JSLHR

Research Article

Dialect Awareness and Lexical Comprehension of Mainstream American English in African American English–Speaking Children

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Purpose: This study was designed to examine the relationships among minority dialect use, language ability, and young African American English (AAE)–speaking children's understanding and awareness of Mainstream American English (MAE).
Method: Eighty-three 4- to 8-year-old AAE-speaking children participated in 2 experimental tasks. One task evaluated their awareness of differences between MAE and AAE, whereas the other task evaluated their lexical comprehension of MAE in contexts that were ambiguous in AAE but unambiguous in MAE. Receptive and expressive vocabulary, receptive syntax, and dialect density were also assessed.
Results: The results of a series of mixed-effect models showed that children with larger expressive vocabularies performed better on both experimental tasks, relative to children with smaller expressive vocabularies. Dialect density was a significant predictor only of MAE lexical comprehension; children with higher levels of dialect density were less accurate on this task.
Conclusions: Both vocabulary size and dialect density independently influenced MAE lexical comprehension. The results suggest that children with high levels of nonmainstream dialect use have more difficulty understanding words in MAE, at least in challenging contexts, and suggest directions for future research.

Key Words: children, cultural and linguistic diversity, education, language, literacy, speech-language-pathology

American English is spoken in a variety of dialects associated with different racial/ethnic groups, geographic regions, and income strata (Wolfram & Schilling-Estes, 1998). Minority dialects such as African American English (AAE) or Southern White English are often contrasted with Standard (or Mainstream) American English (MAE; e.g., Oetting, 2004). Considerable research has examined whether use of a minority dialect has an impact on school achievement. Most of this research has focused on AAE and whether it is related to the Black–White achievement gap in reading (Labov, 1995; Washington, Terry, & Seidenberg, 2013). AAE and MAE not only overlap but also differ with respect to phonology, morphosyntax, and pragmatics (e.g., Craig & Washington, 1994; Rickford, 1999; Washington & Craig, 2002). Sociolinguistic research by Labov (1972) and others (see Rickford, Sweetland, & Rickford, 2004, for a review) has established that AAE is not a linguistically deficient version of the mainstream dialect. Rather, it is representative of the kind of dialectal variation that occurs in most spoken languages (Chambers, 1992). The unresolved questions are not about the linguistic validity of the dialect but rather about the sociocultural conditions under which it is used. In many cases, children speak the minority dialect in the home and community, but the mainstream dialect is used in school. There are further questions about which differences between dialects have a significant impact (positive or negative) and how they affect tasks such as learning to read. Determining whether dialect usage has an impact on children's learning is particularly important, because it can potentially be addressed more readily than other factors that contribute to the achievement gap, such as poverty and its various sequelae (e.g.,

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Editor: Rhea Paul
Associate Editor: Shelley Gray
Received August 23, 2013
Revision received January 20, 2014
Accepted May 29, 2014
DOI: 10.1044/2014_JSLHR-L-13-0228

Disclosure: The authors have declared that no competing interests existed at the time of publication.

poorer nutrition, health care, schools, access to educational resources). For example, recent research suggests that awareness and understanding of the mainstream dialect can be enhanced in short-term programs using contrastive analysis that are aimed at children in the pre-kindergarten to first-grade years (Craig, 2013; Edwards, Rosin, Gross, & Chen, 2013) and can also be taught successfully to older middle and high school children (Lybolt, Gottfred, Anderson, & Olszewski, 2009).

Some early studies revealed that the use of AAE had no impact on school achievement (e.g., Harber, 1977, as cited in Washington et al., 2013). However, in light of the persistence of the achievement gap, there has been a revival of research on the topic, using more advanced experimental methods and quantitative analysis tools. A growing body of research suggests that differences between the home and school dialects have important effects on children's performance (e.g., Charity, Scarborough, & Griffin, 2004; Connor & Craig, 2006; Craig, Kolenic, & Hensel, 2014; Craig, Zhang, Hensel, & Quinn, 2009; Terry & Connor, 2012; Terry, Connor, Petscher, & Conlin, 2012; Terry, Connor, Thomas-Tate, & Love, 2010). These are sometimes termed *dialect mismatch effects*, but the term has been used in different ways and should be interpreted cautiously.

In one of these more recent studies, Terry et al. (2010) found that first-grade children's use of nonmainstream dialect features (as measured using the *Diagnostic Evaluation of Language Variation* [DELV]; Seymour et al., 2005) was negatively correlated with standardized measures of vocabulary size and phonological awareness. In more recent work, Terry and colleagues (Terry & Connor, 2012; Terry et al., 2012) followed children from kindergarten to first grade and from first to second grade. Both studies revealed that nonmainstream dialect use, as measured by the DELV, was significantly and negatively predictive of reading ability; the greater the use of nonmainstream dialect at the earlier measurement point, the poorer the reading outcomes at the later measurement point.

Researchers have proposed several ways in which dialect mismatch may contribute to the achievement gap.[1] It is possible that dialect mismatch, in and of itself, may make learning more difficult. Children who speak a nonmainstream dialect may need to use greater cognitive resources simply to understand instruction in MAE, resulting in fewer cognitive resources that are available for understanding what is being taught (e.g., Harris & Schroeder, 2013). Furthermore, children who speak AAE, in particular, may have difficulty in decoding at early stages of learning to read, given the phonological differences between MAE and AAE (Labov, 1995). An alternative hypothesis is that the problem is not with dialect mismatch per se but that difficulty learning to code-switch from a nonmainstream dialect to MAE is a symptom of more general problems with linguistic flexibility and metalinguistic awareness (Craig et al., 2014; Terry, 2014; Terry & Connor, 2012; Terry et al., 2010, 2012). Clearly, these two explanations are not necessarily mutually exclusive. Furthermore, neither of these explanations is intended to explain *all* of the achievement gap. It is indisputable that there are many risk factors, both environmental and endogenous, that are associated with poverty; these factors contribute to the achievement gap in general and to poor language skills in particular.

Although recent studies have shown that there is a consistent relationship between higher levels of nonmainstream dialect use and poor literacy outcomes, at least in the early school years, it is still unclear why such correlations exist. The current study was designed to investigate factors that might inform our understanding of the relationship between AAE use and school achievement. We measured the "density" of AAE-speaking children's use of AAE and related this measure to children's performance on two experimental language tasks. The first task required participants to associate different-colored animated cartoon monsters with either AAE or MAE and was designed to evaluate one component of what is needed to learn how to dialect shift. In real life, in order to shift from one dialect to another (i.e., from AAE to MAE), children must make the implicit generalization that different groups of people defined along one or more dimensions (White people vs. Black people, people at home vs. people at school, etc.) speak differently. The dialect awareness task was particularly demanding, because it required that children make this generalization in a fairly explicit manner in a short period of time, given limited information about two groups of speakers (the cartoon monsters using different dialects). We would expect that children who performed well on this task would be successful dialect shifters in social contexts that demand it, such as a school setting. On the basis of previous research on successful dialect shifters, we would expect that such children would have larger vocabularies and lower levels of dialect density (e.g., Terry et al., 2010).

The second experiment was designed to measure directly how well the participants could comprehend MAE. Such a task is difficult to design, because there is so much overlap between MAE and AAE. We decided to examine comprehension of words that are ambiguous in AAE, but unambiguous in MAE, because of phonological or morphological differences between the two dialects. For example, the word *coal* is unambiguous in MAE but ambiguous in AAE; it could mean either *coal* or *cold* because of final consonant cluster reduction. The MAE lexical comprehension task is also fairly demanding, but for a different reason. This task requires children who are usually AAE users to interpret spoken words in terms of MAE phonology instead of AAE phonology.

We hypothesized that children who are better at comprehending words such as *coal* that are unambiguous in MAE but ambiguous in AAE would be children with stronger language skills and more experience with MAE, as evidenced by lower dialect density. We also predicted that

[1]A third explanation, which is not addressed in this study, is that teachers may have negative impressions of students who speak nonmainstream dialects (e.g., Labov, 1995), and it is well known that teacher expectations impact academic outcomes (e.g., Cooper, 1979).

there should be a relationship between performance on the two experimental tasks. Children who performed better on the dialect awareness task should be better able to learn to shift between AAE and MAE; therefore, performance on the dialect awareness task should be a predictor of performance on the MAE lexical comprehension task.

Method

Participants

The participants were 83 AAE-speaking children from 4 to 8 years of age (*M* = 6;3 [years; months], *SD* = 1;3, range = 4;0–8;9).[2] As described below, children's use of morphological and phonological features of AAE was evaluated from an informal language sample; all 83 participants used at least one feature of AAE. All children were typically developing, according to parent report, and children with individual educational plans were excluded from the study.[3] All children passed a hearing screening (25 dB at 500, 1000, 2000, and 4000 Hz) prior to testing. We asked all primary caregivers to complete a demographic questionnaire that included questions on the level of education of the primary caregiver and their total family income. This questionnaire was done in interview format or filled out independently, depending on the preference of the adult completing the form. All participants completed norm-referenced measures of expressive and receptive vocabulary (*Expressive Vocabulary Test, 2nd edition* [EVT-2]; Williams, 2007; *Peabody Picture Vocabulary Test—Fourth edition* [PPVT–4]; Dunn & Dunn, 2007, respectively) and a measure of receptive syntax, the Elaborated Phrases and Sentences subtest (EPS) from the *Test for Auditory Comprehension of Language—Third edition* (TACL–3; Carrow-Woolfolk, 1999).

[2]The original sample included 105 African American children from 4 to 8 years of age (*M* = 6;2, *SD* = 1;3, range = 4;0–8;9). There were 24–25 children in each year (4;0–4;11, 5;0–5;11, 6;0–6;11, 7;0–7;11) and nine 8-year-olds (all of whom were in second grade). The children were divided approximately evenly between male (*n* = 54) and female (*n* = 51) overall, and within each age group. However, 19 children were excluded from the analyses because they did not provide analyzable language samples, and an additional three children were excluded because they did not produce any AAE features on their language samples. These 22 children are not included in Table 1 or in any of the analyses.

[3]With young children (such as the 4-year-olds in our sample), it is always difficult to differentiate between dialect features and developmental language features when a morphological feature is omitted or a consonant substitution or deletion is produced (e.g., Oetting, Cantrell, & Horohov, 1999). For the nine children who produced only two or three dialect features, we examined their mean age and expressive vocabulary size to investigate whether these dialect features might actually be age-related developmental errors. This seems unlikely, as their mean age was the same as the group as a whole, but their mean EVT-2 standard score was higher (*M* = 6;3, *SD* = 0;3 for age; *M* = 101, *SD* = 2 for EVT-2 standard score). All other participants used at least six dialect features.

Stimuli

Dialect awareness task. The stimuli were recorded by six young adult female speakers of AAE and six young adult female speakers of MAE. All speakers of AAE were African American and were fluent dialect shifters between AAE and MAE. All speakers of MAE were European American and did not speak AAE. We included a relatively large number of speakers for the two dialects to facilitate generalization in terms of dialect differences rather than speaker differences and so that we could manipulate the familiarity/novelty of the speakers. As described below, three speakers of each dialect were included in the training phase, whereas the test phase included the three familiar speakers of each dialect as well as three novel speakers of each dialect. The speakers were recorded reading two children's books, *The Snowy Day* and *A Letter for Amy* (both by Ezra Jack Keats, 2011/1962; 1998/1968). For the AAE versions of the two stories, we developed AAE scripts (written by an AAE speaker) that contained both morphological and phonological features of AAE. However, as AAE is primarily a spoken rather than a written dialect and use of morphological and phonological features is optional rather than obligatory, we did not require the AAE speakers to follow the scripts exactly. Instead, the AAE speakers were simply instructed to read the stories in AAE, using the scripts as a guide. These recordings were divided into one- to two-sentence chunks. All chunks were normalized for amplitude across all 12 speakers. For the AAE versions of the stories, all one- to two-sentence chunks were rated by an AAE speaker on a 5-point scale (1 = *sparse dialect use*, and 5 = *dense dialect use*). Only stimuli that were rated as 4 or 5 were included in the study. Once the AAE one- to two-sentence chunks had been selected, we chose the same MAE one- to two-sentence chunks.

The visual stimuli for the dialect awareness task were six blue and six red cartoon "monsters." Each monster was paired with two voices, one AAE voice and one MAE voice. Assignment of each dialect to blue versus red monsters was counterbalanced across participants so that red monsters were associated with the AAE dialect for half the participants and with the MAE dialect for the other half. Each monster–voice pair was animated so that it looked as if the monster was "speaking" the sentences (i.e., the monster's mouth opened for vowels and closed for consonants). Each monster had distinct visual characteristics in addition to color in order to maintain children's interest in the task and to help children make the generalization that there are different blue monsters who speak one way and different red monsters who speak a different way.

Comprehension task. The stimuli for the comprehension task were chosen to highlight either a phonological or a morphological contrast between AAE and MAE. The phonological contrast is that, in AAE, the final /t/ or /d/ in a word-final consonant cluster may be deleted if the previous consonant agrees in voicing (e.g., *hold* is produced /hol/, *mist* is produced /mɪs/; Craig, Thompson, Washington, & Potter, 2003; Guy, 1980). Final consonant cluster deletion occurs in both AAE and MAE (particularly in spontaneous speech when the subsequent word is consonant-initial), but is more frequent in AAE. The morphological contrast is that the plural morpheme is optional rather than obligatory in AAE if another number word is present (e.g., *two cat*, *fifty cent*) (e.g., Washington & Craig, 2002). The stimuli for the comprehension task were 18 word pairs (nine for the phonological contrast and nine for the morphological contrast) that differed only in the presence or absence of a final consonant cluster. We included word pairs such as *goal–gold* for the phonological contrast and *cat–cats* for the morphological contrast. Appendix A provides a list of all stimuli for this task. Insofar as possible, all words were familiar to young children and pictureable. Because there are a limited number of possible word pairs for the phonological contrast, some of the target words were less familiar than others (e.g., *bill* and *coal* are less familiar than *ball* and *bus*), and some items were less pictureable than others (e.g., *start* and *hold* are less pictureable than *bald* and *belt*). For this reason, a word/picture familiarization phase was included for this task (see the Procedure section below).

Recordings of stimulus items by an AAE speaker were used in the familiarization phase because we wanted to familiarize children with the object-name–picture pairings in their native dialect. The target words were recorded in the phrase, "*Say _____ please*," so that the final consonant cluster was always followed by a word beginning with a consonant, as this is a phonological context that encourages final consonant cluster reduction. For the phonological contrast, final consonants in clusters were deleted or produced as glottal stops (e.g., *gold* was produced as "gol"). Nonetheless, words with singleton final consonants (mean duration = 5,525 ms) were consistently shorter than words with reduced final consonant clusters (mean duration = 6,019 ms). For the morphological contrast, the plural /s/ was produced on all items, but some consonants were deleted (e.g., *clouds* was produced without the /d/; *lights* was produced without the /t/). As with the phonological contrast, words in the singular form (mean duration = 5,852 ms) were consistently shorter than words in the plural form (mean duration = 6,281 ms). In the test phase, the stimuli were presented in MAE, and all final consonants and consonant clusters were clearly articulated.

Color photographs representing each word were used as visual images. The words were recorded by a young adult female speaking AAE for the training phase and by another young adult female speaking MAE for the test phase. All words were spoken in the carrier phrase *say ______ please* (familiarization phase) or *show me ______ please* (test phase), as word-final consonant cluster reduction is more frequent preceding a stop consonant. Words were normalized for amplitude, separately for the AAE and the MAE speakers.

Procedure

General. All children participated in two or three test sessions of about 1 hr each with breaks. Primary caregivers came with their children and completed the demographic questionnaire. The first session began with the hearing screening and a language sample.

Dialect awareness task. For each participant, all AAE monster–voice dyads were assigned to one color (either red or blue), and all MAE monster–voice dyads were assigned to the other color. Color assignment varied randomly across participants, with 50% of the participants receiving red-AAE/blue-MAE monster–voice dyads and the other 50% receiving the opposite pairing. The dialect awareness task included a training phase and a test phase. In the training phase, three monster–voice pairs for each dialect were presented. On each training trial, a red monster and a blue monster were presented on the opposite sides of a computer touch screen. Each monster, first the one on the left side and then the one on the right, would "say" the same one- or two-sentence chunk of the book, *The Snowy Day*. The first 20 sentences of the story (approximately two thirds of the story) were presented in order, with each one- or two-sentence story chunk presented twice (once in MAE and once in AAE). After each monster "talked," the participant was asked to "point to the monster that talked" on the touch screen. The participant could always tell which monster was "talking" from the animated lip movements. After a one- or two-sentence story chunk had been presented in both dialects, the next trial would begin. In each subsequent trial, the next one- or two-sentence story chunk was presented in both dialects. The position of the red and blue monsters on the right or left side of the screen varied across trials. There were 11 training trials altogether (with each one- or two-sentence chunk presented in both AAE and MAE). The children were not shown the books as the monsters were talking, and they were not told that the sentences they heard were from storybooks in either the training or the test phase. We did not ask the children or their caregivers whether they were familiar with the two stories.

In the test phase, six monster–voice pairs for each dialect were presented: Three were familiar because they had been presented in the training phase, and three were novel because they had not been presented before. In the test phase, as in the training phase, one red and one blue monster were presented on each trial, and the participant heard a one- or two-sentence chunk of a new story (*A Letter to Amy*). In the test phase, as in the training phase, the one- or two-sentence chunks were presented in the order of the story. The task was the same ("point to the monster that talked"), but in the test phase, the child heard the story segment only once (in either AAE or MAE) on each trial, and the monsters were not animated so that the child had no visual cues about which monster was talking. The only way that the participant could answer correctly was whether he or she had made the generalization from the training phase that red monsters speak AAE and blue monsters speak MAE (or vice versa). There were 34 test trials. The test phase was preceded by six practice trials using sentence chunks from *The Snowy Day*, three of which had been presented in the training phase and three of which were from a later part of the story that was not presented during training. The voice–monster dyads during the practice phase were the same six speakers from the training phase. The children were provided with scripted feedback (e.g., "That's not quite right. It was the red monster"). Responses were recorded on the touch screen and scored automatically.

Comprehension task. The comprehension task included a familiarization phase and a test phase. The purpose of the familiarization phase was to ensure that participants were familiar with all of the object-names and all of the object name–picture pairings. In this phase, a picture was shown on a computer screen, and the digitized recording of the name associated with the picture was presented in AAE, "*Say ___, please*." Immediately after this prompt, the participant named the picture. On the rare occasion that a participant forgot a picture-name, he or she was prompted again with the picture-name in AAE and asked to repeat it ("*Say __, please*"). In the test phase, the participant was presented with a randomly sequenced array of three pictures (target; distractor; foil as in *goal*, *gold*, *bus* or *cat*, *cats*, *bill*) and was asked to "*Show me ___.*" See Appendix A for a list of the foils for each target–distractor pair. The test phase was preceded by three practice trials to ensure that the child understood the task. There were 36 trials altogether; each stimulus pair (e.g., *cat–cats*) was presented twice, once with each member of the pair as the target. Because the task was presented in MAE, a response was considered correct only if it was correct in MAE (e.g., a child needed to point to *cat* if the prompt was *cat* and to *coal* if the prompt was *coal*). Responses were recorded by the child touching the picture on a touch screen and were scored automatically.

Dialect density. A 50-utterance language sample was elicited from all participants and recorded. The language sample was elicited in a conversational context (e.g., "What did you do last weekend?" "What's your favorite TV show?" etc.). The language samples were elicited by an AAE-speaking examiner.

Data Reduction and Analysis

For the two experimental tasks, the dependent variable was accuracy at the trial level (correct/incorrect). Both raw scores and standard scores were obtained from the EVT-2, the PPVT–4, and the EPS subtest of the TACL. Average scores for each age group are presented in Table 1.

Information from the demographic questionnaire about both education level and family income category was converted to *z*-scores. We used the average *z*-score of these two indicators as our measure of socioeconomic status (SES) in the statistical analyses (National Center for Education Statistics, 2001). Four primary caregivers did not complete questions about either education level or total family income (n = 3 for education level and n = 1 for family income). All caregivers completed at least one of these two questions. In these cases, the missing data for these four participants were imputed using the regression imputation method across the entire data set of 83 participants (Saunders et al., 2006).

The language samples were orthographically transcribed by an MAE speaker; these transcriptions were then checked and corrected by an AAE speaker who also coded the transcriptions for morphological and phonological dialect features, based on the coding system of Craig and Washington (2004). Orthographic transcription and dialect feature coding were done in Praat (Boersma, 2001), using a Praat script written specifically for this purpose. A representative 10% of the language samples were independently transcribed and coded by a second transcriber/coder. Interrater agreement at the word level for the orthographic transcriptions was 97%; interrater agreement at the token level for dialect features was 93%. Dialect density was calculated as the number of dialect features divided by the total number of words, as proposed by Oetting and McDonald (2002). The average dialect density across the 83 children was .06, and the range was .001–.28. These values are comparable to other studies in which dialect density in conversational speech has been examined (e.g., Craig & Washington, 2004; Horton-Ikard & Miller, 2004). Mean dialect density by age is given in Table 1. As in many previous studies (e.g., Van Hofwegen & Wolfram, 2010), there was a small but significant decrease in dialect density with age (r^2 = .08, p = .009).

Results

Overview

The data for both the dialect awareness task and the MAE lexical comprehension task were analyzed using mixed-effects logistic regression models. For both experimental tasks, we ran a series of mixed-effects models on these data to evaluate the effect of the two trial-level conditions and subject-level variables. The mixed-effects models were estimated using the R software program *lme4* (Bates, Maechler, & Bolker, 2012). The equations for all of the models are given in Appendix B. For each task, we built up these models incrementally. We used Akaike's information criterion to examine model fit; results for both of the tasks showed that model fit improved as subject-level variables were added. The first model for each task included accuracy at the trial level (correct or incorrect) as a function of two trial-level variables. For the dialect awareness task, the trial-level variables were speaker type (familiar vs. novel) and dialect (AAE vs. MAE); the familiar speaker type and the AAE dialect were the reference categories in all models. For the MAE lexical comprehension task, the trial-level variables were contrast type (phonological vs. morphological) and consonant number (singleton vs. consonant cluster); the phonological contrast type and the singleton consonant number were the reference categories in all models.

The second model for each task included subject-level variables at Level 2. These measures were age, expressive vocabulary size (EVT-2 raw score), dialect density, and

Table 1. Information on SES and mean standard scores by age group.

Variable	4;0–4;11	5;0–5;11	6;0–6;11	7;0–7;11	8;0–8;9	Total sample
Age [years;months]	4;7 (0;4)	5;5 (0;3)	6;5 (0;4)	7;7 (0;3)	8;4 (0;3)	6;3 (1;3)
Number of males/females	8 / 9	9 / 10	6 / 13	12 / 11	5 / 0	40 / 43
Average education level of primary caregiver[a]	3.82 (1.19)	2.79 (1.40)	3.47 (1.55)	3.39 (1.31)	2.80 (2.05)	3.32 (1.42)
Average family income[b]	1.65 (0.86)	1.81 (1.12)	1.74 (0.99)	1.78 (1.13)	1.40 (0.89)	1.73 (1.01)
PPVT–4 standard score	95 (10)	95 (13)	95 (9)	97 (13)	92 (10)	95 (11)
PPVT–4 raw score	67 (15)	81 (18)	98 (15)	117 (20)	121 (15)	95 (26)
EVT-2 standard score	96 (9)	94 (11)	96 (11)	96 (10)	90 (10)	95 (10)
EVT-2 raw score	54 (11)	61 (13)	77 (14)	88 (14)	88 (14)	72 (19)
TACL-EPS subtest scaled score	10 (2)	10 (2)	9 (2)	10 (2)	8.(3)	9 (2)
Dialect density	.09 (.08)	.07 (.06)	.05 (.04)	.04 (.05)	.08 (.05)	.06 (.06)

Note. SES = socioeconomic status; PPVT–4 = Peabody Picture Vocabulary Test—Fourth Edition; EVT-2 = Expressive Vocabulary Test—Second edition; TACL = Test for Auditory Comprehension of Language; EPS = Elaborated Phrases and Sentences subtest. Standard deviations appear in parentheses.

[a]The six-step scale for education level was 1 = less than high school degree, 2 = GED , 3 = high school degree, 4 = some college, 5 = college degree, and 6 = postgraduate degree. [b]The five-step scale for total family income level was 1 = below $20,000/year, 2 = $20,000–$40,000/year, 3 = $41,000–$60,000/year, 4 = $61,000–$100,000/year, and 5 = above $100,000/year.

SES.[4] For the MAE lexical comprehension model, accuracy on the dialect awareness task was also included as a subject-level variable. For all models, we included by-subject random intercepts and by-subject random slopes for the two trial-level variables in each model. In mixed-effects models (as in linear regression), a significant effect of a subject-level variable indicates that it is a significant predictor of performance, over and above the other variables in the model.

Dialect Awareness

The dialect awareness task is a two-alternative forced-choice task, and children have a 50% chance of choosing the correct answer by chance alone. The binomial probability theorem is a conservative method of determining whether individual children's performance is significantly above chance, at chance, or below chance, based on the number of response choices and the number of items. The accuracy level for being significantly above chance for this task at the $a = 0.05$ level was 67.64%. Only 44 out of 83 participants had a 67.64% or greater accuracy level, suggesting that this was a difficult task for our participants. As noted above, this task was demanding because it required that children make the implicit generalization that monsters of a particular color (red or blue) differ on the basis of how they speak (whether they speak AAE or MAE) without any explicit information from the examiner on what they should attend to. The participants who performed above chance were significantly older (M = 6;7, SD = 1;2) than the children below chance (M = 5;10, SD = 1;3), $t(81) = 2.88$, $p = .005$. The children above chance also produced significantly more words on their language samples ($M = 433.20$, $SD = 198.78$) relative to the children below chance ($M = 345.87$, $SD = 113.05$), $t(70) = 2.49$, $p = .015$.[5] No other comparisons between these two groups were significant. We included only those children in the statistical analyses whose performance was above chance.

As expected, children's mean accuracy varied across the four conditions: familiar AAE ($M = 92.68$, $SD = 12.44$), familiar MAE ($M = 91.92$, $SD = 11.33$), novel AAE ($M = 82.29$, $SD = 20.57$), and novel MAE ($M = 76.70$, $SD = 23.44$). Not surprisingly, children were more accurate at identifying the dialect of familiar monster–voice pairs than novel pairs. The first mixed-effects model included only the trial-level variables of accuracy as a function of speaker type and dialect. The familiar condition and AAE dialect were the reference categories of the model (see Equation 1 in Appendix B). The only significant effect was speaker type (Estimate = 1.26; $SE = 0.27$; $z = 4.65$; $p < .001$); accuracy was significantly higher for familiar monster–voice dyads relative to novel monster–voice dyads. This result is interesting because it shows that children of all ages rapidly learned individual monster–voice pairings.

We then added the subject-level variables to this model (see Equation 2 in Appendix B). In this model, the significant predictors were expressive vocabulary size (Estimate = 0.05; $SE = 0.02$; $z = 2.58$; $p = .010$) and two interactions, the interaction between SES and speaker type (Estimate = −.81; $SE = 0.29$; $z = 4.76$; $p = .006$) and the interaction between age and speaker type (Estimate = .02; $SE = 0.01$;

[4]Because raw scores for expressive and receptive vocabulary are highly correlated, we ran the models for each experimental task separately with these two measures. For both tasks, we found that raw scores for both expressive and receptive vocabulary were significant predictors if included separately but that only an EVT-2 raw score was a significant predictor when both measures were included. Therefore, we included only EVT-2 in the final models for each task. The raw score of an additional measure from a norm-referenced test (a measure of receptive syntax, the EPS subtest from the TACL) was included initially in this model for each task, but it was removed from the final models because it was not a significant predictor for either task.

[5]The degrees of freedom for the two comparisons (age and total number of words) is different because we used a correction for unequal variances in the latter comparison.

$z = 2.04$; $p = .041$). Children with higher expressive vocabularies were more accurate than children with smaller expressive vocabularies. The significant negative interaction between SES and speaker type indicated that as children's SES increased, the difference in their accuracy scores between novel and familiar monster–voice dyads decreased. By contrast, the significant positive interaction between age and speaker type indicated that as children's age increased, the difference in their accuracy scores between novel and familiar monster–voice dyads increased. Dialect density was not a significant predictor, and it did not interact significantly with any of the other trial-level or subject-level predictors.

Comprehension Task

For both phonological and morphological contrasts, the condition with the word-final singleton consonant should be the most difficult, as these words are ambiguous in AAE, but not in MAE.[6] That is, /kol/ could mean either *coal* or *cold* in AAE, but only *coal* in MAE. Similarly, /kæt/ could mean either *cat* or *cats* in AAE, but only *cat* in MAE. As expected, performance was lower in the singleton consonant condition ($M = 65.84$ and $SD = 14.01$ for the phonological contrast; $M = 62.35$ and $SD = 30.55$ for the morphological contrast), compared with the consonant cluster condition ($M = 75.16$ and $SD = 15.00$ for the phonological contrast; $M = 83.46$ and $SD = 16.12$ for the morphological contrast).

The analysis for the comprehension task was similar to that for the dialect awareness task. First, we ran a trial-level model with accuracy as a function of contrast type and consonant number. The phonological contrast and the singleton consonant conditions were the reference categories of the model (see Equation 3 in Appendix B). In this model, both consonant number (Estimate = 1.44; $SE = 0.14$; $z = 10.01$; $p < .001$) and the interaction between consonant number and contrast type (Estimate = −.97; $SE = 0.18$; $z = -5.32$; $p < .001$) were significant. Accuracy was significantly higher for the consonant clusters than the singleton consonant. The negative interaction indicated that in the singleton consonant condition, the accuracy level was higher for the phonological condition, whereas in the consonant cluster condition, the accuracy level was significantly higher for the morphosyntactic condition.

We then added in the subject-level variables (see Equation 4 in Appendix B). In this model, expressive vocabulary size (Estimate = 0.04; $SE = 0.01$; $z = 3.26$; $p = .001$), dialect density (Estimate = −6.11; $SE = 2.87$; $z = -2.13$; $p = .033$), and two interactions (Contrast Type × Expressive Vocabulary [Estimate = −0.03; $SE = 0.01$; $z = -2.49$; $p = 0.012$] and Consonant Number × Dialect Density [Estimate = 6.41; $SE = 2.06$; $z = 3.11$; $p = .002$]) were significant. It can be observed in Figure 1 that children with higher expressive vocabularies were more accurate than children with smaller expressive vocabularies. By contrast, children with high levels of dialect density were less accurate than children with low levels of dialect density. The significant interactions are illustrated in Figure 2. The negative interaction between contrast type and expressive vocabulary indicated that for children with small expressive vocabularies, accuracy was higher for the morphological contrast than for the phonological contrast, whereas the opposite pattern was observed for children with large expressive vocabularies. The positive interaction between consonant number and dialect density indicated that as dialect density increased, there was an increase in the difference in accuracy between items with consonant clusters and those with singleton consonants.

Finally, we ran one additional model for the 43 children who were above chance on both the dialect knowledge and the MAE lexical comprehension task. We added overall performance on the MAE lexical comprehension task as an additional subject-level predictor. Contrary to our prediction, there was no relationship between accuracy on the dialect awareness task and performance on the MAE lexical comprehension task.

Discussion

This study was designed to investigate relationships among minority dialect use, awareness of alternative dialects, and comprehension of MAE. We did so by developing two experimental tasks to assess AAE-speaking children's awareness of dialect differences (between MAE and AAE) and their lexical comprehension of MAE. For the dialect awareness task, we found that children with higher scores on a measure of expressive vocabulary had higher accuracy scores than children with lower scores. This was not a surprising result. We found that children with larger vocabularies performed better on the dialect awareness task, just as other researchers have found that children with larger vocabularies perform better on many metalinguistic tasks (e.g., Catts, Fey, Zhang, & Tomblin, 1999; Metsala, 1999; Metsala & Walley, 1998). One possible source of this relationship could be learning skills: Vocabulary size is a measure of past learning, and our dialect awareness task also required children to learn, in this case, learning pairings of voices and monsters.

The results from this task suggest that children with larger vocabularies will be better able to figure out the parameters of dialect shifting. We also found that dialect density was not related to performance on this task. It is possible that the dialect awareness task that we designed was simply too demanding for children in this age group, and this is why a relationship between dialect density and accuracy on the dialect awareness task was not observed. Alternatively, the lack of a relationship between these measures may be because our measure of dialect density was

[6]We again used the binomial probability theorem to determine how many participants had performance that was significantly above chance for this three-alternative forced-choice task. Participants needed an accuracy level of 47.22% or higher to be significantly above chance at the $a = 0.05$ level. All but three participants had an accuracy level of 47.22% or higher. The statistical analyses were performed on these 80 participants whose performance was significantly above chance.

Figure 1. Significant interaction between expressive vocabulary size (left) and between dialect density (right). The left plot shows accuracy rate on the Mainstream American English lexical comprehension task plotted as a function of expressive vocabulary size (Expressive Vocabulary Test, Second Edition [EVT-2] raw score), whereas the right plot shows accuracy rate plotted as a function of dialect density. Solid lines show model fit. (It should be noted that the model fits shown in this figure and subsequent figures are similar but not identical to the models in Appendix B. In order to illustrate the cross-level interactions, the dependent variable in these models is average accuracy rate at the child level, whereas the dependent variable in the models of Appendix B is accuracy at the trial level.)

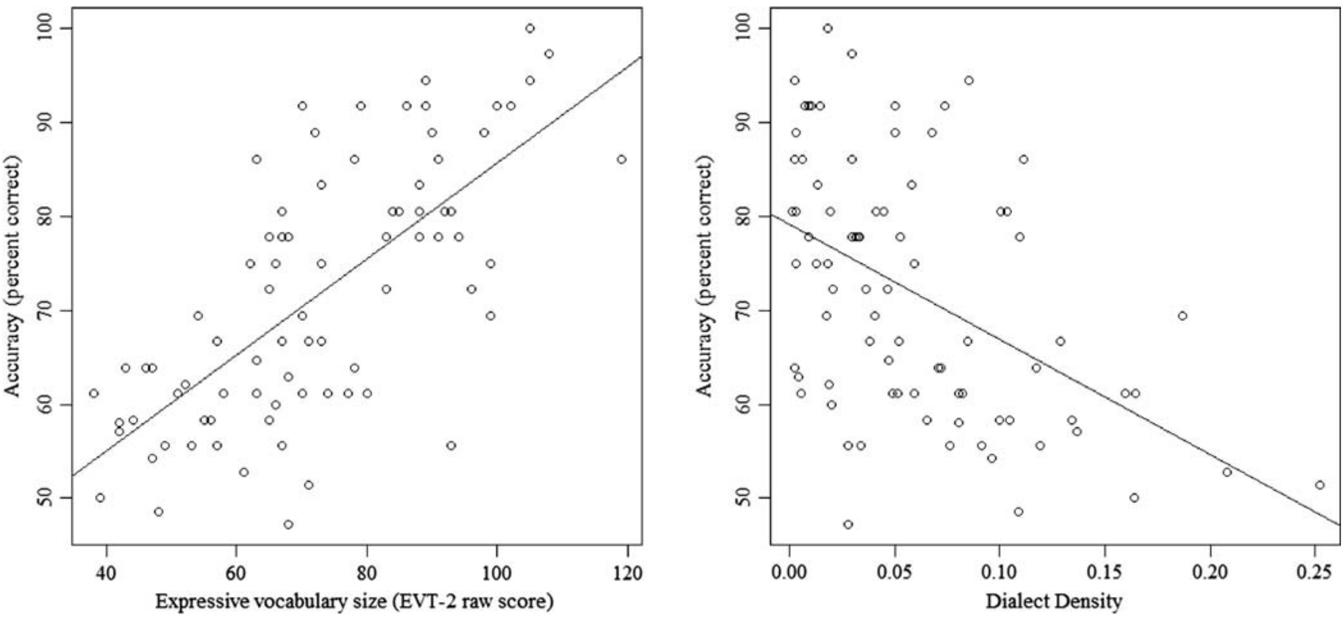
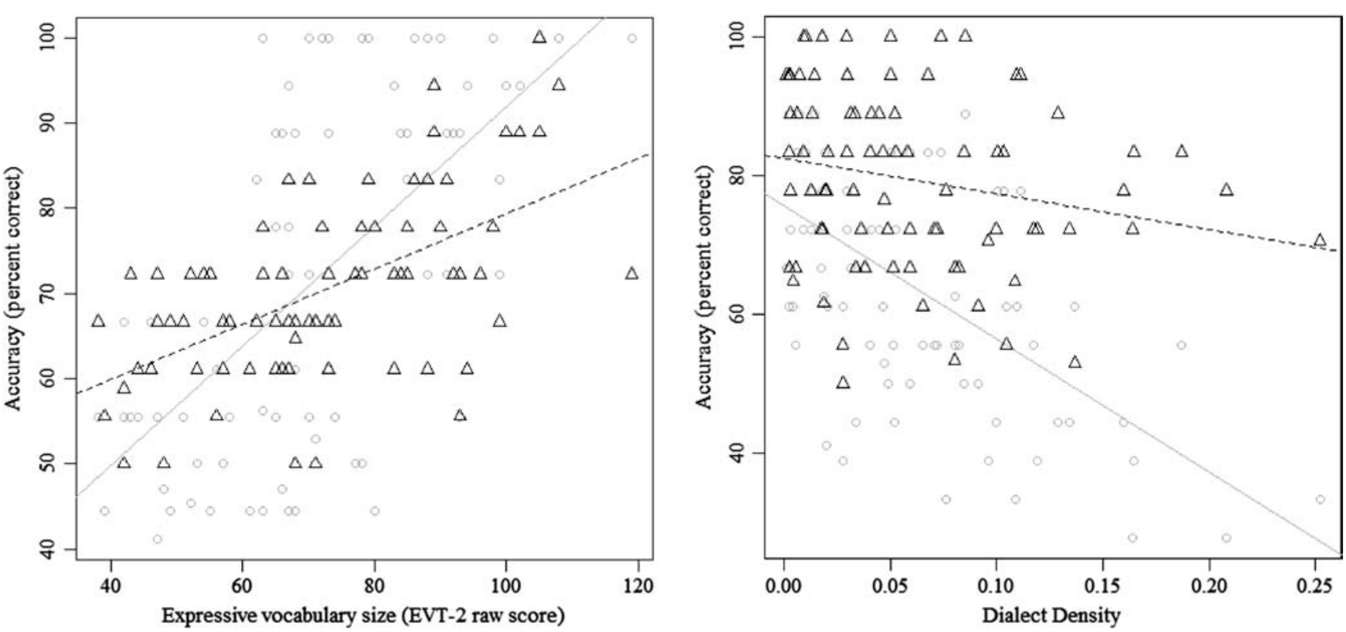


Figure 2. Significant interactions between expressive vocabulary and contrast type (left) and between dialect density and consonant number (right). The left plot shows accuracy rate on the Mainstream American English lexical comprehension task plotted as a function of expressive vocabulary size (Expressive Vocabulary Test, Second Edition [EVT-2] raw score) separated by contrast type. Gray circles show accuracy for the phonological contrast; black triangles show accuracy for the morphological contrast. The gray solid line shows model fit for phonological contrast; the black dotted line show model fit for morphological contrast. The right plot shows accuracy rate plotted as a function of dialect density separated by consonant number. Gray circles show accuracy for the singleton consonant condition; black triangles show accuracy for the consonant cluster condition. The gray solid line shows model fit for singleton consonant condition; the black dotted line shows model fit for consonant cluster condition.



not elicited in a situation that favored dialect-shifting to MAE. Although the language samples were collected in a laboratory rather than a home context, the environment was very child-friendly, the examiner spoke AAE, and the context was conversational. It is quite possible that if we had measured dialect shifting (as in Craig et al., 2014, or Terry, 2014), there would have been a relationship between dialect shifting and performance on the dialect awareness task. Finally, it is also possible that these two measures are simply not related.

We found that there was also a significant effect of expressive vocabulary on accuracy on the MAE lexical comprehension task. As in the dialect awareness task, we found that children with larger vocabularies had better comprehension of MAE. We also found that dialect density was negatively related to MAE comprehension; as dialect density increased, comprehension of MAE morphological and phonological contrasts decreased. Although other researchers (e.g., Terry & Connor, 2012; Terry et al., 2012) have found that higher dialect density is related to poorer performance on standardized measures of language and reading achievement, this is the first study to show that dialect density was directly related to poorer performance on a simple experimental task that taps comprehension of MAE at the lexical level.

We found in this study that both vocabulary size and dialect density independently influenced MAE lexical comprehension. The relationship between dialect density and MAE lexical comprehension that we observed differs from that of several recent studies (e.g., Craig et al., 2014; Terry, 2014). For example, Terry (2014) found that the relationship between phonological dialect density and reading achievement was mediated by phonological awareness. There are several possible explanations for this discrepancy. First, unlike other studies, our dependent variable was accuracy of MAE lexical comprehension in a difficult context (in which children were asked to comprehend words that were unambiguous in MAE but ambiguous in AAE), rather than a score on a norm-referenced measure of language or reading achievement. This task also differs from the studies cited above in that we used an experimental comprehension task, and, as noted above, it was difficult to find words that contrast only in the presence or absence of a final consonant cluster (e.g., *coal* vs. *cold*) that are familiar to children and pictureable. Although we had a familiarization procedure, we cannot be certain that all children were familiar with all of the stimuli in this task. Finally, as noted above, our measure of dialect density was not elicited in a situation that favored dialect shifting to MAE. It is quite possible that, if we had measured dialect shifting instead of dialect density, there would have been a relationship among dialect shifting, language ability, and MAE comprehension, as there is evidence that dialect shifting is related to language ability (e.g., Craig et al., 2014). The result found here simply suggests that children who speak a more dense dialect of AAE have more difficulty recognizing words spoken in MAE, at least in challenging contexts in which there is a morphological or phonological mismatch between MAE and AAE.

In conclusion, this study is one of the first to use experimental tasks to examine the relationship of minority dialect use and language ability to young AAE-speaking children's understanding and awareness of MAE. This study contained two experiments that were designed to test two different explanations of the relationship between dialect mismatch and academic achievement. The results of the dialect knowledge experiment were consistent with the linguistic flexibility/metalinguistic awareness account (Craig et al., 2014; Terry, 2014; Terry & Connor, 2012; Terry et al., 2010, 2012) of this relationship, whereas the results of the MAE comprehension experiment were consistent with the cognitive resources account (Harris & Schroeder, 2013). We found that children with larger expressive vocabularies were more likely to figure out the associations between different dialects and different-colored monsters on the dialect awareness task, which suggests that better linguistic and metalinguistic skills may help children learn how to dialect shift. We also found that children with greater dialect density had more difficulty recognizing ambiguous words in MAE and that this effect was independent of their expressive vocabulary size. This result provides support for the claim that children who speak a more dense nonmainstream dialect may need to expend more cognitive resources simply to understand classroom discourse in MAE (e.g., Harris & Schroeder, 2013). It should be noted that this study did not directly test either the linguistic flexibility/metalinguistic ability or the cognitive resources account of the relationship between academic achievement and dialect mismatch, as we did not assess either metalinguistic awareness or cognitive load. However, the findings of this study suggest fruitful avenues for future research that assesses metalinguistic ability or that evaluates whether children with high dialect density expend greater cognitive resources than their peers with low dialect density when they are listening to MAE. For the latter, it may be possible to adapt experiments that have been designed to evaluate listening effort in adults, such as dual-task paradigms (e.g., Feuerstein, 1992).

These results suggest that it may be helpful for children to learn about differences between "school talk" and "home talk" prior to school entry. Edwards et al. (2013) found that a short-term summer program in which dialect awareness was embedded in a developmentally appropriate emergent literacy curriculum supplement increased prekindergarten children's lexical comprehension of MAE (using the same task as this study) and also increased their phonological awareness (as measured by standardized tests). Similarly, Craig (2013) has developed a contrastive analysis curriculum supplement for kindergarten and first-grade children that was effective in heightening children's awareness of differences between MAE and AAE and in increasing children's production of MAE forms in appropriate contexts. The results of this study, taken together with the promising preliminary results from these intervention programs, suggest that programs designed to familiarize children to differences between AAE and MAE (e.g., Craig, 2013; Edwards et al., 2013) may be an important short-term measure to ameliorate at least some of the negative impact of dialect mismatch.

Acknowledgments

This work was supported by a Wisconsin Institutes for Discovery Seed grant, awarded to Mark S. Seidenberg; National Institute on Deafness and Other Communication Disorders grant R01 02932 and National Science Foundation grant BCS-0729140, awarded to Jan Edwards; and by National Institute of Child Health and Human Development P30 HD03352 grant, awarded to the Waisman Center. We are grateful to all of the children who participated in this study and to their families as well. We also thank Ruby Braxton, Alia Dayne, Elisabeth Piper, Doris Leeper, Monique Mills, Jenny Saffran, Daragh Sibley, and Julie Washington for their contributions to many aspects of this research program.

References

Bates, D., Maechler, M., & Bolker, B. (2012). lme4: Linear mixed-effects models using S4 classes (R package version 0.999999-0). Retrieved from http://CRAN-R-project.org/package=lme4

Boersma, P. (2001). Praat, a system for doing phonetics by computer. *Glot International, 5,* 341–345.

Carrow-Woolfolk, E. (1999). *Test of Auditory Comprehension of Language* (3rd ed.). Austin, TX: Pro-Ed.

Catts, H. W., Fey, M. E., Zhang, X., & Tomblin, J. B. (1999). Language basis of reading and reading disabilities: Evidence from a longitudinal investigation. *Scientific Studies of Reading, 3,* 331–361.

Chambers, J. K. (1992). Dialect acquisition. *Language, 68,* 673–705.

Charity, A., Scarborough, H., & Griffin, D. (2004). Familiarity with school English in African American children and its relation to early reading achievement. *Child Development, 75,* 1340–1356.

Connor, C. M., & Craig, H. K. (2006). African American preschooler's language, emergent literacy skills, and use of African American English: A complex relationship. *Journal of Speech, Language, and Hearing Research, 49,* 771–792.

Cooper, H. M. (1979). Pygmalion grows up: A model for teacher expectation communication and performance influence. *Review of Educational Research, 49,* 389–410.

Craig, H. K. (2013, November 13–17). *Teaching bi-dialectal code-switching to improve literacy achievement*. Workshop presented at the 41st Annual Conference of National Alliance of Black School Educators, Detroit, MI.

Craig, H. K., Kolenic, G. E., & Hensel, S. L. (2014). African American English-speaking students: A longitudinal examination of style shifting from kindergarten through second grade. *Journal of Speech, Language, and Hearing Research, 57,* 143–157.

Craig, H. K., Thompson, C. A., Washington, J. A., & Potter, S. L. (2003). Phonological features of child African American English. *Journal of Speech, Language, and Hearing Research, 46,* 623–635.

Craig, H. K., & Washington, J. A. (1994). The complex syntax skills of poor, urban, African American preschoolers at school entry. *Language, Speech, and Hearing Services in Schools, 25,* 181–190.

Craig, H. K., & Washington, J. A. (2004). Grade-related changes in the production of African American English. *Journal of Speech, Language, and Hearing Research, 47,* 450–463.

Craig, H. K., Zhang, L., Hensel, S. L., & Quinn, E. J. (2009). African American English-speaking students: An examination of the relationship between dialect shifting and reading outcomes. *Journal of Speech, Language, and Hearing Research, 52,* 839–855.

Dunn, L. M., & Dunn, D. M. (2007). *Peabody Picture Vocabulary Test* (4th ed.). Minneapolis, MN: Pearson Assessments.

Edwards, J., Rosin, M., Gross, M., & Chen, J. (2013, November 14–16). *Dialect mismatch and its implications for academic achievement*. Seminar presented at the annual conference of the American Speech-Language-Hearing Association, Chicago, IL.

Feuerstein, J. F. (1992). Monaural versus binaural hearing: Ease of listening, word recognition, and attentional effort. *Ear and Hearing, 13,* 80–86.

Guy, G. (1980). Variation in the group and the individual: The case of final stop deletion. In W. Labov (Ed.), *Locating language in time and space* (pp. 1–36). New York, NY: Academic Press.

Harber, J. R. (1977). Influence of presentation dialect and orthographic form on reading performance of Black, inner-city children. *Educational Research Quarterly, 2,* 9–16.

Harris, Y. R., & Schroeder, V. M. (2013). Language deficits or differences: What we know about African American Vernacular English in the 21st century. *International Education Studies, 6,* 194–204.

Horton-Ikard, R., & Miller, J. F. (2004). It's not just the poor kids: The use of AAE forms by African-American school-aged children from middle SES communities. *Journal of Communication Disorders, 37,* 467–487.

Keats, E. J. (2011/1962). *The snowy day*. New York, NY: Viking.

Keats, E. J. (1998/1968). *A letter for Amy*. New York, NY: Viking.

Labov, W. (1972). *Language in the inner city: Studies in the Black English Vernacular*. Philadelphia: University of Pennsylvania Press.

Labov, W. (1995). Can reading failure be reversed? A linguistic approach to the question. In V. Gadsden & D. Wagner (Eds.), *Literacy among African-American youth: Issues in learning, teaching, and schooling* (pp. 39–68). Cresskill, NJ: Hampton.

Lybolt, J., Gottfred, K., Anderson, R., & Olszewski, A. (2009). Language for scholars: A communication skills building program. *Perspectives on School-Based Issues, 10,* 90–95.

Metsala, J. L. (1999). Young children's phonological awareness and nonword repetition as a function of vocabulary development. *Journal of Educational Psychology, 91,* 3–19.

Metsala, J. L., & Walley, A. C. (1998). Spoken vocabulary growth and the segmental restructuring of lexical representations: Precursors to phonemic awareness and early reading ability. In J. L. Metsala & L. C. Ehri (Eds.), *Word recognition in beginning literacy* (pp. 89–120). Mahwah, NJ: Erlbaum.

National Center for Eduation Statistics. (2001). *Early childhood longitudinal study: Kindergarten class of 1998-99: User's manual for the ECLS-K Base Year Public-Use Data Files and Electronic Codebook* (Tech. Rep. Nos. NCES 2001|-029). Washington, DC: U.S. Government Printing Office.

Oetting, J. B. (2004). Dialect speakers. In R. Kent (Ed.), *MIT encyclopedia of communication disorders* (pp. 294–296). Boston, MA: MIT Press.

Oetting, J. B., Cantrell, J. P., & Horohov, J. E. (1999). A study of specific language impairment (SLI) in the context of nonstandard dialect. *Clinical Linguistics and Phonetics, 13,* 25–44.

Oetting, J. B., & McDonald, J. (2002). Methods for characterizing participants' nonmainstream dialect use in child language research. *Journal of Speech, Language, and Hearing Research, 45,* 508–518.

Rickford, J. R. (1999). *African American vernacular English*. Malden, MA: Blackwell.
Rickford, J. R., Sweetland, J., & Rickford, A. E. (2004). African American English and other vernaculars in education: A topic-coded bibliography. *Journal of English Linguistics, 32,* 230–320.
Saunders, J. A., Morrow-Howell, N., Spitznagel, E., Dore, P., Proctor, E. K., & Pescarino, R. (2006). Imputing missing data: A comparison of methods for social work research. *Social Work Research, 30,* 19–30.
Seymour, H., Roeper, T., & de Villiers, J. (2005). *Diagnostic Evaluation of Language Variation (DELV) – Norm-referenced.* San Antonio, TX: Harcourt.
Terry, N. P. (2014). Dialect variation and phonological knowledge: Phonological representations and metalinguistic awareness among beginning readers who speak nonmainstream American English. *Applied Psycholinguistics, 35,* 155–176.
Terry, N. P., & Connor, C. M. (2012). Changing nonmainstream American English use and early reading achievement from kindergarten to first grade. *American Journal of Speech-Language Pathology, 21,* 78–86.
Terry, N. P., Connor, C. M., Petscher, Y., & Conlin, C. R., (2012). Dialect variation and reading: Is change in nonmainstream American English use related to reading achievement in first and second grades? *Journal of Speech, Language, and Hearing Research, 55,* 55–69.
Terry, N. P., Connor, C. M., Thomas-Tate, S., & Love, M. (2010). Examining relationships among dialect variation, literacy skills, and school context in first grade. *Journal of Speech, Language, and Hearing Research, 53,* 126–145.
Van Hofwegen, J., & Wolfram, W. (2010). Coming of age in African American English: A longitudinal study. *Journal of Sociolinguistics, 14,* 427–455.
Washington, J. A., & Craig, H. K. (2002). Morphosyntactic forms of African American English used by young children and their caregivers. *Applied Psycholinguistics, 23,* 209–231.
Washington, J. A., Terry, N. P., & Seidenberg, M. S. (2013). Language variation and literacy learning: The case of African American English. In C. A. Stone, E. R. Silliman, B. J. Ehren, & K. Apel (Eds.), *Handbook of language and literacy: Development and disorders* (2nd ed., pp. 204–221). New York, NY: Guilford Press.
Williams, K. T. (2007). *Expressive Vocabulary Test* (2nd ed.). Minneapolis. MN: Pearson Assessments.
Wolfram, W., & Schilling-Estes, N. (1998). *American English*. Malden, MA: Blackwell.

Appendix A

Stimuli for Lexical Comprehension Task

Phonological contrast			Morphological contrast		
Singleton	Cluster	Foils[a]	Singular	Plural	Foils[b]
ball	bald	star/car	block	blocks	cart/start
bell	belt	clouds/dogs	book	books	wheel/hole
bill	build	cats/coats	cat	cats	bill/bell
bus	bust	goal/coal	cloud	clouds	ball/light
car	cart	blocks/lights	coat	coats	gold/build
coal	cold	bust/hats	dog	dogs	bald/belt
goal	gold	hat/bus	hat	hats	dog/cloud
hole	hold	block/book	light	lights	cold/hold
star	start	wheels/books	wheel	wheels	cat/coat

Note. This table displays the stimuli organized by type and does not reflect the order in which trials were presented.

[a]The first foil listed appeared in the trial in which the singleton consonant word was the target and the cluster word was the distractor. The second foil listed appeared in the trial in which the cluster word was the target and the singleton consonant word was the distractor. [b]The first foil listed appeared in the trial in which the singular word was the target and the plural was the distractor. The second foil listed appeared in the trial in which the plural word was the target and the singular word was the distractor.

Appendix B (p. 1 of 2)

Formulas for Mixed-Effect Logistic Regression Models

1. Dialect Awareness

Equation 1.
Model 1: Random Intercept and Slope Model with Level-1 Predictors: Dialect and Speaker Type. No level-2 predictors.

Level-1 Model

$$\text{Prob}(StudentChoice.ACC_{ij} = 1|\beta_j) = \phi_{ij}$$
$$\log[\phi_{ij}/(1-\phi_{ij})] = \beta_{0j} + \beta_{1j}*(Dialect_{ij}) + \beta_{2j}*(SpeakerType_{ij})$$

Level-2 Model

$$\beta_{0j} = \gamma_{00} + u_{0j}$$
$$\beta_{1j} = \gamma_{10} + u_{1j}$$

Equation 2.
Model 2: Random Intercept and Slope Model with Level-1 Predictors: Dialect and Speaker Type; Level-2 Predictors: Age, SES and EVT-2 raw score.

Level-1 Model

$$\text{Prob}(StudentChoice.ACC_{ij} = 1|\beta_j) = \phi_{ij}$$
$$\log[\phi_{ij}/(1-\phi_{ij})] = \beta_{0j} + \beta_{1j}*(Dialect_{ij}) + \beta_{2j}*(SpeakerType_{ij})$$

Level-2 Model

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(Age_j) + \gamma_{02}*(SES_j) + \gamma_{03}*(EVT\text{–}2RAW_j) + u_{0j}$$
$$\beta_{1j} = \gamma_{10} + \gamma_{11}*(Age_j) + \gamma_{12}*(SES_j) + \gamma_{13}*(EVT\text{–}2RAW_j) + u_{1j}$$

2. Lexical Comprehension

Equation 3.
Model 1: Random Intercept and Slope Model with Level-1 Predictors: Consonant Number (C vs. CC) and Contrast Type (morphological vs. phonological). No level-2 predictors.

Level-1 Model

$$\text{Prob}(STIMULI.ACC_{ij} = 1|\beta_j) = \phi_{ij}$$
$$\log[\phi_{ij}/(1-\phi_{ij})] = \beta_{0j} + \beta_{1j}*(ConsonantNumber_{ij}) + \beta_{2j}*(ContrastType_{ij})$$

Level-2 Model

$$\beta_{0j} = \gamma_{00} + u_{0j}$$
$$\beta_{1j} = \gamma_{10} + u_{1j}$$

Equation 4.
Model 2: Random Intercept and Slope Model with Level-1 Predictors: Consonant Number (C vs. CC) and Contrast Type (morphological vs. phonological); Level-2 Predictors: Age, SES and EVT-2 raw score.

Level-1 Model

$$\text{Prob}(STIMULI.ACC_{ij} = 1|\beta_j) = \phi_{ij}$$
$$\log[\phi_{ij}/(1-\phi_{ij})] = \beta_{0j} + \beta_{1j}*(ConsonantNumber_{ij}) + \beta_{2j}*(ContrastType_{ij})$$

Level-2 Model

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(Age_j) + \gamma_{02}*(SES_j) + \gamma_{03}*(EVT\text{–}2RAW_j) + u_{0j}$$
$$\beta_{1j} = \gamma_{10} + \gamma_{11}*(Age_j) + \gamma_{12}*(SES_j) + \gamma_{13}*(EVT\text{–}2RAW_j) + u_{1j}$$

Appendix B (p. 2 of 2)

Formulas for Mixed-Effect Logistic Regression Models

Equation 5.

Model 3: Random Intercept and Slope Model with Level-1 Predictors: Consonant Number (C vs. CC) and Contrast Type (morphological vs. phonological); Level-2 Predictors: Age, SES, EVT-2 raw score and Dialect Density.

Level-1 Model

$$\text{Prob}(STIMULI.ACC_{ij} = 1|\beta_j) = \phi_{ij}$$

$$\log[\phi_{ij}/(1-\phi_{ij})] = \beta_{0j} + \beta_{1j}{*}(ConsonantNumber_{ij}) + \beta_{2j}{*}(ContrastType_{ij})$$

Level-2 Model

$$\beta_{0j} = \gamma_{00} + \gamma_{01}{*}(Age_j) + \gamma_{02}{*}(SES_j) + \gamma_{03}{*}(EVT\text{–}2RAW_j) + \gamma_{04}{*}(DialectDensity_j) + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}{*}(Age_j) + \gamma_{12}{*}(SES_j) + \gamma_{13}{*}(EVT\text{–}2RAW_j) + \gamma_{14}{*}(DialectDensity_j) + u_{1j}$$