ABSTRACT
This investigation explores the role of dialect in phonological processing. Perception tasks were utilized to assess the perception of final consonant voicing in children who speak African American English (AAE). Nonsense vowel-consonant syllables containing plosives were manipulated to change the final consonant from voiced to voiceless by manipulating vowel and stop gap duration. These stimuli were then placed in a same-different and a continuum task. Analysis with signal detection theory indicated that the children were not able to reliably perform the same-different task. However, results from the continuum task revealed significant effects for grade level and dialect use. These findings suggest that phonetic differences can influence perception in dialect speakers.

Keywords: Categorical perception, dialect, final consonant devoicing, African American English.

1. INTRODUCTION
It is crucial for children to develop fundamental phonological processing skills so that they are less likely to suffer from academic failure in the future. To better assess the role of phonological knowledge in literacy, one must understand the importance of its component parts. Munson, Edwards, and Beckman [1] suggest that there are four different types of phonological knowledge: perceptual knowledge, articulatory knowledge, higher-level phonological knowledge, and social indexical knowledge. These types of knowledge range from the basic acoustic-perceptual knowledge, including the categorical structure of sounds, to how society influences word use.

Children at risk for reading problems have difficulty perceiving critical differences in speech sounds [2-3]. These children tend to rely more heavily on context than the acoustic qualities of sound to facilitate word reading. Nittrouer and Burton [4] have considered the role of early experiences on the development of speech perception. They noted that children utilize different perceptual weighting strategies than adults when they differentiate phonemes. Children with otitis media with effusion (OME) and those from low socioeconomic backgrounds showed less accurate knowledge of these weighting strategies than other typically developing children of similar chronological ages. In another study, researchers found that children with phonological disorders needed more acoustic information to identify the final consonant in similar sounding words [3]. These studies support the idea that the integrity of phonological representations is critical in the development of word knowledge.

Another factor that might influence phonological representations is the use of dialect, like African American English (AAE) and dialects of British English. Several early studies have shown that there are production and perceptual differences when dialect speakers are compared to speakers of the more standard dialect [5-6]. These differences became more obvious when the task provided fewer contextual cues. Other studies have shown that phonological awareness and spelling ability are influenced by dialect [7-11], with errors being related to dialectal features of the language.

The findings described above would suggest that dialect may play a role in the noted Black-White achievement gap [12]. Therefore, more information is needed on the influence of dialect on the perception of acoustic features associated with AAE. The purpose of this study is to determine what effects that cues indicative of consonant voicing, such as vowel and stop closure duration, have on the perception of final consonant devoicing—a feature characteristic of AAE.

2. METHOD

2.1. Participants
Twenty-six monolingual children in kindergarten through grade 2 participated in this study. Inclusion criteria included: a) be between the ages of 5-7 years, b) be African American and speak
AAE c) pass a hearing screening, and d) pass a speech and language screening. The control group met the same inclusion criteria, except they did not have to be African American and they spoke a more standard dialect of English.

Four women, two Caucasian and two African American, provided the voice samples for the listening experiment. The African American women reported that they used AAE in their more casual conversations, but they recorded the speech samples in Standard American English (SAE).

2.2. Materials

2.2.1. Screening measures

A calibrated audiometer was used to test the children’s hearing in a quiet room. Hearing levels at 20dB were screened at 1000, 2000, and 4000 Hz. The local school protocol was used to assess the children’s speech and language development. This protocol measures various aspects of language as well as articulation. Teacher input also was obtained regarding speech and language abilities to informally confirm the results of the screeners.

The Diagnostic Evaluation of Language Variation (DELV) [13] The DELV was administered to determine if the children were dialect speakers. It is a screener that measures the child’s Language Variation Status. The results indicate the degree of language variation as a strong variation for Mainstreamed American English (MAE), some variation from MAE, or strong variation from MAE, which would classify them as speakers of AAE.

Portions of the Comprehensive Test of Phonological Processing (CTOPP) [14] was administered in order to gain information regarding the child’s phonological awareness abilities prior to testing. Two versions of the test were used depending on the ages of the participants. One version is for ages 5 and 6 while the other is for ages 7 to 24.

2.2.2. Stimuli

VC nonsense syllables were created using all plosives paired with /l, a, ð, N/. Any syllables that resulted in real words were eliminated. The syllables were digitized and analyzed in Praat [15]. Closure duration for the final plosive and the preceding vowel duration were computed for both the voiceless and voiced syllables. To turn a voiced cognate into a voiceless sound, it was necessary to extract milliseconds from the vowel duration and add time to the closure duration. Since the vowel and closure durations were different across the various stimulus items, it was necessary to normalize the changes that were to be made to each syllable so that an equal number of comparisons for each stimulus item could be created. The two acoustic parameters were changed together for each syllable over four separate manipulations in 25% increments. The end result was a change from a voiced to voiceless consonant.

2.2.3. Paired Comparison task

The acoustically manipulated stimuli pairs were placed into EcoS/Win [16] experiment generator. The participant listened to the stimuli pair and clicked “same” (a happy face) or “different” (a sad face) to note if they heard a difference between the two stimuli. Stimuli with same or different percentage changes were compared. The computer recorded if the participant chose the correct answer.

2.2.4. Continuum task

This task is similar to a categorical perception task and was developed using EcoS/Win. For this task, there were five numbered boxes each representing a sound along the continuum from voiced to voiceless. When the participants heard a change or shift in the sound from the voiced to the voiceless phoneme, they were instructed to press the button that corresponded to the point where they heard the shift. The stimuli were presented in a sequential order starting from the voiced or voiceless VC syllable and moving in order from 25% to 100% manipulation. The last stimuli presented were the cognate of the first. The child was instructed to indicate where they heard the phoneme change.

2.3. Procedures

On the first day of testing, the children were brought from their classroom into a quiet, individual room on the school’s property. They completed the hearing screening, speech/language screening, language variation screener, and phonological awareness screener. The order of these screening tests was randomized in order to account for fatigue.
The second day of testing occurred within two weeks of the previous session. The children were brought into the same testing room and instructed to sit down at a laptop computer. The children were instructed as to the nature of the task and given a set of headphones to wear. A trial run using the EcoS/Win experiment generator was administered first in order to train the subjects to the task. Trial runs for both types of tasks were administered. Once the researcher felt that the participant was acquainted with the equipment, the test stimuli were presented. During the same-different experiment, 130 individual stimuli were administered. During the continuum experiment, 24 individual continua were presented.

2.4. Data reduction

The data from the same-different task were analyzed for hits and false alarms so that the responses could be analyzed with signal detection theory. Frequency counts were tabulated for the continuum data and means were computed for listener mean ratings across speakers and consonants.

3. RESULTS AND DISCUSSION

3.1. Same-different task

Listener responses for the same different task were analyzed using the d’ measure from signal detection theory [17]. In this case, the d’ measure assigns a numeric value to the listener’s ability to identify the same stimuli, taking into account the listener’s response bias. Listener bias is considered by analyzing both the listener’s hit rate and false alarm rate. The hit rate was when the child responded correctly to the speech stimuli. The false alarm rate was when the child responded that the stimulus was the “same” when it was actually “different”.

To analyze the effects of dialect use and grade, differences in mean d’ between conditions were analyzed using two Kruskal-Wallis ANOVAs. No significant differences were found for dialect use, $\chi^2(1) = .020, p = .889$ or for grade, $\chi^2(2) = 1.223, p = .542$. Further analysis of the data revealed that only 19/26 children were able to perform the task with a d’ value of 1.0 or greater. No values exceeded 2.0. These values would suggest that most of the children were able to perform the task, but that the same-different task was quite difficult.

3.2. Continuum task

The data from the continuum task were analyzed with chi-square analyses to determine differences in response patterns across the speech signal continuum. Frequency counts for each number on the continuum were obtained for each child. These counts were then summed across participants by dialect status and by grade.

The chi-square analysis for differences in response patterns attributable to dialect status was significant, $\chi^2(3) = 24.35, p < .01$. As illustrated in Figure 1, the speakers of AAE chose the last point on the continuum most frequently, while SAE speakers selected points 3 and 4 more often, with the selection of 5 occurring more frequently. These findings would suggest that the use of final consonant devoicing may be a factor influencing the patterns of performance. Since the stimuli were manipulated from voiced to voiceless and vice versa, the selection of the final point on the continuum would indicate that the distinction between these two types of phonemes must be maximally different for the children to respond.

The chi-square analysis for differences in response patterns attributable to grade was significant, $\chi^2(6) = 12.55, p = .05$. As illustrated in Figure 2, students in kindergarten showed a steady increase in response, with the largest number of responses occurring at the final point in the continuum. This pattern suggests that they may have found the task difficult and did not hear the difference in voicing until the maximum difference was apparent. First graders picked the second point on the continuum most frequently and the second graders maintained a relatively constant response across the continuum, with the last point (#5) receiving the largest number of responses.
To note differences on this task that may be attributable to speaker, a three-way Multivariate Analysis of Variance (MANOVA) was run with consonant as the within subject factor and speaker and dialect as between-subject factors. The mean ratings served as the dependent variable. This analysis revealed a significant consonant by speaker interaction, $F(6,192) = 6.27, p < 0.001$, $\eta^2 = .164$. Post hoc testing with the Tukey A procedure revealed that listeners responded similarly to speakers 1 and 3. Speakers 2 and 4 demonstrated that variability in plosive production (see Figure 3). The noted differences here were not attributable to ethnicity.

These data demonstrate the need for interpretation of allophonic variation in speech perception tasks. Taken together, these results suggest that dialect use can influence the perception of phonetic aspects of speech. The impact of these differences in perception on phonological processing merits further investigation.

4. REFERENCES