Acoustic Characteristics of Vowels Produced by Young Children from the New Orleans Area

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ACOUSTIC CHARACTERISTICS OF VOWELS PRODUCED BY YOUNG CHILDREN FROM THE NEW ORLEANS AREA

A Thesis

Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for the degree of Master of Arts

in

The Department of Communication Disorders

by
Rebecca Elise Dorsa
B.A., Louisiana State University, 2016
May 2019
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ABSTRACT

Understanding dialects and their effects on speech and language is integral to the field of speech-language pathology, as dialectal differences could potentially be misdiagnosed as speech or language disorders if these factors are not well-considered. The number and organization of the vowel system of one regional dialect of American English differs from those of another regional dialects. Therefore, understanding the effect of dialect on vowel productions in children can aid in the accurate evaluation of children from various dialectal backgrounds. The aims of the proposed study were to (1) determine the age at which young children develop acoustic markers of a given dialect and (2) provide the context in which the dialectal features are more prominent. Four three-year-olds whose parents lived in New Orleans, Louisiana, throughout their lives were included in the study. Target stimuli included 5 words for each of following vowels, /i, ɪ,ʊ, u, æ/. A single-word elicitation task and two sentence imitation tasks, one spoken by a speaker from New Orleans and the other from Iowa were used to elicit target sounds. Acoustic patterns of vowels produced by child participants were analyzed using vowel midpoint measured F1 and F2 and vowel duration. The results showed that not all children showed aspects of their dialectal patterns by age three and elicitation method had no considerable effect on vowel patterns of these children. These findings indicate that phonetic level refinement of vowels continue past the age of three and children’s vowel production is not affected by the context (imitative or spontaneous) in which the vowels are elicited.
Introduction

Dialect can be described as variant of speech and language patterns from the mainstream form of a language (ASHA, 2003). According to the American Speech-Language-Hearing Association, speech-language pathologists (SLPs) should be aware not to misjudge a difference as a disorder (ASHA, 1983). This can occur when SLPs do not know the effect a particular dialect can have on a client’s speech and language. Previous studies have shown that children exhibit aspects of their regional dialect similarly to the ways in which they are seen in adults from the same regions as early as three-to-four years of age (e.g., Jacewicz, Fox, & Salmons, 2011). In another study by McGowan, McGowan, Denny, and Nittrouer (2014), showed that children exhibit acoustic characteristics of dialects in their vowels as young as 42 months, in both immediate imitation and spontaneous speech. Although it is not discussed whether one context, imitative or conversational speech, influenced the appearance of the dialect in speech more than the other, this study showed that features of the surrounding speech affected the young children’s speech output. In the current study, vowels produced by young children who were born and raised in New Orleans area were examined to determine if young children as young as 3 years have acquired patterns of their adult community’s dialects. The dialect spoken in New Orleans, Louisiana, is unique in that it is a “version” of the Southern White English (SWE) dialect that does not conform with some of the main patterns of SWE (Carmichael, 2014; Labov, Ash, & Boberg, 2006). Examining whether these dialectal features appear in young children were our first aim of the study. Our second aim was to examine if dialectal features of speech are more prominently shown when elicited using sentence imitation versus non-imitative contexts.
Review of the Literature

Dialectal variation and phonological development in young children

Dialect is described as a variation of a language that is spoken by a group of people within a larger population (ASHA, 1983). Extensive studies have been conducted in the field of sociolinguistics to document patterns of speech that are unique to specific regions and ongoing changes within that region. In the field of Speech-Language Pathology, it is especially imperative to understand different dialectal variations because without this knowledge, children may be misdiagnosed as having a speech disorder that is not present or that is more severe as it is diagnosed due to producing sounds outside of the mainstream form of their spoken language secondary to their dialect (Yavas, 1998). As stated by the American Speech-Language-Hearing Association (ASHA, 2003), “No dialectal variety of English is a disorder or a pathological form of speech or language” (ASHA, 1983). This means SLPs must consider the dialect a child and their parents are speaking, and the potential influence of that dialect on the child’s speech patterns when assessing a child for a speech or language disorder to discern speech differences from speech disorders.

Several previous studies have shown the evidence of dialectal influence on not only phonological development in young children, but also on assessment and diagnosis of children’s articulation skills. For example, Velleman and Pearson (2011) examined the speech of young children who were speakers of General American English (GAE) and African American English (AAE) who had Speech Sound Disorders (SSD). They then compared both groups to children with the same dialect but without SSD. This study found that the ages of acquisition of different phonemes varied greatly by a child’s dialectal background. Moreover, this study showed that children speaking AAE acquired later-developing sounds earlier than those speaking GAE
regardless of their SSD status, though children with SSD reflected patterns of “disorder” more than dialectal features in their speech. Cole and Taylor (1990) also studied articulation skills of 10 children who were speakers of African-American Vernacular English (AAVE) using three standardized tests, the *Templin-Darley Tests of Articulation, Second Edition* (Templin & Darley, 1969), the *Arizona Articulation Proficiency Scale: Revised* (Fudala, 1974), as well as the *Photo Articulation Test* (Pendergast, Dickey, Selman, & Sorder, 1969). They found that on all three tests, more participants scored as having a speech disorder when characteristics of the dialect were not considered. However, after their dialectal features were taken into consideration, none of the children scored as having an articulation disorder, suggesting the necessity of considering a child’s dialectal background before assessing, diagnosing, or providing intervention for a child for a speech disorder (Cole & Taylor, 1990).

Although more attention has been paid to the effect of dialectal features on the assessment and intervention of SSD recently, the majority of studies have focused on the effect of social dialects (AAVE vs. GAE), leaving the effect of regional dialects on speech development and assessment in young children less well investigated.

**Southern White English (SWE)**

Regional dialects of American English include North, Midland, South, New England, Mid-Atlantic, and West. Each of these regions has distinct features in terms of vowel production including chain shifts for the Northern and Southern regions (Clopper, Pisoni, & De Jong, 2005; Labov et al., 2006). Among these six regional dialects, the focus of the current study will be on Southern dialects. The Southern dialects can be characterized with some unique patterns that are distinct from those of the other regional dialects of American English. This pattern is referred to as the Southern Vowel Shift (SVS), which can be characterized with i) fronting of the back
vowels /u/ and /o/ and ii) reversal of vowels /i/-/ɪ/ and /ɛ/-/e/ (Clopper, Pisoni, & De Jong, 2005; Clopper & Pisoni, 2004; Jacewicz, Fox, & Salmons, 2011; Labov, et al., 2006), as can be seen in Figure 1 below. Southern speakers also show iii) raising and fronting of /æ/, which was explored further in the New Orleans Dialect section of this paper. Jacewicz, Fox, and Salmons (2011) examined the speech of adults and eight- to twelve-year-old children from North Carolina and showed that while not all of these SWE characteristics were as prominent in the speech of children, some evidence of SWE, such as overlap in /e/ and /ɛ/ and fronting of /u/ and /o/, was noted in children’s vowel productions.

Figure 1. Southern Vowel Shift (Figure 3. Schematic of the Southern Vowel Shift. Adapted from “Acoustic characteristics of the vowel systems of six regional varieties of American English,” by C. G. Clopper, D. B. Pisoni & Kenneth de Jong, 2005, Acoustical Society of America, 118(3), 1661-1676.)

Across studies, however, the term “Southern” has been used to denote different states in Southern United States, approximately eleven different states including Texas, Louisiana, Mississippi, Oklahoma, Alabama, Georgia, South Carolina, North Carolina, Virginia, Arkansas, and Tennessee (Clopper, Pisoni, & De Jong, 2005). Therefore, it is unclear whether or not patterns of SVS appear consistently across all Southern regions of the United States. In fact, in their study, Labov et al. (2006) indicated that speech patterns of New Orleans, one region in Louisiana, show patterns of speech that do not conform with the patterns of SVS.
New Orleans Dialect

Speakers of the New Orleans area, a region located in Southeast Louisiana, are known to have unique patterns that are distinct from other “Southern” regions (Carmichael, 2014; Labov et al., 2006). This includes “relatively high position” of /o/ as well as tense-lax variation of the vowel /æ/. While there is little evidence available about the various dialects in the New Orleans area, Labov et al. (2006) noted the likeness of the New Orleans dialect to that of New York City. Not only were New Orleans and New York linked through business associations, but they were also involved due to the influence of Jewish bankers involved in both cities. This connection through social and business relationships led to similar vowel systems in these two cities’ dialects that continue to be found today. One vowel pattern in the New Orleans dialect that resembles that of a New York dialect is “short-a” (/æ/). New Orleans and New York speakers produce the “short-a” differently for the tense and lax forms. The “tense” form is used in conjunction with “front nasals, voiced stops, and voiceless fricatives in closed syllables,” whereas the “lax” form tends to be used with the open form. For example, the “lax” version of /æ/ would be used in words like “cap” and “family,” that are more lowered and backed, while the “tense” version would be used in “sandwich” or “bands,” that are more raised and fronted. While New Orleans and New York dialects are similar in their uses of the “tense” and “lax” /æ/, New Orleans speakers differ from New York speakers in that “tense” forms were utilized in the auxiliary “have,” and when the “segmental environment” affects the vowel productions. New Orleans and New York dialects are also reported to be parallel with each other for the production of “open-o” (/ɔ/) and /o/, whose pattern is clearly distinguished from that of other Southern cities. New Orleans and New York speakers’ /ɔ/ can be classified as “lower-mid” vowel and /o/ as a “lower-back” vowel, in comparison to the /ɔ/ and /o/ which are both produced in a lower-back
position in most other Southern dialects. At the same time, as stated by Carmicheal (2014), the New Orleans dialect also follows some patterns of other Southern dialects involving diphthongs. The patterns of the Southern and New Orleans dialects are summarized in Table 1 below. In the current study, the focus was on examining vowels differentiate patterns of SVS from that of the New Orleans dialect, which included /i, ɪ, u,ʊ, æ/.

Table 1. Characteristics of Southern and New Orleans dialects

<table>
<thead>
<tr>
<th>Reversal of /i/-/ɪ/ and /e/-/ɛ/</th>
<th>Southern Dialect</th>
<th>New Orleans Dialect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reversed (Jacewicz, Fox, &amp; Salmons, 2011; Clopper, Pisoni, &amp; De Jong, 2005; Clopper and Pisoni, 2004)</td>
<td>No reversal present (Carmichael, 2014; Labov et al., 2006)</td>
<td></td>
</tr>
<tr>
<td>Back vowel fronting (/u/, /ʊ/, /o/, /ɔ/)</td>
<td>Fronted /u/ and fronted /o/, similar to /ɔ/ production (Jacewicz, Fox, &amp; Salmons, 2011)</td>
<td>Fronted productions of /u/ and /ʊ/ (Labov et al., 2006)</td>
</tr>
<tr>
<td>/æ/</td>
<td>Raised (Jacewicz, Fox, &amp; Salmons, 2011; Clopper, Pisoni, &amp; De Jong, 2005; Clopper and Pisoni, 2004)</td>
<td>Split tense (raised and fronted) and lax (lowered and backed) /æ/ (Labov et al., 2006)</td>
</tr>
</tbody>
</table>

Vowel Assessment in Young Children

Previous studies on phonological development in young children have shown that vowels are mastered by the age of three while consonants develop over the course of the first seven or eight years of a child’s life (Smit et al. 1990; Templin, 1957). Due to this belief of vowels being mastered early in the developmental stage with relatively no difficulties, the acquisition and assessment of vowel sounds have been overlooked in the literature. However, studies have shown that vowel acquisition is a gradual process in which phonetic refinement goes well beyond the age of five (e.g., Chung, Kong, Edwards, Weismer, Fourakis, & Hwang, 2012; Davis, Jakielski, & Marquardt, 1998; Pollock, 2013; Stoel-Gammon & Herrington, 1990). Moreover, studies have shown that children with phonological disorders produce vowel errors more
consistently than children without phonological disorders, meaning children who have phonological disorders typically show patterns in their vowel errors while children without phonological disorders show more random errors. This finding suggests that the type of vowel errors reflects the severity of their disorder (Pollock, 2013; Stoel-Gammon & Herrington, 1990). In addition, Davis, Jakielski, and Marquardt (1998) showed that while children with Developmental Apraxia of Speech (DAS) displayed similar vowel inventories as children with typically developing speech, they show lower vowel accuracy in that 96% accuracy is not achieved until age of six. This study also showed that children with DAS demonstrate inconsistent vowel error patterns across productions, which could potentially be a diagnostic marker for identifying DAS. Thus, understanding patterns of vowels produced by young children is as important as understanding patterns of consonants for accurately assessing phonological development of a child. In the current study, five vowels that carry unique dialectal features of SVS and specifically New Orleans dialect will be examined by analyzing vowels produced by 2- and 3-year-olds, who were born and raised in monolingual English-speaking homes, specifically in the New Orleans area within the deep south of Louisiana.

When studying children’s speech productions, researchers have used various methods, the most prominent of which are single-word elicitation task, imitative or conversational speech. Specifically, for the studies that have examined the existence of a dialectal patterns in young children, single-word elicitation task has been most commonly used. For example, Jacewicz, Fox, and Salmons (2011), studied vowels produced by 8 to 12 year old children using a single-word elicitation task, especially in hVd context to minimize the effect of the surrounding phonetic contexts. This study showed that all the children in this age range demonstrate the aspects of their dialectal patterns in the hVd context. In another study by McGowan et al. (2014),
the formant frequencies of vowels produced by six children were examined using two different tasks: immediate imitation from a researcher and spontaneous speech during conversation. This study showed that children as young as 42 months exhibit characteristics of their respective dialects; however, it was not noted if the children showed the acoustic characteristics of their dialects more frequently in one of the two contexts studied, imitative or conversational. Therefore, it was not clear which context is more conducive to acoustic markers of dialect – single-word elicitation tasks or sentence imitation. The second aim of this study was to examine this issue, the context in which features of dialects are more prominently elicited.

**Research Questions**

In the current study, acoustic patterns of five vowels produced by young children who were born and raised in the New Orleans area, who were assumed to carry the unique features of the New Orleans dialect were examined. Specifically, two different elicitation tasks were used to elicit the five target vowels. This was to examine the following two research questions:

1. Do young children develop patterns of their dialect as early as 3 years of age?

   It was hypothesized that children produce some features of their regional dialect as early as the ages of three, but not as clearly as those shown in older children based on the findings of the previous studies described in the previous section.

2. Are dialectal features of regional dialect more prominent in sentence imitation or single-word contexts?

   Given that dialect is more prominently seen in conversational contexts (McGowan et al., 2014), it was hypothesized that the sentence imitation context would yield more clear dialectal features than the single word context.
METHODS

Participants

Participants included five children, aged three years, who were born and raised in the suburban areas of New Orleans (e.g., Metairie and Lakeview) in the Figure 2 below.

![Map of New Orleans and Suburbs](image)

Figure 2. New Orleans and Suburbs, Metairie and Lakeview (Google Maps, 2019)

Children were recruited using various means including word-of-mouth and emails sent to interested parents. All recruitment procedures and methods were approved by the Institutional Review Board at LSU. Inclusion criteria required hearing, receptive language, articulation, and oral motor skills all to be within normal limits. All participants were screened for their oral motor structure and function and hearing. Each child’s receptive language was measured using
the standardized test of receptive language, the *Peabody Picture Vocabulary Test – 4th Edition* (PPVT-4; Dunn & Dunn, 2007). All had no history of speech, language, or hearing disorders, and speech, hearing, and receptive language were found to be within normal limits. All but one child (CN03) completed all testing procedures. Due to lack of compliance, CN03 did not complete all testing procedures and was not included in the data analysis. For the final analysis, data from 4 children were included.

In order to control for language and dialect influences, only children who were born and raised in a monolingual Southern White English (SWE) speaking environment were included in the current study. The linguistic background of each child and their parents were determined by a parent questionnaire (see Appendix A). Each child’s articulation skill was measured using the standardized test of articulation, *Goldman-Fristoe Test of Articulation-3rd Edition* (GFTA-3; Goldman & Fristoe, 2015), and only children with a standardized score of 85 or higher were included. The detailed background of each participants is summarized in Table 2.

Table 2. Participant Information

<table>
<thead>
<tr>
<th>ID</th>
<th>Age (yr; month)</th>
<th>Gender</th>
<th>Language background</th>
<th>Current city of residence</th>
<th>GFTA-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN01</td>
<td>3;9</td>
<td>M</td>
<td>Mother: born and lived in New Orleans throughout her life; Father: born and raised Atlanta, GA, lived in New Orleans for 8 years</td>
<td>Lakeview</td>
<td>113</td>
</tr>
<tr>
<td>CN02</td>
<td>3;11</td>
<td>M</td>
<td>Both parents born, raised, and has lived in New Orleans for 15 years after a move to Mississippi</td>
<td>Metairie</td>
<td>108</td>
</tr>
<tr>
<td>CN04</td>
<td>3;4</td>
<td>M</td>
<td>Both parents born, raised, and lived in the area for 25 years</td>
<td>Metairie</td>
<td>93</td>
</tr>
<tr>
<td>CN05</td>
<td>3;1</td>
<td>F</td>
<td>Both parents born, raised and lived in the New Orleans for &gt; 30 years.</td>
<td>Metairie</td>
<td>105</td>
</tr>
</tbody>
</table>
Stimuli

Target stimuli were 25 monosyllabic single words containing English vowels /i/, /ɪ/, /ʊ/, /u/, and /æ/. In this study, both the word elicitation (picture-naming) and sentence repetition tasks were used to elicit target vowels. Tasks were counterbalanced to account for participant fatigue. Target words were real words that were within the vocabulary of young children. The codas of all target words were controlled to be voiceless in order to avoid an effect on vowel duration, and all onsets were stops or voiceless fricatives for the same reason. The detailed list of target words is summarized in Table 3.

Table 3. List of Target Words

<table>
<thead>
<tr>
<th>Target Vowels</th>
<th>Words</th>
<th>Number of Words</th>
</tr>
</thead>
<tbody>
<tr>
<td>/i/</td>
<td>feet, beep, seat, peek, seek</td>
<td>5</td>
</tr>
<tr>
<td>/ɪ/</td>
<td>kick, pick, sip, hit, hip</td>
<td>5</td>
</tr>
<tr>
<td>/ʊ/</td>
<td>book, cook, hook, took, foot</td>
<td>5</td>
</tr>
<tr>
<td>/u/</td>
<td>tooth, juice, boots, soup, hoop</td>
<td>5</td>
</tr>
<tr>
<td>/æ/</td>
<td>pat, sat, cat, back, hat</td>
<td>5</td>
</tr>
</tbody>
</table>

**TOTAL**        25

For the sentence repetition task, 25 sentences that included each of the above listed target vowels were used. Each sentence included two to five morphemes, which are the average number of morphemes appropriate for children ages 2;6 to produce (Brown, 1973). A list of all target sentences is provided in Table 4.

Table 4. List of Target Sentences

<table>
<thead>
<tr>
<th>Target Vowels</th>
<th>Sentences</th>
<th>Number of target sentences</th>
</tr>
</thead>
<tbody>
<tr>
<td>/i/</td>
<td>See the feet</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Car goes beep</td>
<td></td>
</tr>
<tr>
<td></td>
<td>See the seat</td>
<td></td>
</tr>
<tr>
<td></td>
<td>See him peek</td>
<td></td>
</tr>
<tr>
<td></td>
<td>See them seek</td>
<td></td>
</tr>
</tbody>
</table>

(table cont’d)
<table>
<thead>
<tr>
<th>Target Vowels</th>
<th>Sentences</th>
<th>Number of target sentences</th>
</tr>
</thead>
</table>
| /i/          | See him **kick**  
See him **pick**  
See her **sip**  
See him **hit**  
See his **hips** | 5 |
| /ɔ/          | See the **book**  
See him **cook**  
See the **hook**  
She **took**  
See the **foot** | 5 |
| /u/          | See the **tooth**  
See the **juice**  
See the **boots**  
See the **soup**  
See the **hoop** | 5 |
| /æ/          | See her **pat**  
He **sat**  
See the **cat**  
See her **back**  
See the **hat** | 5 |
| **TOTAL**    |           | 25 |

(table cont’d)

**Procedures**

All recordings took place in the child’s home. Each participant’s parent/guardian was first asked to complete a consent form and a short questionnaire. This was followed by a set of screening tasks, as described above. After the screening procedures were completed, the participant began the testing procedures. First, for the word-elicitation task, each child was seated in front of a laptop screen where pictures corresponding to each target word was presented. Each child was asked to name the object or action displayed on a laptop screen (Figure 3). A short practice session was provided prior to the actual experiment to familiarize the child to the testing procedure. After each child became familiar with the testing procedures, target words were elicited spontaneously.
Figure 3. The sample picture of the target word *book*. This was used for picture-naming and sentence repetition tasks.

Upon the completion of the word-elicitation task, each child was asked to begin the sentence imitation task. For this task, each child was asked to imitate a list of short phrases or sentences after the model sentence was provided. Two models were provided to each child, one from a monolingual English speaker who is from Kenner, Louisiana, (1st author) and the second from a speaker from Urbandale, Iowa. Both speakers were graduate students in the Communication Disorders department at the Louisiana State University (LSU). The first speaker lived in Baton Rouge for six years and the second for less than one year to attend graduate school. Each block that contained speech models of each of the above-mentioned speaker were played to each child participant. The order of the block alternated between participants. The same picture used for the picture-naming task was shown during the sentence imitation task in order to provide a child with a context for the target sentences. All productions were recorded using a high-quality audio recorder (Marantz Professional PMD661) and a microphone (Shure Wired Microphone SM58) at a sampling rate of 44,100 Hz.
Analyses

All the analyses were performed using an open-access speech analysis program, *Praat* (Boersma & Weenink, 2019). For each target vowel, the first two formant frequencies at the vowel midpoint and vowel duration were measured. The first two formant frequencies at the vowel midpoint were measured as this is one of the most widely accepted methods for measuring vowel acoustic characteristics and also comparing vowel development within and between children over time (e.g., Hillenbrand et al., 1995; McGowan et al., 2014) and vowel duration was measured as Southern vowels are characterized as having longer vowel duration than the other regional dialects of American English (e.g., Clopper, Pisoni, & De Jong, 2005; Fridland, Kendall, & Farrington, 2014).

For each target vowel, first, vowel boundaries were defined. The onset of the vowel was defined as the place where the clear glottal pulses could be seen and the vowel offset was defined as the last point where the last clear glottal pulse showed and the point in which there was a loss of clear F2 formant patterns. Then, the first two formant frequencies at the vowel midpoint and the duration of each vowel were extracted. Figure 4 shows an example of vowel boundaries.

Figure 4. Vowel boundaries of the vowel /ʊ/ as in the word *cook*. 
Because the data obtained can be complicated with the difference of vocal tract sizes between adults and the children, the data were normalized using the Lobanov method (Lobanov, 1971) (with Vowels package (Kendall & Thomas, 2009) for R (R Core Team, 2014) to examine the true phonetic differences across vowel patterns. This method is commonly used in the field of Speech-Language Pathology in order to negate the effect of differing vocal tract sizes while maintaining the “true” characteristics of vowels including dialectal features.
RESULTS

In order to answer the two raised research questions, i) do young children develop patterns of their dialect as early as three years of age, and 2) are dialectal features of regional dialect more prominent in sentence imitation or single-word contexts, vowels produced by each child across the tasks were analyzed. To compare the children’s vowel patterns to those of adults who provided the model speech, all the vowel productions were normalized to account for an effect from the varying vocal tract sizes.

Picture Naming Task

As for the acoustic patterns of the five vowels (/i, ɪ, u, ũ, æ/) elicited using the picture naming task, the focus was on examining the existence of the following features: i) /i/-/ɪ/ reversal, ii) /u/ fronting, and iii) tensed /æ/, all of which are the key features of the New Orleans dialect. This analysis was performed descriptively and the midpoint measured F1 and F2 of the five target vowels of all four children and these patterns are depicted in Figure 5.

First, as can be observed in Figure 5, consistent with our hypothesis, no evidence of /i/-/ɪ/ acoustic reversal was observed. Across all four participants, /i/-/ɪ/ pairs maintained relative separation from one another, with no clear evidence of /i/ backing and lowering and /ɪ/ fronting or raising. Some overlapping patterns of /i/ and /ɪ/ were found in CN01 as many of his /ɪ/ productions were more fronted than those of the other three children. However, even this child’s productions of /i/ were still more fronted and raised as compared to those of /ɪ/, with no evidence of acoustic reversal. One noticeable pattern was from CN04 whose /ɪ/ vowels were lowered and backed as compared to those of other children, whose patterns were very closer to those of /æ/ and /ʊ/. Perceptually, his /ɪ/ vowels were very similar to /ɛ/.
Figure 5. Picture-naming task F1 and F2 values of 5 vowels (/i, ɪ, æ, ʊ, u/) of each child. Each vowel symbol in light grey represents productions of each vowel and those in black represent mean F1 and F2 of each vowel.

Second, as for /u/ fronting, two of the four participants, CN02 and CN04, showed clear /u/ fronting. The F2 of /u/ of these two children were similar to or higher than those of /ʊ/. However, no clear /u/ fronting was observed for CN01. The F2 of /u/ for this child was consistently lower than those of /ʊ/, except for the one token. For CN05, some overlapping F2 patterns of /u/ and /ʊ/ was noted but overall, F2 values of /u/ were not as high as those observed in /u/ of CN02 and CN05. For the patterns of CN04, a wide range of F2 patterns were observed. Two of five of his /u/ vowels had F2 values very similar to those of /i/, while the other three showed F2 lower than 2000Hz. Different from /u/ of the four other children, those of CN04 did not show overlap with /ʊ/.

Third, as for the /æ/ pattern, all four participants generated relatively stable patterns as compared to those of the other four vowels, except for CN02 whose F1 varied across his productions of /æ/. As for the existence of tensed or laxed /æ/, this cannot be determined because of the lack of a reference point, which will be further discussed in the Discussion section.

In summary, the acoustic patterns of vowels varied among each of the children. While two of the four children, CN02 and CN04, showed some evidence of /u/ fronting, this pattern
was not clearly demonstrated in the other two children CN01 and CN05. As no firm conclusion could be based on these findings using visual inspection, in the next section, further analysis was performed after the data was normalized.

**Sentence Imitation Task**

To determine if dialectal features of the New Orleans dialect are more prominent in sentence imitation or single-word contexts, vowel patterns of the children that were elicited after two different model adult speech were examined. Two model speech were provided, one from those of a speaker with the same dialectal background as children (New Orleans speaker) and the other from a speaker with a different regional background (Urbandale, IA speaker).

**Vowel formant patterns**

The acoustic patterns of five vowels produced by each of the two speakers are illustrated in Figure 6.

As can be observed in Figure 6, both speakers did not show an evidence of /i/ - /ɪ/ reversal, and showed a clear distinction between the two vowels. For the /u/-/ʊ/ pattern, the Iowa speaker demonstrated greater degree /u/-/u/ overlap than the Louisiana speaker; however, her productions of /u/ were similar to the Louisiana speaker in that /u/ was consistently more fronted than /u/. As compared to their productions of /ʊ/, both speakers maintained higher F2 values for /u/, which indicates more fronted productions of /u/ than /ʊ/. Lastly, while both speakers demonstrated some variety in their productions, more fronted and raised /æ/ that typically show when /æ/ is preceded by either a front nasal, voiceless fricative, or voiced stop was not clearly present.
Figure 6. Adult model productions’ F1 and F2 values of 5 vowels (/i, ɪ, æ, ʊ, u/). The figure on the left shows vowels produced by the New Orleans speaker and the figure on the right shows vowels produced by the Iowa speaker. Each vowel symbol in light grey represents productions of each vowel and those in black represent mean F1 and F2 of each vowel.

Overall, the results showed that while it was originally anticipated that the two speakers would show distinct patterns of their respective dialects, the chosen models’ productions of each vowel were relatively similar to each other. The implications of this acoustic similarity of vowels produced by the two adult speakers to the overall findings of the current study will be discussed further in the Discussion.

Figure 7. Sentence imitation F1 and F2 values of 5 vowels (/i, ɪ, æ, ʊ, u/) of each child. Each vowel symbol in light grey represents productions of each vowel, and those in black represent mean F1 and F2 of each vowel.

(fig. cont’d)
The patterns of vowels produced by young children were then compared to those of adults. While CN01 and CN02 demonstrated more /u/ fronting when imitating the models as compared to their spontaneous productions, both children demonstrated relatively consistent patterns for the other four vowels. Similarly, CN04’s spontaneous and repetition productions were consistent and did not exhibit any clear difference across tasks. For CN05, the primary
difference seen between her spontaneous and imitative productions is that she showed more stable productions of each vowel when imitating each of the models.

First, the repetition productions were compared with the adult models for evidence or lack of the /i/-/ɪ/ reversal. Three of four participants demonstrated relatively distinct /i/ and /ɪ/ productions, regardless of the model provided by exhibiting lower F1 and higher F2 values for /i/ compared to /ɪ/. CN01 demonstrated more overlap between these two vowels when repeating the model produced by the New Orleans speaker, which is particularly interesting given the model speaker’s distinct productions of these vowels.

Second, each of the productions were examined for /u/ fronting. As seen in the spontaneous speech productions, /u/ and /ʊ/ were overlapped across models for many of the children. While CN01 demonstrated distinct productions of /u/ and /ʊ/ with clear /u/ fronting, these vowels were separate from each other regardless of the model; however, CN01 did not demonstrate /u/ fronting during spontaneous speech. This indicates that CN01’s vowel productions were influenced by the models provided while the other three children’s vowel productions were not.

Third, the participants’ productions of /æ/ were evaluated following the repetition task. All four speakers demonstrated consistent productions of /æ/ between models. While each child had some outlying productions of /æ/, their mean F1 and F2 values were consistent.

These three patterns together indicate that, with some exceptions, the participants’ productions of each vowel were not dependent on the model provided. Therefore, these three-year-old children do not alter their vowel productions when provided with differing models.
As the patterns shown in Figures 6-7 could be complicated by the effect of different vocal tract sizes across adults and children, the data was normalized using the Lobanov method (Lobanov, 1971).

Figure 8. Adult and child normalized F1 and F2 values of 5 vowels (/ɪ, ɪ, æ, ʊ, u/). Each vowel symbol in light grey represents productions of each vowel, and those in black represent mean F1 and F2 of each vowel.

(fig. cont’d)
Even after the normalization, the overall patterns of child’s vowels remained very similar to the patterns from the raw F1 and F2 measures. The vowels of the two adult speakers still showed similar patterns to each other with no apparent dialectal differences; no acoustic reversal of /i/-/ɪ/ pair, clear evidence of /u/ fronting, and stable productions of /æ/ with no clear split as seen in the Labov (2006) study. The overlap in F2 patterns between /u/ and /ɪ/ was also evident in the Lobanov normalized F1 and F2 patterns for both adult speakers. Confirming the patterns observed in figure 9, no clear difference in vowels across the three elicitation conditions were shown, except the pattern showing less variability when repeated after the model productions.

**Vowel Duration**

The duration of vowels across different tasks were measured to examine the second research question, if features of regional dialect are more prominent in sentence imitation or single-word contexts. [this are depicted in figure 9] The repeated measures of ANOVA were used to examine the effect of different tasks on vowel duration for each of the five vowels. The result showed no significant differences in vowel duration across the tasks (spontaneous single-word, LA sentence imitation, and IA sentence imitation) for all five vowels (/i/: [F(2,9)= 3.99, p=0.06]; /ɪ/: [F(2,9)= 0.54, p=0.60]; /u/: [F(2,9)= 1.14, p=0.36]; /u/: [F(2,9)= 0.29, p=0.75]; /æ/: [F(2,9)= 0.50, p=0.62]). The Tukey HSD post hoc analysis showed that the only significant difference was found in the /i/ vowels, between the duration of /i/ elicited in spontaneous single-word
context was longer than those of the sentence imitation after LA speaker (spontaneous > LA sentence imitation, p=0.03). None of the other vowel categories showed significant duration differences across tasks, suggesting no effect of task on acoustic realization of dialectal features in vowels of young children.

It was anticipated that the children’s vowel durations would be longer when repeating the Louisiana model because one characteristic of Southern dialects is an increased vowel duration. Besides the difference in the speakers’ productions of /æ/, the Louisiana and Iowa speakers’ vowels were generally similar in duration as seen in Table 5. This was expected given that the vowels were elicited in short sentences in a lab setting.

![Figure 9. Average child vowel durations for each task.](image)

![Table 5. Average vowel durations for each adult speaker in milliseconds (ms).](image)
<table>
<thead>
<tr>
<th></th>
<th>/i/</th>
<th>/ʌ/</th>
<th>/ɒ/</th>
<th>/u/</th>
<th>/æ/</th>
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<td>135 (18)</td>
<td>131 (18)</td>
<td>160 (22)</td>
<td>178 (40)</td>
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<tr>
<td>IA speaker</td>
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<td>135 (6)</td>
<td>118 (20)</td>
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DISCUSSION

In this study, two research questions were examined, 1) do young children develop patterns of their dialect as early as 3 years of age and 2) are dialectal features of regional dialect more prominent in sentence imitation than in single-word contexts? Five vowels elicited using three different conditions were analyzed by using vowel midpoint extracted F1 and F2 values as well as vowel duration. The result showed that not all children develop patterns of their dialect as early as 3 years of age. For example, although all the children were born and raised in the home environment where both parents were speakers of the New Orleans dialect, no apparent patterns of /u/ fronting as well as fronted and raised /æ/ were observed. Even for the /i/-/ɪ/ reversal, while the children demonstrated separated productions of /i/ and /ɪ/ across tasks, this may be credited to the similarity in the two models’ productions of /i/ and /ɪ/.

There are two potential explanations for the relatively less apparent dialectal patterns in vowels produced by young children. One reason is that these children (and their parents) could be exhibiting what Koops (2014) refers to as the “de-Southernization” of the Southern regional dialects. This means that younger generations are not exhibiting as many or as clear characteristics of the Southern dialect due to the influence of non-southerners in these areas.

The second reason why these children demonstrated a lack of the New Orleans patterns is that each child’s language input is different. Their parents may vary in the degree in which the New Orleans dialect affects their speech. This means the input each child is receiving is different and could affect the development of the dialect.

For the second research question, vowels produced using a sentence imitation task did not elicit more aspects of regional dialect than those elicited using a single-word elicitation task, which differs from our initial hypothesis. This may have been caused by two reasons:
First, the New Orleans speaker used in the current study has lived in Baton Rouge, Louisiana for six years for school. Her vowels may be more neutralized than someone who has lived in New Orleans for their entire life. Therefore, the children were not receiving a model with a clear New Orleans dialect to imitate. Second, because the New Orleans speaker’s sentences were collected in a laboratory setting, the dialectal features of her speech may have been less evident as compared to when speaking in a less formal setting.

Implications

While it is premature to make any firm conclusions based on the findings of the current study due to the small number of participants, some of the implications may include the following. First, different from our initial hypothesis, we did not see an effect of different elicitation tasks on the acoustic characteristics of vowels produced by children. Regardless of how the vowels were elicited, children tended to maintain their own vowel patterns. This suggests that either elicitation method, spontaneous picture naming or sentence imitation, would elicit similar patterns of vowels. This finding also indicates that young children are less sensitive to the speech input provided to them, which suggests that using a therapist’s speech as a model production during an intervention does not necessarily alter the phonetic characteristics of a child’s vowels. Again, these implications cannot be confirmed until more research is conducted with similar results.

Limitations and future direction

Although the current study provided the preliminary findings on the development of dialectal features in vowels produced by young children, there were limitations that need to be addressed in the future studies. First, there were only four children included in this study. To make a firm conclusion, future research should include a larger number of participants,
specifically with a wider age range. It is also suggested that future studies control for socio-economic status as this can also affect dialect development. Second, the Louisiana model provided did not carry clear features of the New Orleans dialect. In order to see if children respond to the model speech provided, future studies should include a model produced by someone with a more-apparent New Orleans dialect, such as one from an older generation. This will determine if this causes more aspects of the dialect to be seen in children’s speech. Third, the current study included only F1 and F2 measured at the vowel midpoint. Studies have shown that inclusion of the changes in formant patterns across the vowel duration (inherent spectral change) provide more accurate characteristics of vowels than only vowel midpoint F1 and F2 (Morrison, 2013). Therefore, future studies should include the use of these acoustic measures.
References


Templin, M. C. (1957). Certain language skills in children; their development and interrelationships.


Appendix A. Parent Questionnaire

Participant Questionnaire

Thank you very much for your interest in our study.

Please complete this brief questionnaire about you and your child and hand it to an investigator.

Child’s name: ____________________________  Parent(s) name: ____________________________

Parent(s) e-mail address: ____________________  Parent(s) phone number:____________________

Child’s date of birth: _______________________  Child’s gender: __________________________

Where was your child born? __________________________

How long has your child lived in Louisiana? __________________________

What is your child’s primary language? __________________________

What is your/primary caregiver’s language? __________________________

Does your child speak English at home? Yes ______ No ______

Does your child speak English at school or daycare? Yes ______ No ______

If you chose No for either question, what other languages does your child speak at home, school, or daycare?

________________________________________________________________________

Where were you born? __________________________

Where have you (child’s parents) lived in your life and for how long?
(e.g.; Southern California – 5 years; Madison, Wisconsin – 3 years)

________________________________________________________________________

________________________________________________________________________
Appendix B. Adult Models and Child Participants Average F1 and F2 Values

<table>
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<th>SPONTANEOUS PRODUCTIONS</th>
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Average F1 and F2 Model Speakers
VITA

Rebecca Elise Dorsa first attended Louisiana State University where she earned her Bachelor of Arts in Communication Disorders in December 2016. She began her Master of Arts degree in August 2017 at Louisiana State University and will graduate in May of 2019. Her thesis was completed under the guidance of Dr. Hyunju Chung. Upon graduation, Rebecca plans to work as a clinical fellow speech-language pathologist in a private practice setting.