes changes with children's increasing chronological and/or developmental age. This study analyzed speech input from 44 adults to four different age groups of listeners (i.e., three groups of children at 6, 18, and 36 months of age and one group of adult listeners) in terms of frequency of occurrence of consonant and vowel classes. Results revealed that consonant stop, nasal, fricative and glide manner classes as well as all four consonant place classes were significantly different in speech directed to the four different age groups. A perspective is discussed to better understand the nature of frequency input of phonological sound classes.

Keywords: child-directed speech; frequency of phonological sound classes; frequency of speech input

Introduction

Investigation of speech input to children has continued to receive research attention for both theoretical and applied reasons. The role of 'nature - nurture' in child development has been of great interest to theories of language acquisition (Keating, 2011). This question is often evaluated in terms of how much of language skill is innately specified compared with conceptualizations of language learning through child motor maturation and perceptually based ambient language exposure. Thus, investigation of speech and language input has been used as an important tool to parse the roles of 'nature' and 'nurture.' Investigation of speech register is also necessary because it supports understanding of applied questions; how can child language teachers and speech-language pathology practitioners intervene effectively with children whose language development is not appropriate to their chronological age expectations to support improvement in their speech and language skills. Understanding of the role of speech and language input

can enable practitioners to tailor appropriate input to optimize children's language development toward developmental age expectations.

Contemporary research suggests that the frequency of segments or phonological sound classes in speech input is a significant aspect of child speech development (e.g., Ingram, 1989; Stokes & Wong, 2002; Tsurutani, 2007; Van Severen et al., 2013). In perception studies, infants and young children have been shown to use statistical learning strategies to extract segmental patterns from speech input occurring in their ambient language (e.g., Saffran et al., 1996). In production studies, Japanese- and Korean-learning children produced higher frequencies of dorsal than coronal stops, consistent with the higher frequencies of dorsal than coronal stops in the Japanese and Korean languages, respectively (Beckman et al., 2003; Lee et al., 2010). Although previous researchers commonly assumed that speech input frequency might affect children's perception and production development, the nature of the frequency of phonological sound classes in speech input has not been fully examined.

Differences in frequencies of phonological sound classes between speech registers

Two opposite findings have been reported among the few studies examining the frequency of phonological sound classes in speech input. Lee et al. (2008) examined the frequency of phonological sound classes of speech input to Korean children. Data were analyzed in terms of phonological manner and place classes. In Korean (Hur, 1985), the stop class consists of three bilabial plosives (/p, p', p^h/), three alveolar plosives (/t, t', t^h/), and three velar plosives (/k, k', k^h/). The affricate class also comprises three phonemes (/tʃ, tʃ', $tʃ^h$/). The three-way distinctions called lenis, fortis, and aspirated are unique aspects of Korean stops and affricates. Unlike stops and affricates, the fricative class includes only lenis and fortis (/s, s'/) and glottal /h/. Sonorant sounds include lateral /l/, glide (/w, j/), and three nasals (/m, n, ŋ). Similar to English, the velar nasal is only permitted at the coda position. Consonant place classes are labial (/ m p p' p^h w/), coronal (/n t t' t^h s' s j r l tʃ, tʃ', $tʃ^h$/), dorsal (/ŋ k k' k^h/), and glottal (/h/). The seven Korean monophthongal vowels were analyzed in terms of vowel height and front/back dimensions including high-front (/i/), mid-front (/e/ or /ɛ/), high-central (/ɨ/), mid-central (/ʌ/), low-central (/a/), high-back (/u/), and mid-back vowel (/o/).

Lee et al. (2008) found that the frequency of consonant and vowel sound classes was significantly different between speech to adults (hereafter, adult-directed speech, ADS) and speech to infants (hereafter, infant-directed speech, IDS). It should be noted that IDS is also termed speech to children (CDS) in the available literature. Thus, IDS or CDS are considered as the same throughout; terminology is reported consistent within each study addressed here.

Lee and Davis (2010) replicated their methodology with English IDS in order to evaluate whether Korean patterns are universal or language-specific relative to English language findings. Lee and Davis (2010) collected data from 20 participants (10 ADS and 10 IDS participants). Participants were asked to speak to either their 12-month-old child or another adult for 20 minutes using the same four stimuli sets for both groups (i.e., dog and pig, car and truck, house and family members, and toy foods). One thousand syllables from each participant were selected for analysis. The transcribed data were analyzed in terms of consonant manner classes. In English, manner classes included stop /b p d t g k/, nasal /n m ŋ/, fricative /f v ð θ s z ʃ ʒ h/, affricate /tʃ dʒ/, glide /w j/ and liquid /r l/. Vowels were analyzed in terms of eight categories including 11 monophthongs (high-front /i ɪ /,

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mid-front /e ɛ/, low-front /æ/, mid-central /ə ʌ/, high-back /u ʊ/, mid-back/o ɔ/, and low-back /ɑ/), and three phonemic diphthongs (/aɪ/, /aʊ/ and /ɔɪ/). The authors found similar results to those found for Korean. Specifically, more stops and glides were produced in English IDS than in ADS. In contrast, more fricatives, affricates, and liquids were used in English ADS than in IDS. In terms of vowels, more high-back vowels were produced in English IDS than in ADS.

English and Korean frequencies of phonological sound classes in speech input were also found to be different between IDS and ADS in Japanese (Tsuji et al., 2014). Similar to Lee and colleagues (2008, 2010), Tsuji et al. analyzed Japanese consonants and vowels in terms of phonological sound classes. According to the authors, consonant manner classes included stop (/b p, d, t, g, k/), fricative (/ɸ, v, s, z, ʃ, ʒ, ç, h/), affricate (/ts, ʧ, dʒ/), nasal (/m, n, ɲ, ŋ, ɴ/), glide (/w, j/), and liquid (/r/). Consonant place classes are composed of labial (/p, b, ɸ, v, m/), coronal (/t, d, s, z, ʒ, ʃ, ç, ts, ʧ, dʒ, n, ɲ, j, ɾ/), and dorsal (/k, g, h, ŋ/). Vowels are also categorized as high-front (/i, ii/), mid-front (/e, ee/), low-central (/a, aa/), high-back (/u, uu/), mid-back (/o, oo/). Japanese vowels have a phonemic length contrast (i.e., short and long).

Twenty-two Japanese mothers whose children were ages 1 year and 6 months (1;6)-2;0 participated. IDS and ADS speech was obtained when each mother interacted with her child (IDS) or with an adult (ADS), respectively. Speech samples were obtained for 30-minute period using books and toys. Samples were analyzed from running speech as well as the word-initial sounds of content words (i.e., word-initial samples). The frequency of consonants observed was different between the two types of analyses. In terms of word-initial samples, significantly more stop and labial sound classes were produced in IDS than in ADS. In contrast, the word-initial samples showed significantly fewer occurrences of coronal place as well as fricative and glide manner classes. In the running speech samples, significantly more labial and affricate sound classes and fewer coronal sound classes were found in IDS than in ADS. High front and low central vowels were frequent in both IDS and ADS speech registers.

The previous studies examining this question in three different languages (English, Korean, and Japanese) have commonly analyzed phonological properties in terms of the percentages of each phonological sound class between IDS and ADS. By analyzing sound classes, the findings of each study are comparable despite the different segmental properties of each language. Thus, the data can provide useful information of language-universal and language-specific characteristics of phonological properties across different languages.

In addition to the benefits of the cross-linguistic comparability, the adoption of phonological sound classes in speech research has important theoretical and practical foundations for understanding child speech development and learning. Although the main purpose of the current study was to examine whether IDS/CDS differed from ADS, the findings of the current study may provide additional information on whether IDS/CDS shows some commonality with children's speech production given the fact that the phonological sound classes have been used for examining speech produced by infants and young toddlers (Lee et al., 2010; Michell & Kent, 2009). Analyzing speech data in IDS/CDS based on phonological sound categories can allow us to indirectly examine the role of IDS/CDS on speech development more fully. The broad phonological sound classes are useful in understanding speech development because young children may develop some precise features or non-default features of their phonological system on different developmental timetables (Bernhardt & Stemberger, 1998). A number of studies examining speech development in infants and toddlers have been conducted by

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examination of phonological sound categories (Boysson-Bardies & Vihman, 1991; Levitt & Aydelott Utman, 1992; Teixeira & Davis, 2002; Vihman et al., 1994)

Similarity in frequencies of phonological sound classes between speech registers

Daland (2012) has reported opposite findings based on analysis of speech input using existing database corpora. While findings from Lee and colleagues (Lee et al., 2008; Lee & Davis, 2010) and Tsuji et al. (2014) were based on experimental studies, Daland analyzed the CHILDES corpus (MacWhinney, 2000) for CDS and the Buckeye corpus (Pitt et al., 2005) for ADS. He found that only glides were significantly higher in CDS than in ADS input, arguing that such difference was small or undetectable as compared to natural variation. Although Daland agreed with Lee and colleagues (2008, 2010) that frequency variation is affected by topic-associated words, he proposed weaknesses in Lee and Davis (2010)'s methodology. According to Daland, IDS and ADS samples in Lee and Davis's study were not representative because they were collected with limited sets of stimulus materials in an experimental setting. Frequency of phonological sound classes was asserted to be heavily influenced by target stimuli materials. However, Daland did not specify the children's ages for the CHILDES corpus whereas Lee and colleagues (Lee et al., 2008; Lee & Davis, 2010) and Tsuji et al. (2014) focused on speech spoken to infants who were chronologically younger than 2 years of age. It is, thus, not certain whether the child's age may also play a role in the frequency of phonological sound classes of input speech.

Daland also raised a question regarding parametric statistics used in Lee and Davis (2010) analyses. He suggested that non-parametric statistic may be more appropriate to estimate differences in frequency of phonological sound classes between CDS and ADS because sound data were not stationary and ergodic based on the /l/ sound in his corpus although it should not be generalized to all segments 'Stationary' refers to the probability that an event is constant. 'Ergodic' indicates that all sources are equivalent. Although Daland provides useful methodological insights, it is premature to conclude from available experiments the 'true' nature of the frequency of phonological sound classes and language processing. Further studies are warranted to verify Daland's interpretation of findings. Thus, this study adopted both parametric and non-parametric methods to obtain supplemental validation for his conclusions.

Sloos and Van De Weijer (2015) also analyzed French data from the CHILDES corpus for CDS (MacWhinney, 2000) and the GOUGENHEIM corpus for ADS (Gougenheim et al., 1956) to evaluate phonological structures such as the frequency of front rounded vowels, nasal vowels, secondary articulation, onsetless syllables, consonant clusters, code obstruents, code sonorants, and syllable structure between the two speech registers. Their main goal was to determine whether it is methodologically adequate to use ADS to study input patterns in language acquisition studies. They hypothesized that the frequency of occurrence of different phonological structures is not likely to differ very much between different speech styles especially ADS vs. CDS. The authors first evaluated how many words commonly occurred in each speech corpus and found that only 45% of ADS words were produced in CDS, which they considered 'low'. They noted "the ADS corpus cannot be used as a substitute for the CDS corpus" (p.79). They selected overlapping tokens (i.e., the 450 most frequent words in both corpora) and found a very strong correlation between ADS and CDS in phonological properties, suggesting that frequencies of phonological structures in CDS and ADS occurring in words common to both corpora were very

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similar. However, the authors analyzed phonological properties, it is not still certain that the frequency of each phonological sound class is similar or different between these two speech registers.

Age-related changes in frequency of phonological sound classes in IDS/CDS

While no consensus is available on overall frequencies of phonological classes between IDS/CDS and ADS, another aspect that has not been investigated is whether speech input frequencies in IDS/CDS change as children's speech and language develops over time. Age-related change in mothers' speech style has been reported in previous studies (e.g., Kondauova et al., 2013; Liu et al., 2009; Phillips, 1973; Wheeler, 1983). Liu et al. (2009) reported that CDS addressed to a younger group of children (i.e., 0;7-1;0) exhibited acoustic-phonetic exaggeration such as expanded vowel space, longer vowels, higher pitch, and greater lexical tone difference as compared to ADS. However, they found that the extent of acoustic exaggeration was significantly smaller in CDS addressed to an older group of children (i.e., 5;0), supporting the hypothesis that mothers adjust prosodic aspects of their speech directed toward children as a function of the child's growing language abilities. Buchan and Jones (2014) also examined phonological reduction changes in maternal speech in northern Australian English. In their pilot study with four mother-child dyads, they found that the deletion of word-initial /h/ and word-final /v/ increased between 1;6 and 2;0, but decreased between 2;0 and 2;6. The authors suggested that mothers fine-tune their speech as children's receptive and productive language knowledge increases. Although Buchan and Jones (2014) showed frequency of phonological sound classes changes over time in maternal speech, their study was limited to only two segments. It is still not certain whether overall frequency changes of phonological sound classes occur in CDS.

The role of the frequency input of IDS/CDS in speech development

Lee et al. (2008) examined the role of the input speech frequency by questioning whether frequency of phonological sound classes is similar or different between IDS/CDS and ADS. A large number of previous studies used dictionary counts or ADS when they compared child' speech with phonological characteristics of the child's ambient language (e.g., Boysson-Bardies et al., 1989; Levitt & Aydelott Utman, 1992; Teixeira & Davis, 2002; Zamuner, 2003). When Lee and colleagues (2008, 2010) found differences between IDS/CDS and ADS in both Korean and English languages, they claimed that mothers may tend to intuitively match phonetic propensities that are present in infant production repertoires during their interactions with their children. At the same time, they argued that input speech frequency is mediated by lexical choice as well. When mothers interact with their children, they may adjust their conversation to the child's level by choosing words and grammatical structures appropriate to the child's level of development. Although diverse findings among available published studies have been reported, authors commonly agree that the frequency of segments or phonological sound classes is closely associated with lexical items used in different research designs. One of the well-known characteristics of IDS/CDS is that it focuses on 'here and now' objects and events (Snow & Ferguson, 1977) and vocabulary in IDS/CDS is known to be repetitive. Although caregivers may not intentionally address certain vocabulary to the child, these repetitive verbal behaviors are believed to facilitate vocabulary development as well. Similarly,

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caregivers may not intentionally adjust their speech input frequency. Phonological distribution patterns may be an artifact of vocabulary produced. This general question of lexical-phonological interactions with speech style is important to validly establish the parameters needed to understand the role of speech style in the typical development of speech and language capacities.

To extend basic research validly to applied clinical practices, identifying the role of speech style in input is critical to support optimal intervention practices for children with clinical speech disorders. What would be the direct or indirect role of IDS/CDS speech patterns in supporting children in their course of speech development if speech input provided by educational providers such as speech pathologists or special educators is similar to ADS after eliminating lexical effects? One way to investigate the nature of the frequency of phonological sound classes in adult speech input without lexical biases would be to examine frequencies of sound classes between IDS/CDS and ADS using similar lexicon items. However, the lexicon items should still be age-appropriate for children.

Purpose of the study

Understanding of the potential role of IDS frequencies of phonological sound classes in speech input during speech acquisition in young children has not achieved consensus across available research. To resolve these different findings, it is necessary to adopt more rigorous study designs and statistical methods. The current study adopted a similar methodology to Lee and Davis (2010). However, significant modifications were applied in order to obtain a more representative sample relative to the differences in findings described by Daland (2012). Importantly, a broader set of stimulus materials was employed to avoid lexical biases. Instead of using a limited number of animal toys, over twenty animal toys were provided to mothers. They were asked to select the toys they *wanted* to play with their children. Data for the current study were collected for 40 minutes enabling a larger database than the 20-minute samples in Lee and Davis (2010). The current study, however, still used phonological sound classes as the analysis unit to make the results of this study comparable with methods in previous studies (Lee et al., 2008; Lee & Davis, 2010; Tsuji et al., 2014).

With respect to data analyses, crossed random effects multilevel modeling was adopted to identify any significant differences among the groups. In addition, following Daland's (2012) recommendation, a non-parametric method (Kruskal-Wallis test, Wayne, 1990) that does not require a particular form of population distribution was also utilized to supplement the findings from the parametric multilevel modeling. A more detailed rationale for these statistical analyses will be addressed in the Methods section.

Furthermore, to understand the nature of frequency differences in phonological sound classes implemented with different listeners, investigating whether frequencies of phonological sound classes in input speech changes across developmental time could be a potentially important dimension of research to understand the role of frequency of speech input in children's phonological acquisition. Thus, the current study examined change over time in characteristics of phonological sound classes of adults' speech input to three age groups of children (6, 18, and 36 months of age) as well as to an adult listener group. Accordingly, the current study has the goal of understanding how frequencies of phonological sound classes are potentially adjusted in input speech to three chronological/developmental age groups of children developing typically (IDS/CDS) and in speech to

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another adult (ADS). This goal is explored through analysis of consonant and vowel sound classes in a speech directed to these four groups.

Method

Participants

A total of 44 native English-speaking individuals living in the southwestern US participated. Thirty-three adult speakers were mothers; the other 11 were university students with no children. The 33 mother's children were divided into three age groups; 6, 18, 36 years of age. All participants had limited exposure to other cultures and languages and had no speech, language, or cognitive impairments.

Data collection

Speech input spoken to the children by their mothers was recorded at home in order to obtain more naturally occurring speech samples. These participants were asked to wear a small traveling bag on their waist, with a Tascam DR-10L Micro Portable Audio Recorder inside. A Lavalier microphone connected to the recorder was clipped to their clothing. During the initial 2-3 minutes, they were asked to play with their children using several toys in the way they usually interacted. Subsequently, four types of target stimuli materials were provided to obtain the CDS speech samples. The types of stimuli materials included various farm and wild animals, various vehicles, various toy dishes, fruits and vegetables, and a miniature house with furniture and family members. The orthography and IPA symbols of these words are listed in Appendix A. Toys were selected because they are commonly used in naturalistic mother-child interactions in various cultures (Fernald & Morikawa, 1993; Lee et al., 2008; Lee & Davis, 2010) and reflect daily activities at home for children. However, some toys (i.e., toy fruits and vegetables and a miniature house with family members) were not age appropriate for the 6-month-old children. Thus, only animals and vehicle toys were used for this group. For the 18- and 36-month-old groups, adult participants were asked to play with their child for 10 minutes. For the 6-month-olds, adult participants were asked to play with toys available in their home or interact without toys if they preferred for 20 minutes. Then, animals and vehicle toys were provided for another 20 minutes. A total of 40 minutes of recording was obtained for each adult participant's sample with their child across age groups.

After a 5-minute introduction period to explain procedures, each adult participant then talked to another adult for 40 minutes. The same stimuli materials used for the samples to children were provided in order to reduce lexical bias. Each speaker was asked to talk about any idea that came to mind when she saw the materials. Conversations for each toy lasted for approximately 10 minutes. All speech samples were collected with the same microphone and recorder used for the children's samples.

Data analysis

After excluding interjections and names, the first 500 syllables produced with each set of test materials across all samples were selected for analysis. In total, 2,000 syllables were obtained from each participant (i.e., 500 syllables * 4 types of test materials per participant). For the speech sample spoken to 6-month-old children, the first 1,000 syllables

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were obtained during free-style speech interactions; then another 500 syllables were selected with each set of stimuli materials. Altogether, 88,000 syllables were analyzed across all four groups. It should be noted that if any lexical items were included more than two times in the samples consecutively, uses a third time and after were not included to avoid lexical influences on frequencies of phonological sound classes.

Analysis of frequency of phonological sound class

To achieve the goal of comparing CDS/IDS and ADS speech styles in understanding the distribution of phonological sound classes in child-adult social interactions, data were transcribed by native English speakers trained in the use of IPA conventions at the level of broad phonemic transcription with child speakers. First, consonants were analyzed in terms of manner of articulation; categories included stop /b, p, d, t, g, k/, nasal /n, m, ŋ/, fricative /f, v, θ, ð, s, z, ʃ, ʒ, h/, affricate /ʧ, ʤ/, glide /w, j/ and liquid /r, l/. Consonants were also analyzed in terms of place of articulation, including labial, coronal, dorsal, and glottal. The labial category was composed of bilabial and labio-dental places, the coronal category included inter-dental, alveolar, and palatal places. Velar and glottal categories consisted of velar and glottal sounds, respectively. Vowel data were analyzed in terms of 7 vowel categories (high-front /i, ɪ/, mid-front /e, ɛ/, low-front /æ/, mid-central /ə, ʌ, ɚ, ɝ/, high-back /u, ʊ/, mid-back/o, ɔ/, and low-back /ɑ/). Overall frequency of each consonant and vowel category was calculated using the Logical International Phonetic Program (LIPP) computer software (Oller & Delgado, 1990).

To calculate reliability for phonetic transcriptions of vowel and consonant categories, a native English speaker, blind to study hypotheses, re-transcribed 20 percent of randomly selected utterances from the sample. Consonant reliability was calculated categorically in terms of each consonant manner and place of articulation. Also, vowel reliability for 10 categories was obtained. Voiced and voiceless distinctions for consonants and tense-lax distinction for vowels were not considered. Consonants and vowels showed 96% and 95% reliability in both the CDS and ADS samples.

Statistical analysis

To address potential effects of statistical designs on diverse findings in the research literature, the current statistical design was broadened from Lee and Davis (2010). Analyses were directed toward comparisons of the frequency of sound classes in each of consonant (manner and place) and vowel (monophthongal) categories among the four age groups. An important analytic consideration was the clustered nature of observations — i.e., the frequency was measured for a collection of segments (i.e., consonants and vowels; level 1) within each participant (level 2). Analyses that ignore such clustering underestimate standard errors of effect parameters, thereby increasing the risk of Type I error above a nominal alpha level (Moerbeek, 2004). Thus, crossed-random effects multilevel modeling (Hox, 2010; Raudenbush & Bryk, 2002) was employed to properly handle non-independence among the observations. Specifically, models included fixed effects for groups. Models also included random effects for participants and consonants/vowels (i.e., variations in frequency across different participants and different consonants/vowels) which were crossed at the same level (level 2) to account for nested sources of variability. In addition, toys were included as a level-1 covariate in order to minimize potential bias due to different stimulus materials used and thus increase generalizability of

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the findings. The model parameters were estimated using the restricted maximum likelihood (REML) technique. When an overall group difference was significant at .05 alpha level, estimated group means were pairwise compared at a corrected alpha level (.05 / 6 = .008; i.e., Bonferroni adjustment).

This modeling approach assumes that the frequency observations in the speech samples were drawn from a parametric probability (i.e., Gaussian) distribution. If there is considerably more or less variation in the sample frequency distribution(s) than expected in the population distribution, parametric tests can be unreliable. Thus, as Daland (2012) suggested, a non-parametric Kruskal-Wallis test was also performed in a subsequent analysis. As detailed later, these non-parametric test results also supported the findings from the parametric multilevel modeling. All the parametric and non-parametric analyses were conducted using SAS 9.4 (SAS Institute, 2002–2012).

Results

Consonant manner of articulation

Figure 1 shows the estimated means and standard errors of the six consonant manners in the four groups analyzed. Multilevel modeling results indicated that stop, nasal, fricative, and glide manner categories were significantly different among the four groups (F (3, 1141) = 22.45, $p < .001$ for stops; F (3, 485) = 5.33, $p < .01$ for nasals; F (3, 1469) = 3.78, $p < .01$ for fricatives; and F (3, 321) = 16.20, $p < .001$ for glides). No significant differences were found in affricates and liquids (F (3, 40) = 0.72, $p = .54$ for affricates; F (3, 485) = 2.30, $p = .08$ for liquids). Non-parametric Kruskal-Wallis test results achieved the same outcomes, except for significant differences indicated for affricates ($p < .05$).

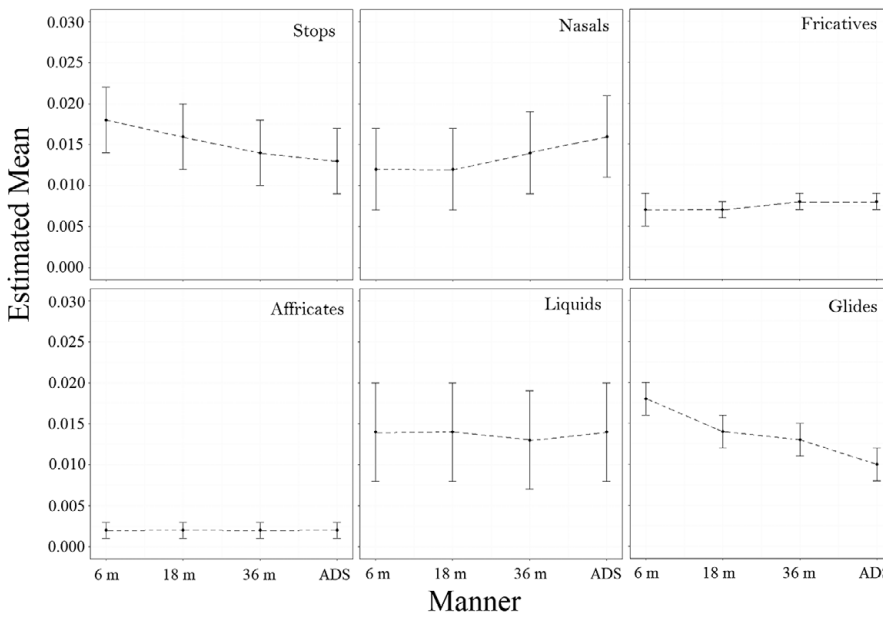

Figure 1. Estimated means and standard errors for each consonant manner category in three group of CDS and ADS.

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Speech addressed to 6-month-olds contained stops most frequently compared with other phonological categories analyzed. Pairwise comparisons revealed that stops in speech addressed to 6-month-olds were significantly higher than in the other groups ($p < .001$). Stops in speech input to 18-month-olds were also significantly higher than those in speech spoken to adult listeners ($p < .001$). Glides showed a similar pattern to stops. The frequency of glides in speech addressed to 6-month-olds was significantly higher than those in the other groups ($p < .001$). Glides in speech spoken to 18- and 36-month-olds were also significantly higher than in speech to adults ($p < 0.001$ for 18 months and $p < .05$ for 36 months).

Nasals and fricatives showed opposite patterns across speaker groups. Nasals were produced most frequently in speech to adults followed by speech spoken to 36-month-olds, 18-month-olds, and 6-month-olds. Pairwise comparisons revealed that nasals in speech to adults were significantly more frequent than those in speech spoken to six or 18-month-olds ($p < .05$ and $p < .01$, respectively). The estimated mean and standard errors of fricatives among the four groups looked similar. However, the frequency of fricatives in speech to adults and to 36-month-olds were significantly higher than in speech to 6-and 18-month-old children ($p < .01$ for both). The other comparisons (i.e., affricate and liquids) were not statistically significant among the four groups at the Bonferroni-adjusted alpha level.

In summary, frequencies of stops and glides were higher, but nasals and fricatives were lower frequency in mother's speech to the two younger groups (6-month-olds and 18- month-olds) than in speech to the other older child (36-month-olds) and adult speaker groups.

Consonant place of articulation

Figure 2 shows the estimated means and standard errors of the four consonant places in the four groups of speakers. Multilevel modeling results indicate that all four place categories were significantly different among the four groups (F (3, 49) = 21.19, $p <$ .001 for labials; F (3, 2617) = 6.21, $p < .001$ for coronals; F (3, 485) = 11.90, $p < .001$ for dorsals; and F (3, 322) = 3.27, $p < .001$ for glottals). These findings were also supported by Kruskal-Wallis test results, although the differences in coronals were not significant in non-parametric testing ($p = .13$).

Pairwise comparisons indicated that labials in speech addressed to 6-month-olds were significantly more frequent than the rest of the groups ($p < .001$ for all groups). In addition, labials in speech addressed to 18-month-olds were significantly more frequent than speech spoken to 36-month-olds ($p < .05$). Coronals in speech addressed to six and to 18-month-olds were significantly less frequent than in speech spoken to 36-month-olds ($p < .05$ for both groups) as well as speech to adults ($p < .01$ for 6 months and $p < .05$ for 18 months). Both dorsals and glottals were produced least frequently in speech to adults, followed by speech spoken to 36-month-olds, 18-month-olds, and 6-month-olds respectively. All pairwise comparisons were significant for dorsals ($p < .01$ for all comparison) except for speech between 18- and 36-month-olds and speech spoken to 36-month-olds and to adults. For glottals, the only pairwise comparison that showed significance was between speech addressed to 6-month-olds and to adults ($p < .05$).

In summary, frequencies of stops, dorsals, and glottals were higher, but coronal frequencies were lower in mother's CDS speech directed to all three child groups than in their ADS speech directed to adults.

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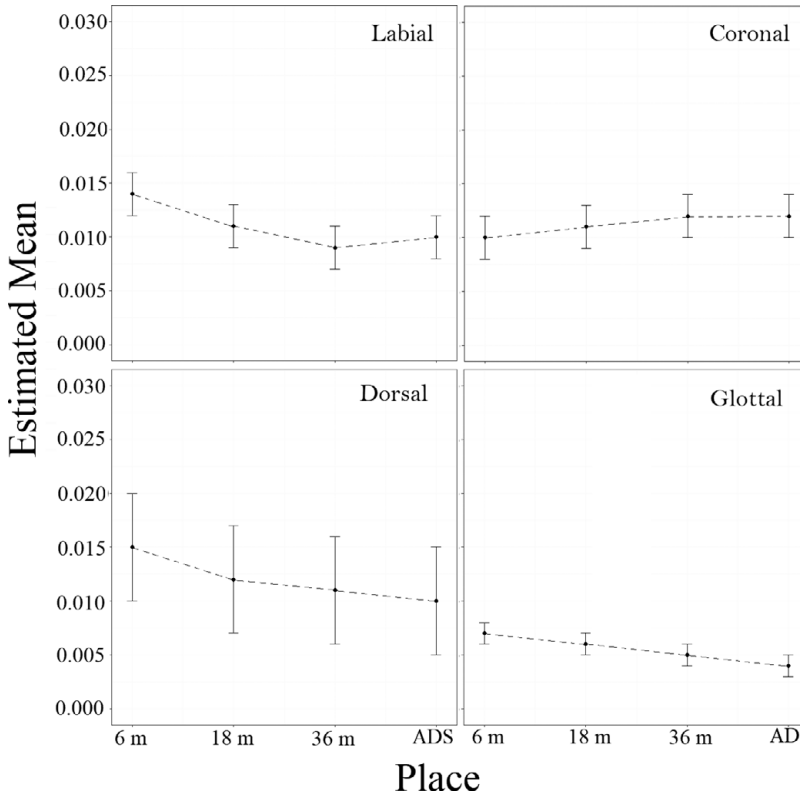

Figure 2. Estimated means and standard errors for each consonant place category in three group of CDS and ADS.

Vowels

Figure 3 shows the estimated means and standard errors of seven vowel categories analyzed among the four groups. Multilevel modeling results indicate that three vowel categories (mid-front, low-front, and high-back) were significantly different among the four groups ($F(3, 157) = 9.14$, $p < .001$ for mid-front; $F(3, 41) = 3.47$, $p < .05$ for low-front; $F(3, 46) = 51.30$, $p < .001$ for high back). The other vowels (i.e., high-front, mid-central, mid-back, and low-back) were not significantly different from each other ($F(3, 38) = 1.42$, $p = .25$ for high-front; $F(3, 42) = 0.66$, $p = .58$ for mid-central; $F(3, 41) = 1.66$, $p = .19$ for mid-back; and $F(3, 42) = 2.30$, $p = .09$ for low-back). However, in non-parametric testing, all seven vowel categories were significantly different across the four groups ($p <$ .001–.05).

Pairwise comparisons indicated that high-back vowels were significantly different from each other ($p < .001$–.05) in that high-back vowels were most frequent in speech spoken to 6-month-olds, followed by speech to 18-and 36-month-olds and to adults. Speech to adults produced significantly less frequent mid-front vowels than speech addressed to 18- or 36-month-olds ($p < .001$ and .05, respectively). In terms of low-front, the only significant comparison was between speech spoken to 36-month-olds and to adults ($p < .05$). All other pairwise comparisons were not statistically significant at the Bonferroni-adjusted alpha level.

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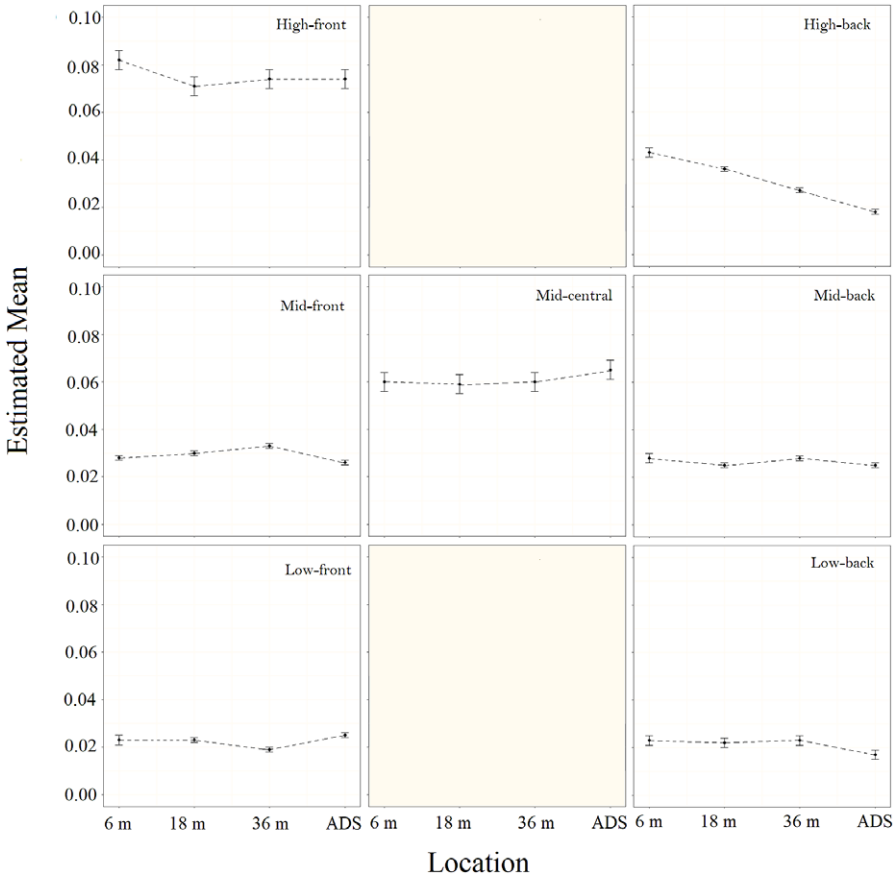

Figure 3. Estimated means and standard errors for each monophthong vowel in three group of CDS and ADS.

In summary, only high-back vowels showed the developmental changes found in consonant manner and place. Frequency of high-back vowels was higher in speech to the 6-month-old infants and their frequency decreased as listener age increased.

Discussion

The goal of this study was to resolve issues in currently available research related to the frequency of phonological properties in input speech and to provide additional insight on the role of speech input style from adults in the development of young children in the formative stages of speech and language development. Four speaker groups were analyzed to understand better frequency changes in phonological sound classes as children's chronological age increases (i.e., IDS/CDS to 6-,18-, and 36-month-olds) compared with adult-directed speech (ADS, speech with an adult speaker).

In past research, two groups of researchers (Lee et al., 2008; Lee & Davis, 2010; Tsuji et al., 2014) found that the frequency of phonological sound classes differed between ADS and CDS/IDS based on experimental data. In contrast, Daland (2012) claimed that such

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differences would be small or undetectable and frequency variation of speech input might be affected by topics discussed or lexical effects based on toys used during mother and child interaction based on analyses of data from spontaneous corpora.

To overcome the limitations of the previous studies, more natural speech samples designed to control for lexical bias related to use of a narrow set of stimulus materials were used. Over fifty toys were provided to mothers to make their own selection of the toys they wanted from the array. Data were collected for 40 minutes to enable a larger database of utterances for analysis. Broader statistical analyses were implemented with the data, including both crossed random effects multilevel modeling to identify any significant differences among the groups and a non-parametric method (i.e., Kruskal-Wallis test, Wayne, 1990) that does not require a particular form of the population distribution to supplement the findings from the parametric multilevel modeling. Finally, while previous studies focused on one age group, three age groups of children (i.e., 6, 18, and 36 months of age) were included to examine changes over chronological age in the frequency of phonological sound classes as children actively develop their phonological system.

Based on our more comprehensive study design, we found that frequencies of phonological sound classes in speech input to young children (i.e., CDS/IDS) were indeed different as children's chronological age increased as well as compared to speech spoken to adults (i.e., ADS), consistent with Lee and colleagues (Lee et al., 2008; Lee & Davis, 2010) and Tsuji et al. (2014). We found significantly different frequency distribution patterns for both consonant manner and place. Differences in vowel frequencies were limited to only three categories.

Consonant manner

Findings for consonant manner indicated that stops and glides were produced more frequently in the mother's speech to 6-, and 18-month-old children (CDS) than in their speech directed to adult listeners (ADS). Stop frequencies in speech directed to 36-month-old children were not significantly different in frequency than in speech directed to adult listeners. The finding of the current study was consistent with previous research in English (Lee & Davis, 2010) in that stops in CDS were significantly more frequent than in ADS. Although more studies in other languages are warranted, the substantially higher frequency of stop consonant manner in CDS was not observed in two Asian languages. Unlike English, both Korean and Japanese studies did not find a significant difference in the frequency of stop manners between ADS and IDS (Lee et al., 2008; Tsuji et al., 2014). Recall that Tsuji et al. analyzed frequency of phonological sound classes in both running speech and word-initial content words. Although Tsuji et al. (2014) found more stops in IDS than in ADS for word-initial content words, because the current study only analyzed running speech data, the results of the running speech in Tsuji et al. were mainly compared with the current findings.

Nasals were significantly less frequent in speech directed to 6- and 18-month-olds than in speech directed to 36-month-olds and ADS in the current study. Frequencies for fricatives were similar to nasal frequencies. Fricatives were significantly higher in ADS and to 36-month-old children than in speech directed to 6- and 18-month-old children. These findings were consistent with Lee and Davis' (2010) findings for English. However, findings for English were slightly different from study of Korean (Lee et al., 2008). Korean ADS showed a higher frequency of fricatives, but a similar nasal frequency to IDS. Unlike

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Korean and English, the available Japanese study (Tsuji et al., 2014) found no difference in fricatives and nasals between ADS and IDS.

The findings of the current study support claims in previous studies (Lee et al., 2008; Lee & Davis, 2010) that, generally, stops, and glides, described as early developing sounds in children's production output, were more frequent in speech directed to the two youngest child groups. In contrast, fricatives are considered later developing sounds in child speech production, and are more frequent in the 36-month-old children in the speech to adults. As Dinnsen et al. (1990) proposed, stops, nasals, and glides as ballistic movements incorporate simple articulation movement with regulating velo-pharyngeal valving. In contrast, fricatives and affricate sounds require regulation of lingual configuration and fine force control to generate frication noise (Kent, 1992). Therefore, the current study confirms previous findings that stops and glides are more frequent in CDS than in ADS while fricatives are more frequent in ADS and CDS.

In addition to articulatory complexity, the previous studies posited frequency of phonological sound class differences might be affected by lexical choice in a specific language (Lee & Davis, 2010; Tsuji et al., 2014). For example, the frequent use of glides in CDS may be influenced by the frequent use of word 'you' in English CDS (Gerometta & Shafer, 2008). This frequency effect can be explained by language-specific patterning because the sounds of the equivalent word in Korean (/nʌ/ or /tangʃin/) and Japanese (/anata/) are different from English. Furthermore, the pronoun 'you' is often omitted and termed an 'empty pronoun' in Korean and Japanese (Suh, 1991). Although the current study did not conduct lexical analyses, the greater frequency of glides may be attributed to the use of pronouns in English CDS.

Unlike the previous study (Lee & Davis, 2010) where significantly more affricate and liquid sounds were found in English ADS, the current study found no significant differences between the three child listener groups and the adult listener group for these sound categories. Non-parametric results revealed similar outcomes based on parametric multilevel modeling outcomes. It is not clear why these patterns would not be more frequent in the speech to adult listeners than to child listeners. However, the different results with the same language population indicate that as Daland (2012) claimed, the frequency of phonological sound classes may be influenced by corpus size. When Tsuji et al. (2014) analyzed the frequency of sound classes for running speech as well as word-initial content words, the findings of the frequency of sound classes differed between IDS and IDS. In other words, the frequency of affricates was only different between the two groups in running speech where overall frequency was evaluated. In contrast, the frequencies in word-initial words only were different for stops, fricatives, and glides between ADS and IDS. Thus, the non-significance findings between affricates and liquids in the current study may be also attributed to the small corpus in the previous study (Lee & Davis, 2010). It also remains difficult to eliminate the effect of the number of participants or the variety of materials used to collect speech samples on the frequencies of sound classes. Further studies are warranted to examine frequencies of phonological sound classes in various contexts.

Consonant place

While frequencies of phonological sound classes have been commonly examined for consonant manner, the frequency of the consonant place has not been examined in English ADS and IDS. Similar to previous studies of Korean and Japanese, the current

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study found that the frequencies of consonant place were also different among speech directed to the four groups of speakers. Labial sounds were produced more frequently in CDS, but coronal sounds were less frequently produced in speech spoken to the two youngest child groups (6 and 18 months) than to the 36-month-old group and to adults. In addition, unlike Korean and Japanese, English CDS to all the child groups showed more dorsal and glottal sounds than ADS to the adult group.

The frequency of labial sound class in CDS seemed to be consistent with English-learning children's speech output developmental patterns because the labial sound class has been frequently observed in early child speech production inventories (e.g., Bernhardt & Stemberger, 1998). Given that more labials were produced in both Korean and Japanese IDS than in ADS (Lee et al., 2008; Tsuji et al., 2014), more frequent use of labials in IDS/CDS may be a universal pattern. However, the coronal and dorsal sound patterns were opposite to the English-learning children's production output patterns in that coronal consonants occur earlier in English-learning children's developmental output inventories. Dorsal sounds have been frequently described as a later developing sound in most early child speech production inventories, and as occurring at a lower frequency in adult output in English. Among two sounds /h/ and /ʔ/ counted as a glottal place, /ʔ/ is not an English phoneme.

In addition to labial place, an earlier onset of coronal compared to dorsal place is also frequently reported in child speech development in various languages (e.g., Howard, 2007 for British English; Rose & Wauquier-Gravelines, 2007 for French; Goldstein, 2007 for Spanish). Regardless of earlier onset of coronal consonants, the less frequent coronal sounds in CDS were observed in all three previous studies examining the frequency patterns of phonological sound classes between ADS and IDS/CDS (Lee et al., 2008; Lee & Davis, 2010; Tsuji et al., 2014). When compared to ADS, the lower frequency of coronal consonants may result from higher frequency of the other places in IDS/CDS. In other words, when the percentage of each place was measured, if the percentage of labial and other places increased in CDS/IDS, the percentage of coronal place would decrease. The decreased percentage of coronal consonants in CDS/IDS may not affect a child's learning of coronal consonants because coronal consonants are the most frequent place of articulation across languages. For example, 66% and 64% of consonants are classified as coronal in English (Mines et al., 1978) and in Korean (Jin, 1993). In Japanese IDS, coronal ratios were higher than labials and dorsals (Tsuji et al., 2014). Because the higher frequency of coronal sounds is already matched with child production patterns, it may not impact the percentage of coronal sounds decrease in IDS/CDS.

The higher frequency of dorsal and glottal sounds produced in input to the youngest child group in English CDS could be a side effect of the exaggerations reported in early IDS (Fernald et al., 1989). These patterns may not be related to mothers' teaching function in English. Instead, they may serve to increase a child's attention. The increased frequency of a certain sound in a language was also observed. For example, Korean fortis sounds are generally less frequent than other consonants produced in Korean ADS (Lee et al., 2008). However, this sound was produced frequently in Korean IDS, possibly due to the fact that the acoustic signature of the sounds may be more perceptually prominent to infants. In other words, the acoustic amplitude and vocal pitch of the following vowel in producing fortis sounds may be perceptually prominent for infants (Jun, 2006). Therefore, the frequency of phonological sound classes is not only affected by caregiver's unconscious and conscious choice of lexicon to assist child's speech development, but also encourage their child to attend to interact with caregivers and increase awareness of sounds. Further studies are warranted to explicate this hypothesis more clearly.

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Vowels

The two statistical treatments achieved different results for vowels. Multilevel modeling results indicated that mid-front, low-front, and high-back categories significantly differed among the three child listener and the adult listener groups. The other vowel categories were not significantly different from each other across the four groups. However, based on non-parametric Kruskal-Wallis testing, all seven vowel categories differed significantly among the four groups.

Based on these conflicting results, multilevel modeling was pursued to make a more conservative interpretation. Outcomes indicated that high-back vowels in input were significantly different from each other across the four listener groups, with highest frequency in the youngest listener group (6-month-olds), and decreasing frequency across the three other groups (i.e., 18- and 36-month old listeners and adult listeners respectively). The high frequency of high-back vowels produced in CDS as compared to ADS to adults was consistent with previous studies of English (Lee & Davis, 2010; Lee et al., 2010) and consistent with previous findings regarding English-learning children's speech production repertoire. Rvachew et al. (2006) reported that English-learning infants produced more frequent high-back vowel [u] than French-learning infants through the age ranges of 0.8 to 1.6.

While the high-back vowel was the only monophthongal vowel that differed between ADS and CDS in the previous study, the current study also found differences in the frequency of mid-front and low-front vowels. It is not certain why these two front vowels were also more frequent in CDS than in ADS. It may be that changes in input to child and adult listeners may be centered on alterations in consonants more than in vowel patterns. This possibility should be explored further to consider how vowels may support young listeners during the development of the sound system as well as how they may be varied in diverse types of adult listeners.

Frequency of phonological sound classes between IDS/CDS and ADS

Regardless of increased corpus size, the current study clearly showed a consistent finding that the frequency of most phonological sound classes differs between the two speech registers. The main methodological difference between the two group of researchers (i.e., Lee et al., 2008; Lee & Davis, 2010; Tsuji et al., 2014 vs. Daland, 2012; Sloos & Van De Weijer, 2015) was in data collection method. One group of researchers collected data from participants in an experimental setting using the same materials with age specified whereas the other group of researchers adopted an existing database. Obviously, the existing database provides great benefits for conducting research in that it can provide researchers with an efficient and cost-effective method for answering research questions. However, the current study demonstrated that the secondary analysis of data may not always bring the same results as an experimental study does in evaluating frequency of phonological classes because the existing corpus may not specify child's age and the materials used in the study. For instance, the current study found that the differences in frequency of phonological classes are greater between IDS/CDS and ADS in speech to 6 months-old whereas the frequencies of the phonological classes were similar between 36 month-olds and adults. Without specification of child participants' ages, the existing data collapsed caregivers' speech spoken to children at all different ages. More data were obtained from older children so the results could be similar between the two registers. Daland (2012) noted in his Methodology section "…the original sub-corpora comprising

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the corpus were collected by a variety of researchers working with children of varying ages and for varying purposes (p. 1100)". Therefore, researchers should carefully interpret their results when secondary analysis is made. It might be difficult to argue that the frequency of phonological properties is not different between the speech registers when child age was not specified.

The role of IDS/CDS on children's phonological acquisition

Although the current study did not make a direct comparison between child and IDS/CDS, our finding would provide helpful insight into the role of IDS/CDS on children's phonological acquisition. We found several matched patterns between our IDS/CDS data and child speech output properties reported in the current literature. For example, the overall consonant manner patterns showed a high frequency of stops and glides, but lower frequency of fricatives, a high frequency of labial place and the highest frequency of high-back vowels especially to the 6-month-old group. Several accounts attempt to explain the role of IDS/CDS during early speech development. Cross (1977) asserted that caregivers match their speech to their child's production capacities by noting that the input to rapidly developing children is graded continuously in tune with their linguistic and communicative abilities. Similarly, Sundberg (1998) proposed that mothers use the infant's vocalizations to tune to the infants' phonological abilities and adjust their IDS to infants' level of phonological development. Fernald and Morikawa (1993) also suggest that mothers modify and adjust their speech to complement the perceptual and cognitive immaturity of their child. Such fine-tuning/adjusted IDS argument is also consistent with Lee and Davis's claim (Lee & Davis, 2010) that mothers may be sensitive to their child's developmental stage of speech production mastery and adjust their speech to the level of the child's production capacities. However, it should be noted that caregivers' speech input may not always intend to match children's speech development. Beside the consonant manners and a few places, the current study could not find consistent patterns of other consonant place and vowels relative to the children's phonological output development patterns. Instead, it may demonstrate psychosocial functions such as maintaining children's attention. Thus, consistency between the two speech styles may not occur. Fine-tuning/ adjusted IDS accounts should be further verified in future studies.

Unlike previous studies (Lee et al., 2008; Lee & Davis, 2010; Tsuji et al., 2014), the current study employed three groups of children at 6, 18, and 36 months of age to examine the potential for frequency changes in speech input over time as the children develop their phonological output skills. Examining how phonological properties of caregiver's speech may change with increase in child age could provide a more in-depth insight on the role of IDS/CDS. Visual inspection showed that frequencies of stops, nasals, fricatives, and glides change as the children's chronological age increases. The frequencies of consonant place class also change as the children's chronological age increases. More importantly, the frequency of mothers' speech produced to 36-month children was more similar to speech directed to adults (ADS). These overall trends as well as similar frequency of phonological sound classes between speech to 36-month children and to adults may be explained by a scaffolding hypothesis that CDS input may play a scaffolding role in assisting children to develop their own repertoire of ambient language patterns. Vygotsky's (1978) sociolinguistic learning theory asserted that children's learning is accomplished by adult's engagement to assist the child in developing beyond the skills the child already possesses.

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Then, a question arises: "what causes such phonological changes in mothers' input?" One possible reason of the phonological property changes in caregivers' speech might be the increase in diversity of the lexicon and of sentence structures as their child's chronological age increases. For example, when a child is 6-month old, mothers may tend to say "what" and "you" more frequently. As result, more glides are produced as we found in this study. During an adult's interactions with 36 month-olds or other adults, however, conversations may not focus on asking fundamental names such as "what is this?" because listeners may already know their names and may not focus on asking or directing a listener to do by using a pronoun "you". It should be also noted that previous studies indicated cultural differences in use of pronouns and speech style (Fernald & Morikawa, 1993; Lee & Nakayama, 2000). Due to the close association of lexical and phonology development, mothers' phonological use may be influenced by the lexicon they choose when they interact with their children depending on their age. Examining potential relationship(s) between lexical and phonological properties was not within the scope of the current study. A more precise examination of whether phonological properties change as children grow could be accomplished by cross-linguistic studies because frequent lexicons used in children's speech could differ among languages.

The importance of speech input is highlighted more in speech pathology services. Our finding provides an important clinical implication. When speech-language pathologists teach a child with speech sound disorder specific phonemes, they carefully select words salient for the child that contain the target sounds. By repeatedly addressing the words and providing ample opportunity for the child to produce the words during therapy, children get more exposure to the sound supporting the child's development of accurate production for communication. Thus, given the inherent relationship between the lexicon and phonological development in children with and without speech sound disorders, it is more meaningful to educators and speech pathologists to understand how the frequency of phonological sound classes is different between ADS and CDS/IDS when the same lexical opportunity is given to both ADS and IDS/CDS speakers.

It is also important to note that the size of the corpus could also play a role in frequencies of phonological sound classes. For example, the frequency of affricates and liquids within the same population (i.e., English-speaking mothers) in the current study differed from the data results for the previous study of English (Lee & Davis, 2010). When Tsuji et al. (2014) analyzed the same corpus in two different ways (overall frequency vs. word-initial) in Japanese, the frequencies of each consonant manner and place category were different. Therefore, the different frequencies of phonological sound classes could be observed if studies were conducted using a different methodology. Furthermore, different phonological patterns could be observed when data were collected using different materials to elicit speech samples. Therefore, it is plausible to propose that differences between the two groups of researchers regarding frequency of segments and phonological sound classes may also be attributed to the different sample size.

In addition, the statistical methodology may also affect the significance of the findings. While the two statistical analysis types employed in this study found similar results for consonants, vowel results differed between the non-parametric Kruskal-Wallist test and the crossed random effects multilevel modeling. Thus, future studies should carefully consider the type of statistical method implemented to investigate frequency analyses of speech input in ADS and CDS.

Conclusions and future studies

In conclusion, expansions of the methods used in previous research relative to length of samples and diversity of materials used for samples were implemented: to enable a more valid sample that was not affected by stimulus bias and contained adequate materials for analysis. As a result, outcomes are seen as moving toward options for consensus on the role of CDS versus ADS input patterns for basic dimensions of speech input to child listeners at differing language development levels contrasted with connected speech between adult speakers and listeners, indicating the potential role of change over time in input addressed to children. Although the current study focused on the frequency of phonological sound classes in speech input to children, further studies are warranted to examine 'segmental' analysis between CDS/IDS to obtain a more precise understanding of how children develop each phoneme in their language relative to input values. Also changes of phonological properties of IDS/CDS and their relationship with lexical and syntactic structures over time should be examined cross-linguistically in future studies.

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Appendix A

Toys provided to the participants of the study

Animals		Vehicles		Food/Dishes		Furniture/Family Members	
Orthography	IPA	Orthography	IPA	Orthography	IPA	Orthography	IPA
Pig	pɪg	Cars	karz	Pan	pæn	Girl	gɝl
Cow	kaʊ	Tractor	træktɚ	Pickle	pɪkəl	Boy	bɔɪ
Lion	laɪən	Airplane	ɛrplen	Fork	fɔrk	Baby	bebi
Bull	bʊl	Pilot	paɪlət	Knife	naɪf	Daddy	dædi
Rhino	raɪno	Truck	trʌk	Carrot	kɛrət	Mommy	mami
Chickens	ʧɪkənz	Scooter	skutɚ	Apple	æpəl	Brother	brʌðɚ
Zebra	zibrə	Driver	draɪvɚ	Sandwich	sændwɪʧ	Sissy	sɪsi
Elephant	ɛlɪfɪnt	Construction Worker	kʌnstrəkʃən wɚkɚ	Plate	plet	Clothes	kloz
Snake	snek	Tow Truck	to trʌk	Toast	tost	House	haʊs
Alligator	ælɪgetɚ	Dump Truck	dʌmp trʌk	Egg	ɛg	Chairs	tʃɛrz
Sheep/lamb	ʃip	Luggage	lʌgəʤ	Fish	fɪʃ	Closet	klɔzɪt
Giraffe	d͡ʒɛræf	Cart	kart	Chicken	tʃɪkən	Light	laɪt
Ducks	dʌks	Train	tren	Mushroom	mʌʃrum	TV	tivi
Donkey	dɔŋki	Trailer	trelɚ	Tea	ti	Table	tebl̩
Bear	bɛr			Coffee	kɔfi	Couch	kaʊtʃ
Cat	kæt			Lemon	lɛmən	Tree	tri
Tiger	taɪgɚ			Weenie	wini	Bed	bɛd

(Continued)

Animals		Vehicles		Food/Dishes		Furniture/Family Members	
Orthography	IPA	Orthography	IPA	Orthography	IPA	Orthography	IPA
Dog/Puppy	dɔg/pʌpi			Skillet	skılıt	Stove	stov
Penguin	pɛŋgwın			Spatula	spæʧələ	Sink	siŋk
Bunny	bʌni			Salt	sɔlt	Lamp	læmp
Hippo (Hippopotamus)	hıpo (hıpopatəməs)			Pepper	pɛpɚ		
Horse/ Horsie	hɔrs/hɔrsi			Sausage	sɑsıdʒ	Bookshelf	bʊkʃɛlf
				Pear	pɛr	Fire	faır
				Pepperoni	pɛpɚoni		
				Tomato	təmeto		
				Eggplant	ɛgplænt		
				Cheese	ʧiz		
				Cup	kʌp		
				Dish	dıʃ		
				Pot	pɑt		
				Cutting board	kʌtiŋ bɔrd		
				Spoon	spun		
				Bowl	bol		
				Vegetables	vɛdʒtəbəl̩z		
				Strawberry	strɔbɛri		

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