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Spelling in African American children: the case of final consonant devoicing

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Abstract This study examined the effect of dialect variation on children's spelling by using devoicing of final /d/ in African American Vernacular English (AAVE) as a test case. In line with the linguistic interference hypothesis, African American 6-year-olds were significantly poorer at spelling the final *d* of words such as *salad* than non-African American students after their spelling performance on other parts of the words was statistically taken into account. Specifically, African American students were more likely than non-African American students to produce spelling errors such as *salat* for *salad*. Such misspellings were particularly common in African American children who showed higher rates of devoicing when pronouncing the words. African American students did not have more difficulty than non-African American students in spelling the final *t* of words such as *planet*. The results suggest that the spellings of some words are particularly opaque for speakers of AAVE and that instruction should take account of this opacity.

Keywords Spelling · African American English · Dialect · Phonology · Literacy · Achievement gap · Linguistic interference

Introduction

In the US and other countries, some groups of children tend to perform more poorly in school than others. One concern in the US is that Black students have lower literacy skills, on average, than other groups of students (Jencks & Phillips, 2011; Seidenberg, 2013). The Black–White achievement gap has a number of possible

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explanations, which are not mutually exclusive. These include the fact that African American children are more likely than White children to grow up in low-income families and more likely to attend poor-quality childcare centers and schools (Burchinal et al., 2011; Jencks & Phillips, 2011). Here we ask whether the phonological properties of the dialect that a number of African Americans speak, African American Vernacular English (AAVE), is a contributing factor in the case of spelling, one important literacy skill.

Learning to spell in English is a long process, and children make spelling errors for a number of reasons (Ehri, 2000; Treiman & Kessler, 2014). For example, errors such as *gad* for *glad* reflect the difficulty that young children often have in breaking initial consonant clusters into smaller units. Other errors, such as *dringk* for *drink*, reflect a lack of graphotactic knowledge, in this example the fact that *ng* should not occur before *k*. Still other errors reflect differences between the phonological forms that children produce and those assumed by the spelling system. For example, the fact that second vowel of *ticket* is typically pronounced as /ɪ/ in British dialects can lead British children to misspell the word as *tickit*. This error is less common among children who speak Australian dialects of English, where this vowel is pronounced as /ə/ (Kemp, 2009). In the present study, we asked whether some of the spelling errors of African American first graders reflect AAVE pronunciations in the same way that errors such as *tickit* for *ticket* reflect British pronunciations.

African American Vernacular English

Before delving further into the possible contributions of AAVE to spelling, it is important to discuss the nature of AAVE and of dialects in general. Every native speaker of a language learns a dialect of that language, and English has a number of dialects. Some are regionally defined, and others are associated with particular ethnic groups. In the US, one dialectal division is between what is called Standard American English (SAE) and AAVE. AAVE and SAE are similar in many respects, but the two dialects have some phonological, morphological, and syntactic differences (e.g., Green, 2002; Thomas, 2007). For example, final consonant clusters are more likely to be reduced in AAVE, as in /gɒl/ for *gold*, and AAVE does not use *be* in certain sentence patterns, as in “He old” instead of “He is old.” The majority of African American children show AAVE patterns in their speech when they enter school (Pearson, Conner, & Jackson, 2013), although there is variability across children in the extent of AAVE use. AAVE was historically viewed as a deficient language system. Linguistic research has shown, however, that it is as complex and rule governed as SAE or any other dialect of any language (e.g., Labov, 1972). It is nevertheless possible that use of AAVE might influence literacy acquisition. We review hypotheses and research on this topic in the section that follows.

Linguistic interference, reading, and spelling

According to many studies (e.g., Charity, Scarborough, & Griffin, 2004; Craig & Washington, 2004), although not all (Apel & Thomas-Tate, 2009), African

American children who use AAVE patterns more frequently in their speech tend to have poorer reading skills, on average, than African American children who use these features less frequently. Some investigators have suggested that this correlation between AAVE use and literacy skill reflects, in part, a causal link from AAVE linguistic features to literacy (Labov, 1995; LeMoine, 2001). According to this *linguistic interference hypothesis*, written English aligns less closely with spoken language for speakers of AAVE than for speakers of SAE, leading to certain difficulties in learning to read and write for AAVE speakers. For example, a child who normally says “He fitna be ten” may have some difficulty reading and understanding the sentence “He is about to be ten,” and a child who pronounces *gold* as /gol/ may omit the *d* when spelling the word. Even though children who often use AAVE features in their own speech have some knowledge of SAE forms (Terry, 2014), this knowledge may be incomplete. This may increase cognitive load and lead to difficulties in such tasks as understanding, decoding, and spelling words (Edwards et al., 2014; Harris & Schroeder, 2013; Terry, Hendrick, Evangelou, & Smith, 2010).

The correlation between AAVE use and literacy skill could reflect a direct causal link from the former to the latter, in line with the linguistic interference hypothesis. However, there are other possible explanations for the correlation, which are not mutually exclusive. One possibility is that some third factor is associated with both use of AAVE and lower literacy skill. Socioeconomic status (SES) may be such a factor. African American children from lower SES homes are more likely to use AAVE than African American children of higher SES (Ratusnik & Koenigsnecht, 1976; Washington & Craig, 1998), and SES is also associated with academic achievement. Another possibility is a causal link in the reverse direction, such that being read to and learning to read improve children’s knowledge of SAE and lead to decreased use of AAVE. Consistent with this view, Black children’s use of AAVE declines across the early school years (Craig, Thompson, Washington, & Potter, 2003; Craig & Washington, 2004; Horton & Apel, 2014). Still another idea is that there is a causal link from AAVE use to academic achievement but that it is indirect (Goodman & Buck, 1973). Specifically, teachers may have less positive attitudes toward children who speak AAVE than toward children who use the higher-status SAE, lowering their expectations for AAVE speakers (Cecil, 1988; Fogel & Ehri, 2006). This may result in lower levels of achievement for children who often use AAVE features in their speech. Yet another possible contributor to the observed correlation between AAVE use and literacy skill may be that children who use many AAVE features when tested by an unfamiliar adult in a school setting, a context in which use of SAE would normally be considered appropriate, may tend to have low levels of metalinguistic skill (Terry, 2014). It may be lack of knowledge about the contexts in which it is considered appropriate to speak different dialects rather than use of AAVE itself that is linked to lower literacy skills.

With regard to spelling, the particular literacy skill of interest here, there is not clear evidence on whether linguistic interference influences the spelling of AAVE speakers. Several researchers have tested the linguistic interference hypothesis by examining spelling errors in the written compositions of Black students. Cronnell (1984) noted misspellings such as *pon* for *pond* and *gol* for *gold* among Black third

and sixth graders, and Horton-Ikard and Pittman (2010) observed some such errors in tenth graders. These researchers suggested that the errors reflect the reduction of final consonant clusters that often occurs in AAVE. However, Groff (1978) found few errors of this sort in Black fourth to sixth graders, and Wolfram and Whiteman (1971) found few such errors in tenth graders. Wolfram and Whiteman (1971) did notice errors such as *wild* for *while* among African American tenth graders. *While* is not pronounced with a final /d/ in either AAVE or SAE, so this error is not a direct reflection of AAVE pronunciation. However, some Black students may have placed *while* in the same category as words like *gold*—words with final /l/ in their spoken form and final *ld* in their written form—and may have added *d* to their spellings for this reason. The amount of information that can be gained by studying students' written compositions may be limited, however, because writers may tend to avoid words that they have difficulty spelling. In addition, these studies did not include comparison groups of SAE speakers. To support the linguistic interference hypothesis, it would be necessary to show that spelling errors such as *gol* for *gold* are more common among AAVE speakers than among otherwise similar SAE speakers.

Other researchers have taken an experimental approach when looking for effects of AAVE on children's spelling. Kohler et al. (2007) and Patton-Terry and Connor (2010) used a dictation task, finding some misspellings among African American first to third graders that appeared to reflect AAVE pronunciations. For example, African American children sometimes spelled the nonword /hest/, as pronounced by a speaker of SAE, without a final *t* (Kohler et al., 2007). Such errors may reflect the reduction of the final consonant cluster that occurs in AAVE, an outcome that would be consistent with the linguistic interference hypothesis. However, the studies did not include the SAE comparison groups that would be necessary to support this idea.

Surprisingly, a literature review found only two studies that compared the spellings of African American and non-African American children on the same items. O'Neal and Trabasso (1976) asked whether Black third and fifth graders were more likely than White children to produce the same spellings for pairs of words that are homophones in AAVE, such as *coal* and *cold*. No such difference was found, a result that fails to support the linguistic interference hypothesis. However, the researchers observed some errors on specific segments that appeared to reflect AAVE pronunciations, as when Black children failed to include a final *t* in *coldest*. Kligman, Cronnell, and Verna (1972) gave Black and White second graders a multiple-choice spelling test in which some of the incorrect choices reflected AAVE pronunciations. For example, *bub* was one option for *bulb*, in line with the fact that AAVE speakers may omit /l/ in such words. The Black students were 7 % more likely than the White students to choose the AAVE-related errors, *bub* in the present example. The difference between the two groups was significantly smaller, 2 %, for errors that were not related to AAVE. One concern about these studies is that they examined a variety of linguistic patterns and, in some cases, included just a few items tapping each pattern.

In none of the studies discussed so far did researchers assess children's pronunciations of the words that they were asked to spell. Patton-Terry and Connor (2010) assessed dialect use in a general way by examining children's speech when

they repeated sentences and described pictures. African American second graders whose speech was less similar to SAE tended to produce more misspellings than children whose speech was more similar to SAE. The linguistic interference hypothesis predicts a stronger correlation between speech characteristics and misspellings for dialect-related misspellings (e.g., *mouf* for *mouth*) than for other misspellings (e.g., *nouth* for *mouth*). Patton-Terry and Connor reported such a pattern, but the difference between the two correlation coefficients was small. Thus, it is difficult to determine whether the relationship between AAVE use and spelling was specific to the phonological characteristics of AAVE.

The present study

The present study went beyond previous research in several ways in an attempt to provide more conclusive evidence on whether phonological features of AAVE directly influence children's spelling, as the linguistic interference hypothesis predicts. We compared the spellings produced by African American students to those produced by non-African American students, we assessed children's pronunciations of the words they were asked to spell, and we examined a particular phonological pattern of AAVE in a way that allowed for the study of dialect-related spelling errors on both words that are pronounced similarly in AAVE and SAE and words that are pronounced differently.

The phonological pattern that we investigated was the devoicing of final /d/. Final obstruent devoicing is a common feature of AAVE in Detroit, where our study was conducted (Wolfram, 1969). For example, African Americans in Detroit often pronounce the name of a major thoroughfare, Woodward Avenue, with [t] or glottalized [t] at the ends of both syllables. Devoicing occurs even in Black speakers whose speech is otherwise very similar to SAE. By focusing on one linguistic pattern, the present study responded to the recommendation of Kohler et al. (2007, p. 166) that future studies "should focus more narrowly on children's spelling of specific linguistic patterns."

Treiman (2004) found that African American university students from Detroit made some spelling errors on relatively uncommon words that reflected the devoicing of final /d/. For example, they sometimes misspelled *haggard* as *haggart*, a *voicing error*. The African American university students made significantly more such errors than White university students. They also made voicing errors on words that are pronounced similarly in the two dialects, such as *thicket*. Spelling errors like *thicked* for *thicket* do not arise because African American adults pronounce this word with final [d]. Rather, African American adults have observed that words ending with [t] in their dialect are sometimes spelled with final *d* (as in *salad*) and sometimes spelled with final *t* (as in *carrot*). When spelling a relatively uncommon word that ends with [t], therefore, they may be unsure of the correct spelling.

The present study examined children performing at the kindergarten to first-grade level rather than adults. Our first research question was whether African American children would have more difficulty than non-African American children in spelling the *d* of words like *salad*. We predicted that, in line with the linguistic interference

hypothesis, African American children would produce fewer correct final consonants on these words and more *t* substitutions, as in *salat*. Moreover, these differences between African American and non-African American children could not be explained solely on the basis of overall spelling ability. A second research question was whether African Americans would have more difficulty than non-African Americans in spelling the final *t* of words such as *carrot*. That is, would African American children make voicing errors even on final consonants that are pronounced similarly in AAVE and SAE? A third research question concerned the relationship between pronunciation and spelling in African American children. The linguistic interference hypothesis predicts that those African American children who are more likely to devoice the /d/ of words like *salad* are more likely than other children to spell these words with final *t* but no more likely to misspell other parts of the words. That is, the effects should be specific.

Our study was conducted in the metropolitan area of Detroit, Michigan, which has a high degree of residential, economic, and linguistic segregation between Blacks and Whites. On average, academic achievement is lower in Detroit city schools than in suburban schools, and poverty rates are higher (Darden & Thomas, 2013). Our African American participants lived within the city limits, where the large majority of the population is Black and where Black children typically attend schools that have mostly Black students and teachers. These children were tested around the middle of first grade. Given that very few White children attend Detroit city schools, our non-African American group consisted of children who lived and attended schools in suburbs with majority White populations. Anticipating that the non-African American children would be better spellers than the African American children, we tested approximately half of the non-African American children near the end of kindergarten and the other half during the first half of first grade. In our statistical analyses, we controlled for overall spelling ability by using a measure of children's ability to spell portions of the words other than the final *t* or *d*.

Method

Participants

The African American participants were 29 children (15 girls) who were tested around the middle of their first-grade year. One additional child did not complete the study because of absences from school. These children attended a public school in Detroit that served a low-income population. Virtually all of the students and over 80 % of the teachers at the school were African American. The great majority of the African American participants had lived in Detroit their entire lives. All were native speakers of English, and none were receiving special education due to speech problems or serious developmental disorders. Table 1 provides information about the children's ages and their performance on the spelling subtest of the Wide Range Achievement Test, 3rd edition (WRAT-3; Wilkinson, 1993), which asks children to write letters and simple words. The African American children's mean score on the WRAT-3 placed them at the boundary between the kindergarten and the first-grade level.

Table 1 Mean values on general measures for African American and non-African American children

Measure	African American children	Non-African American children	<i>t</i> test for group difference
Age in months	81.2 (5.1)	75.2 (3.9)	$t(59) = 5.16, p < .001$
WRAT-3 spelling subtest raw score	17.8 (1.9)	17.9 (1.7)	$t(59) = .31, p = .76$
Spelling distance score	3.3 (0.6)	2.7 (0.5)	$t(59) = 3.90, p < .001$

Standard deviations in parentheses

Thirty-two non-African American children (20 girls) who attended public and parochial schools in middle-class suburbs of Detroit also completed the study. Thirty-one were Caucasian and one was Asian American. All were native speakers of English, and none received special education due to serious speech problems or developmental disorders. The schools that these students attended had very few African American students. Fifteen of the non-African American children were tested near the end of kindergarten and 17 during the first half of first grade. As Table 1 shows, the African American and non-African American groups had similar mean scores on the spelling subset of the WRAT-3 even though the non-African American students were significantly younger than the African American students.

Stimuli

The experimental spelling test included eight words in which the final consonant was *t* (*carrot, cricket, desert, fruit, mat, pilot, planet, plate*) and eight words with final *d* (*blood, hundred, liquid, salad, sled, stupid, weed, wizard*). The two types of words were equated as closely as possible for number of letters, number of syllables, and frequency of appearance in reading materials designed for first graders (Zeno, Ivens, Millard, & Duvvuri, 1995). For each word, we constructed a sentence with the word in the final position. The words were presented in the same randomly chosen order to all children.

Procedure

The experimental spelling test was given to the children in small groups in a quiet location at their school. The African American students were tested by an African American experimenter whose cultural and linguistic background was similar to theirs. The non-African American students were tested by one of two White experimenters. This procedure was chosen because it was most natural for these students, the teachers of the African American students being mostly African American speakers of AAVE and the teachers of the non-African American students being non-African American speakers of SAE. For each word, the experimenter said the word, read the sentence, and then said the word again. The children were then asked to spell the word. The experimental spelling test was divided into two sessions if children became tired. During the next session, children were given the spelling subtest of the WRAT-3. After this, each child was asked to say the words

from the experimental spelling test. For this task, the experimenter pronounced each word aloud and said it in the sentence. The experimenter then asked the child to say the word. The child's pronunciations were audio recorded.

Scoring

The spelling of an experimental word was scored as having the correct final consonant if it ended in *d* or *de* for a word with *d* as its final consonant or if it ended in *t* or *te* for a word with *t* as its final consonant. Examples are *ude* for *weed* and *kort* for *carrot*. A spelling was scored as having a voicing error on the final consonant if it ended in *t* or *te* for a word with *d* as its final consonant or if it ended in *d* or *de* for a word with a final *t*. For example, *slaet* for *salad* and *dzd* for *desert* have voicing errors.

Children's pronunciations of the final consonants were coded based on the audiotapes as [d], [t], or not scorable. The coders, who were speakers of SAE and who were not informed about whether the specific children whose pronunciations they were scoring were African American or not, were instructed to score a pronunciation as [d] if they judged it as closer to [d] than to [t] and as [t] if they judged it closer to [t]. If they judged the pronunciation to be equally distant from [t] and [d], or if it was garbled or too soft to score, it was considered unscorable. Each pronunciation was assessed by two coders, and disagreements were resolved through discussion. Based on independent scoring of the pronunciation data from 20 children, half African American and half not, the coders agreed 92 % of the time.

String-edit metrics (see Kruskal, 1983) were used to obtain a measure of children's performance on the experimental spelling task outside of the target consonant. Using the program Ponto (Kessler, 2009), we counted one unit of distance for each deletion and addition necessary to transform the child's spelling into the correct spelling and 1.4 units for each substitution. So that this measure would reflect performance on parts of the spelling other than the final consonant, omissions of the final consonant did not receive penalty points, nor did one-letter substitutions on the final consonant. For example, *pld* for *planet* received 3 penalty points, 1 for omission of each of *a*, *n*, and *e*. The error on the final consonant was not penalized. As another example, *lad* for *sled* received 2.4 penalty points: 1 for the missing *s* and 1.4 for the substitution on *e*. As Table 1 shows, the mean spelling distance score was significantly higher for African American children than non-African American children. That is, the African American children spelled the non-target portions of the words more poorly than the non-African American children. This was true even though the two groups performed similarly on the WRAT-3 spelling subtest, where spellings of whole words are scored simply as correct or incorrect.

Results

Correct spellings of final *d* and *t*

Table 2 shows the mean proportion of spellings with the correct final consonant for the *t* and *d* words of the experimental spelling test. A mixed model analysis of these

Table 2 Mean proportion of spellings with correct spelling of final consonant for African American and non-African American children

Final consonant	African American children	Non-African American children
<i>d</i>	.31 (.24)	.79 (.22)
<i>t</i>	.72 (.26)	.82 (.22)

Standard deviations in parentheses

data was conducted using data at the trial level with random intercepts for participants and words. This and other mixed model analyses were carried out in R version 3.1.1 (R Core Team, 2013) using the package lme4 (Bates, Maechler, Bolker, & Walker, 2013). Given that the dependent variable was binary, a logit link function was used. The fixed factors were group (non-African American vs. African American) and final consonant (*t* vs. *d*). The mean spelling distance score of the child was included as another fixed factor. It served as a control variable, its inclusion allowing us to ask whether African American and non-African American students showed differences in their spellings of final consonants beyond those expected on the basis of their spelling performance on other segments of the words. Spelling distance was centered prior to analysis, and all main effects and interactions were included in the model. There were significant main effects of group ($\beta = 2.06$, $SE = 0.35$, $p < .001$) and final consonant ($\beta = 2.48$, $SE = 0.51$, $p < .001$), which were qualified by a significant interaction between them ($\beta = -2.34$, $SE = 0.41$, $p < .001$). There was also a main effect of spelling distance ($\beta = -1.64$, $SE = 0.43$, $p < .001$). Children who had lower distance scores, that is, better spellings of the non-target portions of the words, were more likely to spell final consonants correctly than children who had higher distance scores.

To shed light on the interaction between group and final consonant, we conducted separate analyses for final *d* and final *t* words using the factors of group and spelling distance. The analysis of final *d* words showed significant effects of participant group ($\beta = 2.24$, $SE = 0.43$, $p < .001$) and distance score ($\beta = -1.93$, $SE = 0.55$, $p < .001$) and no interaction. The significant effect of group in this analysis indicates that, in response to our first research question, African American students performed significantly more poorly than non-African American students on final *d* even after their poorer spelling of other parts of the words was taken into account.

The analysis of final *t* words showed only a significant effect of distance score ($\beta = -1.78$, $SE = 0.42$, $p < .001$). The nonsignificant effect of group ($p = .39$) in this analysis speaks to our second research question. It indicates that African American students were statistically indistinguishable from non-African American students in their correctness on final *t* after their poorer spelling of the other parts of the words was statistically taken into account.

Voicing errors on final *d* and *t*

Children made a variety of errors when spelling the final consonants. Sometimes they included no plausible rendition of the consonant, as in *bolu* for *blood* or *w* for

Table 3 Mean proportion of spellings with voicing error on final consonant for African American and non-African American children

Final consonant	African American children	Non-African American children
<i>d</i>	.35 (.21)	.03 (.06)
<i>t</i>	.06 (.15)	.02 (.04)

Standard deviations in parentheses

weed, and sometimes they substituted *t* for *d* or *d* for *t*, as in *wet* for *weed*. Table 3 shows the mean proportions of spellings of this latter type, namely those that had a voicing error on the final consonant. The linguistic interference hypothesis predicts that African American children should make more such errors than non-African American children, even after performance on other parts of the words is statistically taken into account.

Statistical analyses of these data used mixed model analyses like those described earlier, except that the dependent variable was whether or not a spelling contained a voicing error. There was a significant effect of group ($\beta = -3.30$, $SE = 0.51$, $p < .001$), such that African American children made more voicing errors than non-African American children. The main effect of final consonant ($\beta = -2.60$, $SE = 0.54$, $p < .001$) reflected the fact that spellings of *d* as *t* were more common than the reverse. These main effects were qualified by an interaction between group and final consonant ($\beta = 2.07$, $SE = 0.80$, $p = .009$) and an interaction between group and spelling distance score ($\beta = 2.31$, $SE = 0.89$, $p = .010$).

Given the interaction involving final consonant, we conducted separate analyses of voicing errors on words with each final consonant. An analysis of voicing errors on final *d* words using the factors of group and distance score showed that African American students made significantly more voicing errors than non-African American students ($\beta = -3.32$, $SE = 0.52$, $p < .001$). There was also a significant interaction between group and distance score ($\beta = 2.27$, $SE = 0.89$, $p = .011$). This interaction arose because voicing errors on final *d* were associated with poor spelling of the other parts of the words among non-African American children but not among African American children.

A separate analysis of voicing errors on final *t* words using the factors of group and distance score showed no significant effects. That is, whereas African American students made significantly more voicing errors than non-African American students on final *d* words after their performance on other parts of the words was statistically taken into account, the two groups of students did not show a reliable difference in voicing errors on final *t* words.

Pronunciations of final consonants and relationship to spelling

The proportion of final consonant pronunciations that were not scorable was fairly low: 6 % for the African American group and 5 % for the non-African American group. Table 4 shows the mean proportion of scorable pronunciations of the final

Table 4 Mean proportion of scorable pronunciations with voicing changes on final consonant for African American and non-African American children

Final consonant	African American children	Non-African American children
<i>d</i>	.41 (.22)	.03 (.08)
<i>t</i>	.00 (.00)	.01 (.04)

Standard deviations in parentheses

consonants that involved a change of voicing as a function of final consonant and group. Due to the lack of variability in one cell, mixed effects models could not be used to analyze the data. However, the association between final consonant and group was significant by Fisher's exact test ($p = .011$). This association reflects the fact that voicing changes were much more common among African American children on final /d/ than final /t/. Voicing changes were very uncommon on both /t/ and /d/ for non-African American children.

There was a good deal of variation among the African American children in how often they devoiced the final /d/s of words like *salad*. Across children, the proportion of scorable pronunciations of final /d/ that involved a change in voicing ranged from .00 to .86. A final analysis was conducted to address our third research question about whether this variability in pronunciation across students was mirrored in their spellings. For African American students, there was a significant correlation between the proportion of scorable pronunciations of words with final *d* that involved a change of voicing and the proportion of *t* spellings of these words ($r = .48$, $p = .004$, one tailed). Importantly, there was no significant relationship between the measure of voicing change in pronunciation and spelling distance score, which reflects the quality of the spelling of other parts of the words ($r = .00$, $p = .99$).

Discussion

The goal of the present study was to determine whether the dialect that a number of Black US children speak, AAVE, has a bearing on the academic difficulties that these children sometimes experience. Several previous studies have shown a negative correlation between use of AAVE and literacy achievement (e.g., Charity et al., 2004; Craig & Washington, 2004), and the linguistic interference hypothesis posits a direct causal link from the former to the latter (Labov, 1995; LeMoine, 2001). However, there are a number of potential reasons, other than linguistic interference, why children who use many AAVE features in their speech tend to have poorer literacy skills than those who use few AAVE features. For example, the correlation may be due to a third variable, it may reflect teachers' negative attitudes about speakers of AAVE (Cecil, 1988; Fogel & Ehri, 2006) or students' lack of knowledge about when it is appropriate to shift from one dialect to another (Terry, 2014), or several of these things may make a contribution.

Using devoicing of final /d/ as a test case, we found evidence for linguistic interference in one important literacy skill, spelling. Our first research question was

whether, as predicted by the linguistic interference hypothesis, African American children have more difficulty spelling the *d* of words like *salad* than non-African American children. The results fit this prediction. Even after ability to spell other parts of words was statistically controlled, young African American children were less likely than non-African American children to correctly spell the *ds* of words such as *salad* and more likely to make voicing errors such as *salat*. These results strengthen those of previous studies (e.g., Kligman et al., 1972) by showing reliable differences between the spelling patterns of African American and non-African American students on dialect-sensitive parts of words but not on other parts of words. The results further show the importance of employing a sensitive measure of spelling performance on parts of words that are not affected by dialect. Continuous measures, such as the distance score that we used, may be particularly useful for this purpose (Clemens, Oslund, Simmons, & Simmons, 2014).

Our second research question was whether African American children would make voicing errors even when spelling final consonants that are pronounced similarly in AAVE and SAE, such as the final consonant of *planet*. The linguistic interference hypothesis would be compatible with either a positive or a negative answer to this question, and the answer would provide information about exactly how linguistic interference occurs. We found that errors on final *t* were no more common among African American first graders than they were among non-African American students after overall spelling ability was statistically taken into account. The same was true for voicing errors in particular. A different pattern of results was previously found in university students, where African American students made significantly more voicing errors when spelling both final *t* and final *d* than non-African American students (Treiman, 2004). The different pattern of results for young children and university students supports the idea that the way in which people select among alternative spellings for sounds changes with experience (Treiman & Kessler, 2006, 2014). Young children, it appears, make their selection with little regard to the position of a word in which the sound occurs. Thus, African American first graders who classify the final consonants in their pronunciations of *salad* and *planet* as more similar to /t/ than /d/ tend to spell the consonants using *t*, the letter that is most commonly associated with /t/ across all positions of words. African American adults vacillate between *t* and *d* in such cases, when they do not know the correct spelling of a word, because they tend to spell a sound based on how it is spelled in the same positions of other words. Having observed two spellings for the same sound in word-final position—*t* in words like *planet* and *rivet* and *d* in words like *salad* and *rigid*—they may misspell the final consonants of words like *thicket* as well as the final consonants of words like *haggard*. The combined results for children and adults indicate that linguistic interference in spelling occurs across a range of skill levels but that its nature changes with experience. To further test this suggestion in the case of AAVE, it would be valuable to test students at a variety of grade levels.

Our third research question concerned the relationship between pronunciation and spelling in African American children. The linguistic interference hypothesis predicts that the relationship should be specific. That is, those African American children who are more likely to devoice the /d/ of words like *salad* should be more

likely than other children to spell these words with a final *t* but no more likely to misspell other parts of the words. We found a relationship of this sort, in line with the preliminary results of Patton-Terry and Connor (2010) for other linguistic features.

AAVE is unexceptional as an example of dialectal variation. All languages have dialects, and the dialects often differ along the same dimensions as in the AAVE case. The present findings suggest that AAVE is also unexceptional in the effects of dialectal variation on literacy learning. Children in a number of societies learn a dialect at home that differs from the dialect that they will need to use at school. In countries that use Arabic, for example, the dialects that children speak at home differ in many ways from the literary Arabic that is used in school. Children's unfamiliarity with the latter dialect at the time that they enter school contributes to difficulties in literacy acquisition (e.g., Abu-Rabia, 2000). Another example of dialect variation and its effects on literacy was mentioned earlier: Children who speak British and Australian dialects of English make different types of spelling errors on certain words (Kemp, 2009; see also Treiman, Goswami, Tincoff, & Leevers, 1997 for differences in spelling errors between children who speak American and British dialects of English). AAVE differs from some other cases of dialect variation in that its use is more related to race and culture than to geography. Regardless of the origin of dialect variation, research results suggest that this variation can influence literacy acquisition.

Many factors contribute to the Black–White achievement gap in the US in literacy and other areas (Burchinal et al., 2011; Jencks & Phillips, 2011; Seidenberg, 2013). The idea that linguistic interference is one contributor in the area of spelling, as suggested by our findings, does not mean that other factors are not important. Linguistic interference may occur with syntax and morphology, areas that were not investigated here but that have been the focus of other studies (e.g., Craig, Zhang, Hensel, & Quinn, 2009; Ivy & Masterson, 2011). Poverty, educational opportunity, attitudes, and knowledge about dialect shifting are also likely to be involved. Although many factors are at play, a finding that language variation is one contributor is important, in part because it suggests avenues for intervention that should be easier to achieve than, for example, the elimination of poverty.

The letters in English spellings do not show a one-to-one correspondence to the phonemes in the words' pronunciations in any current dialect of English. But portions of the spellings of some words, including those like *salad*, are more opaque for speakers of AAVE, who tend to devoice the final consonant, than they are for speakers of SAE. Other examples of words whose spellings may be more opaque for speakers of AAVE than for speakers of SAE include *rest* (where the final /t/ is more often dropped in AAVE than SAE), *bulb* (where the /l/ may be dropped in AAVE), and *mouh* (where the /θ/ may be pronounced as /f/ in AAVE). Our results suggest that teachers and curriculum developers should be mindful of such dialect variations and their effects on children's spelling and reading. Teachers understand that *stumack* for *stomach* is a reasonable and logical misspelling for a speaker of any current dialect of English. Similarly, teachers should understand that *salat* for *salad* is a reasonable and logical error for a speaker of AAVE. Speakers of AAVE who produce such misspellings may not be lacking in phonemic awareness or knowledge

of basic letter-sound correspondences. Just as teachers and spelling curricula may devote special attention to difficult words like *stomach*, so they may need to devote extra attention to certain types of words, including those like *salad*, when dealing with children who use AAVE. Just as teachers can point out the *ch* spelling of the /k/ of *stomach* without requiring children to change their pronunciation of the word, so they can point out the *d* spelling at the end of *salad* without asking AAVE speakers to say the word differently. Indeed, recent findings suggest that methods such as these improve the spelling performance of AAVE speakers (Pittman, Joshi, & Carreker, 2014).

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