Applied Psycholinguistics (2023), **44**, 610–633
doi:10.1017/S0142716423000243

ORIGINAL ARTICLE

The impact of dialect differences on spoken language comprehension

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(Received 1 June 2022; revised 14 March 2023; accepted 2 April 2023; first published online 02 May 2023)

Abstract
Research has suggested that children who speak African American English (AAE) have difficulty using features produced in Mainstream American English (MAE) but not AAE, to comprehend sentences in MAE. However, past studies mainly examined dialect features, such as verbal *-s*, that are produced as final consonants with shorter durations when produced in conversation which impacts their phonetic saliency. Therefore, it is unclear if previous results are due to the phonetic saliency of the feature or how AAE speakers process MAE dialect features more generally. This study evaluated if there were group differences in how AAE- and MAE-speaking children used the auxiliary verbs *was* and *were,* a dialect feature with increased phonetic saliency but produced differently between the dialects, to interpret sentences in MAE. Participants aged 6, 5–10, and 0 years, who spoke MAE or AAE, completed the DELV-ST, a vocabulary measure (PVT), and a sentence comprehension task. In the sentence comprehension task, participants heard sentences in MAE that had either unambiguous or ambiguous subjects. Sentences with ambiguous subjects were used to evaluate group differences in sentence comprehension. AAE-speaking children were less likely than MAE-speaking children to use the auxiliary verbs *was* and *were* to interpret sentences in MAE. Furthermore, dialect density was predictive of Black participant's sensitivity to the auxiliary verb. This finding is consistent with how the auxiliary verb is produced between the two dialects: *was* is used to mark both singular and plural subjects in AAE, while MAE uses *was* for singular and *were* for plural subjects. This study demonstrated that even when the dialect feature is more phonetically salient, differences between how verb morphology is produced in AAE and MAE impact how AAE-speaking children comprehend MAE sentences.

Keywords: Listening Comprehension; Linguistic Diversity; African American English; Subject-Verb Agreement

Dialects of a language are typically defined as mutually intelligible, which allows speakers of different dialects to communicate (Gooskens et al., 2018; Trudgill & Chambers, 2017). However, a small body of research suggests that both adults and children may have difficulty using dialect features that are present in one dialect but not the other as cues in spoken language comprehension (Bühler, 2017; Beyer et al., 2015; De Villiers & Johnson, 2007; Edwards et al., 2014; Jones et al., 2019). For instance, Bühler (2017) found that adult Swiss German speakers show processing differences (as measured by ERPs) in a word comprehension task with words that have dialect-specific pronunciations that result in different pronunciations in Swiss German and High German.

Difficulty using dialect-specific features as cues for spoken language comprehension has also been observed in dialects of American English with speakers of African American English (AAE), a non-mainstream dialect, and Mainstream American English (MAE), a dialect that is considered to be "standard." Research has shown that both AAE and MAE speakers can have difficulty using phonological and morphological features that are not within the respective dialects as spoken language comprehension cues (Beyer et al., 2015; De Villiers & Johnson, 2007; Edwards et al., 2014; Jones et al., 2019). The differences in how AAE and MAE speakers use features present in one dialect but not the other are of interest, particularly for AAE-speaking children. This is because the primary medium of instruction within the classroom is spoken language and the dialect of instruction is almost always MAE (Brown et al., 2015; Byrd & Brown, 2021; Connor & Craig, 2006; Edwards et al., 2014; Gatlin & Wanzek, 2015; Labov & Baker, 2015). Since MAE is the predominant dialect used within the classroom for instruction, academic success depends in part on the accurate and efficient comprehension of MAE to understand new concepts. Therefore, if AAE-speaking children have difficulty understanding their MAE-speaking teachers, this could lead to academic consequences based on how students use MAE features as comprehension cues and not their academic abilities. While there have been efforts to move away from MAE as the "standard" dialect for academic instruction and performance, they have been slowed by political and societal barriers (Barton & Coley, 2010; Paris, 2012; Sleeter, 2012; Young, 2010; Young et al., 2014). As advocacy continues to promote linguistic diversity within the classroom, there remains a need to understand how dialect differences impact the academic experiences of AAE-speaking children, specifically in spoken language comprehension.

There has been limited research examining how listening to a *contrastive feature*, which is a feature present in one dialect but not the other, impacts spoken language comprehension. The existing evidence suggests that both adult MAE speakers and child AAE speakers have difficulty using contrastive features as comprehension cues. This type of linguistic mismatch can occur when speakers of one dialect hear a different dialect that contains contrastive features. For instance, MAE-speaking courtroom stenographers, who are trained to be 95% to 98% accurate in transcribing a verbatim record of proceedings, on average transcribed only 60 % of AAE speakers' sentences accurately (Jones et al., 2019). MAE-speaking stenographers were particularly inaccurate in transcribing the speech of AAE speakers when it included common and frequently used AAE features. These findings are further supported by work that has examined how adult MAE speakers used stressed /bɪˈn/ (hereafter 'stressed BIN'), a feature of AAE, to comprehend AAE sentences in a spoken language comprehension task (Beyer et al., 2015). Stressed BIN refers to an event in the remote past or an event that has occurred for a long undisclosed period of time (Beyer et al., 2015; Green, 1998; Labov, 1972, Rickford, 1975).

Beyer et al. (2015) presented adult AAE and MAE speakers with prerecorded sentences that included both stressed BIN (e.g., S*he been on the phone*), regular *been* (e.g., *She has been on the phone for a long time)*, and fillers. They found that while AAE speakers accurately used stressed BIN to infer an event that occurred a long time ago, MAE speakers incorrectly assumed that it referred to an event that occurred in the recent past. Beyer et al. (2015) described the MAE speakers' interpretations of stressed BIN as pseudo-comprehensions, where the listener felt confident in their understanding of what they heard but ultimately failed to use the cue appropriately.

The small number of studies that evaluate how linguistic mismatch impacts children's listening comprehension has focused on how AAE-speaking children use contrastive features that are present in MAE but not AAE to comprehend MAE words or sentences they hear. Edwards et al. (2014) investigated how 4- to 8-year-old children who spoke AAE interpreted MAE words that are ambiguous in AAE but not MAE because of phonological and morphological differences between the dialects. For example, consonant clusters can be optionally produced in AAE (e.g., *gold* can be produced as /goʊld/ or /goʊl/) but only as /goʊld/ in MAE (Green, 2002). Edwards and colleagues found that AAE-speaking children were less accurate at comprehending words that were ambiguous in AAE due to phonological and morphological differences between the dialects (e.g., plural marker –*s* and final consonant clusters) in comparison to words that did not have dialect-sensitive features. Furthermore, dialect density (quantified as the number of features of AAE that children used in a language sample relative to the total number of sentences in the language sample) predicted performance independently of language experience (quantified as vocabulary size).

Other studies have examined the impact of linguistic mismatch on children's comprehension of verbal morphology in sentences. De Villiers and Johnson (2007) examined how AAE- and MAE-speaking children, aged 4–7 years, used third-person singular -*s* in spoken language comprehension tasks. Overt third-person singular marking is obligatory in MAE, while zero marking is obligatory in AAE (e.g., *The cat eat**s** the mouse* in MAE vs. *The cat eat_ the mouse* in AAE; Green, 2002, 2010; Newkirk-Turner & Green, 2016, 2021). De Villiers and Johnson found that MAE-speaking children produced third-person singular -*s* by the age of 4 years but did not reliably use it as a comprehension cue in sentences where the plural morpheme on the noun is coarticulated with the beginning of the verb (e.g., *The cat sleeps on the bed*) until the age of 6 to 7 years. By contrast, AAE-speaking children did not reliably produce third-person singular -*s* in production or use it as a comprehension cue at the age of 6 or 7 years (De Villiers & Johnson, 2007; Newkirk-Turner & Green, 2016, 2021). Beyer and Hudson Kam (2012) used a picture-choice task to examine how AAE- and MAE-speaking children in 1st and 2nd grade used a wider variety of morphological forms that are contrastive between AAE and MAE (e.g., past tense -ed, third-person singular -s, future contracted -ll; *she'll or he'll*). In the task, participants listened to sentences that were produced in MAE and were instructed to select the picture that best matched what they heard. In the test sentences, participants had to rely on the verb morphology as cues to comprehend the tense of the sentence (e.g., *"She walk**ed** from the library")*. Beyer and colleagues found that both AAE- and MAE-speaking children correctly comprehended sentences with shared morphological forms (e.g., plural -s);

https://doi.org/10.1017/S0142716423000243 Published online by Cambridge University Press

however, only the MAE-speaking children successfully used contrastive features that are produced in MAE to comprehend tense in MAE sentences. There was no age- or grade-related change in how contrastive dialect features were used as comprehension cues to understand MAE sentences. These results suggest that although AAE-speaking children are consistently exposed to MAE in the classroom, they are more likely to use their grammatical knowledge of AAE when comprehending MAE sentences they hear.

However, the studies that have evaluated how AAE-speaking children use contrastive dialect features to comprehend MAE sentences have focused on features that typically have lower phonetic saliency (e.g., past tense -ed, verbal -s). The term "phonetic saliency" was brought into the acquisition literature by Leonard et al. (1997) and Leonard (2014) and has been used to refer to morphological features that are usually realized as final consonant clusters that are coarticulated with the following word in spontaneous speech, and whose duration is influenced by the position of the morpheme within the sentence. Inflectional morphemes with low phonetic saliency are generally produced later with full-syllable morphemes that have greater phonetic saliency (e.g., contractible copula and auxiliary vs. uncontactable copula and auxiliary) (Bortolini et al., 2006; Leonard et al., 1997; Leonard, 2014). While the comprehension of low-phonetic-saliency morphemes has been less well studied, as compared to production, there is some evidence that phonetic saliency also affects comprehension. For example, 5-year-old MAE-speaking children are not reliable at using verbal -s as a comprehension cue, although they consistently use it in production at earlier ages (De Villiers & Johnson, 2007; Kouider et al., 2006; Lukyanenko & Fisher, 2016; Wood et al., 2009). This raises the possibility that prior findings with AAE-speaking children confounded linguistic mismatch and the phonetic saliency of the features used for testing. To address this limitation, the current study examines a feature that is produced as a whole syllable which has increased phonetic saliency. This allowed us to determine the extent to which linguistic mismatch impacts how AAE-speaking children broadly use MAE morphology for sentence comprehension.

The purpose of this study was to examine if a contrastive morphological feature with greater phonetic saliency (a whole syllable), *was* vs. *were,* also leads to differences between AAE- and MAE-speaking children's performance in spoken language comprehension tasks. In AAE, the same verb form (*was*) is used for both plural and singular subjects, while MAE differentiates between single and plural verb forms (*She was walking*/*They was walking* in AAE and *She was walking*/*They were walking* in MAE; Green, 2002; Green & Sistrunk, 2015; Newkirk-Turner, Oetting, & Stockman, 2014).[1] The use of *was* with both singular and plural subjects is a highly consistent feature of AAE and shows a minimal decrease in use with age in elementary school (Craig & Washington, 2004; Washington & Craig, 2002). In addition, both *was* and *were* are produced as whole non-contracted syllables in both AAE and MAE, and thus they have more phonetic saliency than previously tested features (e.g., past tense and third-person singular -s), which can have shorter duration times and become less distinct when coarticulated. Furthermore, the use of auxiliaries such as *was* and *were* are used consistently as comprehension cues in young MAE-speaking children (Kouider et al., 2006; Lukyanenko & Fisher, 2016; Wood et al., 2009).

This study will also examine if a participant's dialect density is predictive of how *was* and *were* are used as a comprehension cue. There is conflicting evidence on how dialect density, a measure of dialect use in production, predicts how MAE features are used in spoken language comprehension. Edwards et al. (2014) found that dialect density was predictive of how AAE speakers comprehended words and phrases that contained contrastive dialect features. Other studies (De Villiers & Johnson, 2007; Beyer & Hudson Kam, 2012) did not directly examine the relationship between dialect density and comprehension; however, they did not observe age- or grade-related changes in comprehension of MAE. Since, previous research has shown that as age and grade increase, AAE-speaking students' dialect density decreases (Brown, et al., 2015; Gatlin & Wanzek, 2015), this suggests that a decrease in the production of AAE features may not equate to increased use of MAE verb morphology as a comprehension cue. This study will evaluate if dialect density is predictive of how AAE-speaking participants perform in a spoken language comprehension task with a more phonetically salient cue, *was* and *were*.

This study addresses two questions: (1) are there differences in how AAE- and MAE-speaking children use *was* and *were* to comprehend spoken language? and (2) does dialect density predict how *was* and *were* are used to comprehend spoken language for AAE speakers? One possibility is that children who speak AAE will perform similarly to their peers who speak MAE because of the greater phonetic saliency of *was* and *were*, relative to the previously tested features (i.e., -ll, -ed, and verbal -s). This would suggest that previous results are due to the lower phonetic saliency of the features, and children who speak AAE use information about MAE grammar to interpret MAE sentences if the feature is phonetically salient. Alternatively, it is also possible that children who speak AAE will have difficulty using *was* and *were* to differentiate between singular and plural subject despite their increased phonetic saliency because the differences between how inflectional verb morphology is used in AAE and MAE will influence how AAE-speaking children attend to the feature as a comprehension cue. The latter result would support the claim presented in the previous studies that children who speak AAE, and potentially other non-mainstream dialects, use the morphological rules of their predominant dialect to interpret sentences spoken in another dialect such as MAE. Lastly, it is possible that changes in dialect density will be predictive of how participants use *was* and *were* as comprehension cues and that as dialect density, or the number of AAE features produced, increases participants will be less sensitive to the auxiliary verb as a cue. Alternatively, it is possible that changes in dialect density will not be predictive of how participants use *was* and *were,* which would mean that familiarity or production of an MAE feature may be unrelated to how an MAE feature is used as a comprehension cue by a child who speaks a non-mainstream dialect. The results from this study will broaden our theoretical understanding of how children who speak different varieties of American English attend to contrastive features to process sentences in dialects that differ from their own.

Methods

Authors' positionality statement. As in all research, it is helpful to understand our positionality and, therefore, our lens on the data. The first author is an African

https://doi.org/10.1017/S0142716423000243 Published online by Cambridge University Press

Table 1. Participant demographics

Group	*n*	Gender	Race	PVT (SS)	Age in months	Dialect Density
MAE speakers	44	Female *n* = 23 Male *n* = 21	Asian *n* = 3 Black *n* = 21 White *n* = 20	*M* = 111, *SD* = 13; Range = 83–142	*M* = 8; 5, *SD* = 1; 0; Range = 6; 5–10; 0	*M* = 0.11, *SD* = 0.45, Range = 0.00–0.36
AAE speakers	25	Female *n* = 10 Male *n* = 15	Black *n* = 20 White *n* = 5	*M* = 100, *SD* = 13; Range = 77–128	*M* = 8; 3, *SD* = 0; 7; Range = 7; 0–9; 11	*M* = 0.45, *SD* = 0.34, Range = 0.08–0.93

Note. *M* and *SD* stand for mean and standard deviation, respectively. PVT (SS) = PVT standard score (normalized *M* = 100 and *SD* = 15). Dialect Density was calculated by taking the number of non-mainstream features produced on the DELV-ST and dividing by the total number of scorable items.

American woman who speaks multiple dialects of American English, including Southern American English, AAE, and MAE. The second author is an Asian American woman who is a bilingual speaker of English and Mandarin. The third author is a monolingual speaker of MAE who lives in a bilingual household where both English and Greek are spoken. The authors' linguistic experiences shape their beliefs that all languages and dialects are valid methods of communication in academic spaces. Furthermore, these authors' research has been centered on understanding the relationship between linguistic variation, cognitive processes, and academic outcomes. All three authors are committed to supporting linguistic diversity in academic spaces.

Participants. Sixty-nine participants, aged 6; 5 to 10; 0 years, were recruited from across the US, with most recruited from the Maryland/DC and Georgia areas. Due to the COVID-19 pandemic, participants were tested virtually, and their race was used as a proxy to increase the likelihood of recruiting participants from communities who were more likely to speak AAE and MAE. However, a standardized assessment was used to determine the dialect variation a participant spoke once they consented to participate. Parents of participants provided informed consent, and families received compensation (i.e., $20) for their participation in the study. See Table 1 for participant demographics.

Standardized assessment measures

Participants were administered part 1 of the *Diagnostic Evaluation of Language Variation-Screener* (DELV-ST) (Seymour, Roeper & deVilliers, 2003) and the *Picture Vocabulary Test-remote administration* from the National Institute of Health cognitive toolbox (PVT) (Weintraub et al., 2013). Both assessments were administered virtually over zoom.

Part 1 of the DELV-ST is a screening test that is designed to distinguish dialectal variation from MAE by evaluating the production of contrastive features between MAE and AAE. Five items focus on phonological features that differ between the two dialects, and the remaining 10 items focus on dialect differences in subject–verb

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agreement. The DELV-ST provides an age-referenced criterion score that identifies if a participant is a: (a) *MAE speaker*; (b) *has some variation from MAE;* or (c) *strong variation from MAE.* For this study, criterion scores of *some variation from MAE* or *strong variation from MAE* were collapsed into the category of AAE speakers, since these criterion scores indicated they used AAE features in production. In addition, a dialect density score was calculated based on how many AAE features a speaker uses on the DELV-ST and was used as a continuous measure of dialect. This score has been used by other researchers (e.g., Terry et al., 2010, 2012; Terry & Connor, 2012) and was calculated by taking the number of non-mainstream features produced and dividing by the total number of scorable items. For example, a student who used only MAE features would score a 0, and a participant that used only AAE features would score a 1.

The PVT is a standardized measure of receptive vocabulary skills that is designed for remote computer administration. Participants were presented with four images and were instructed to tell the examiner the number of the picture that best matched the definition of the word they heard. The PVT automatically adjusts the number of items and what items are presented based on the participant's age and performance. For most participants, the measure lasted approximately 5 min and contained about 25 items.

Sentence processing task

Stimuli

The sentence processing task was implemented on a web-based application for a tablet. The web-based application was designed using JavaScript, which was adapted from Frank et al. (2016). This web-based application presented visual and auditory stimuli on a tablet and recorded the corresponding data using a secure data server.

Auditory Stimuli Norming. Initially, auditory norming was conducted to find an ambiguous name that could be perceived as one or two people. An ambiguous name that could be perceived as one or two people was necessary to ensure that participants had to rely on the auxiliary verb to disambiguate the sentence. A set of ambiguous and unambiguous names were presented to adult listeners in past tense sentences (e.g., *Carolyn May/Carol 'n May baked cookies; Janice, Don, Carol, and John baked cookies; Alexander baked cookies)*. Past tense verbs were used, so the listeners would have to rely on the proper noun(s) rather than the verb to decide how many subjects were in the sentence. After each sentence was played, adult listeners were asked to identify how many people (one, two, three, or four) completed the action described in the sentence. Unambiguous subject names were included to ensure that participants were accurately completing the task and to make sure the novelty of the ambiguous names were preserved. Through initial auditory norming, the name Julianne Rose from "Julianne *Rose baked cookies*" was selected because it was perceived as one person 50% of the time and as two people 50% of the time. However, when piloting with children, we observed a 2-person bias; MAE-speaking children interpreted most ambiguous sentences as two people regardless of the auxiliary verb. Therefore, to counteract this 2-person bias while preserving some of the perceptual ambiguity of the subject name, a token of *Carolyn May* in the sentence "*Carolyn May baked cookies*" was selected.

In piloting, 67% of adult participants interpreted this name to be one person and 33% interpreted it as two people. When this name was piloted again with MAE-speaking children, the plural bias decreased and participants used both *was* and *were* to determine subject number even though they were not from regions where this conjoined first name is typically used. See Appendix B for a detailed breakdown of the norming results.

Auditory. All auditory stimuli used in both stimuli norming and testing were recorded by the same MAE speaker from the Northeastern US. The auditory stimuli are sentences of the form *<person's name> was <VP-ing>< NP>*. Two items were manipulated in the auditory stimuli: (1) whether the name was ambiguous or unambiguous, (2) whether the sentence contained the auxiliary verb *were* or *was*. All sentences were presented with three names: *Jeremiah* (singular noun phrase, male), *Carter and Joe* (conjoined noun phrase, male), and *Carolyn May* or *Carol 'n May* (ambiguous between singular or conjoined noun phrase, female). The plural auxiliary verb *were* was used with conjoined noun phrases, and the singular auxiliary verb *was* was used with singular noun phrases. In this task, sentences with unambiguous names were used as control trials and sentences with ambiguous names were used as critical trials, since both groups would have to attend to the auxiliary verb to decide if the subject is one or two people. The unambiguous and ambiguous names were matched by the number of syllables. The unambiguous names *Jeremiah* and *Carter and Joe* were both .93 s in duration, and the ambiguous name *Carolyn May* was .86 s in duration. The remainder of the verb phrase in the sentence contained verbs and direct objects that were controlled for age of acquisition; the age of acquisition was 6 years, 0 years, or younger for all verbs and nouns. Each participant heard 28 sentences that contained 7 tokens of each condition (i.e., unambiguous singular noun phrase, unambiguous conjoined noun phrase, ambiguous singular conjoined noun phrase, and ambiguous plural conjoined noun phrase). This ensured that each participant was exposed to every condition while still preserving the novelty of the ambiguous names paired with a single display. (See Appendix A for a list of sentences and age of acquisition information for the verbs and direct objects.) Items were counterbalanced using a Latin Square design to prevent order effects, and pseudo-randomization was used to change the order of each list each time it was presented to a participant. Examples of auditory stimuli can be found here.

Visual. The visual stimuli consisted of layered clip art images that corresponded to the experimental and control sentences. There were four images of the named children: *Carolyn May* (one girl), *Carol 'n May* (two girls), *Jeremiah* (one boy), and *Carter and Joe* (two boys). The images of these children were consistent throughout the pictures. Each sentence type depicts a single action that is completed by one or two people. The presentation of the images in the 2×2 array were fixed to reduce task demands (see Figure 1). Insofar as possible, the images were identical except for the identity of the people completing the action.

Procedure

All participants were administered the assessments virtually via Zoom on devices that were capable of sharing screens or had touchscreen capabilities. Shared screen

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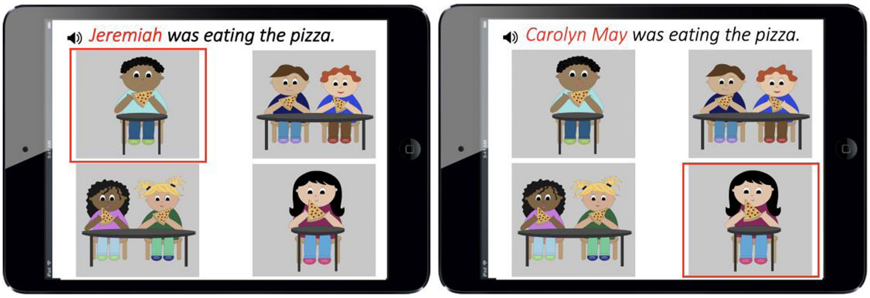

Figure 1. An example of the visual and auditory stimuli. The auditory stimuli were not presented on the screen but are presented here for purposes of illustration. The image outlined in red was the target response for the auditory stimuli provided.

functions were used to administer the DELV-ST and PVT, and a web link was sent to participants to open the web application on the participant's personal touchscreen device (i.e., iPad or other tablets, touchscreen computer, and touchscreen phone). Participants' parents were asked to find a quiet room and use headphones during the administration of all tasks.

Before beginning the sentence comprehension task, participants were given a story introducing them to six characters: *Jeremiah*, *Carter and Joe*, *Carolyn May*, and *Carol n' May*. As the story was told, the picture of each character(s) moved to help participants associate the name they heard in the story with what the characters looked like visually. To evaluate whether participants knew the names of the characters, the first set of practice trials had four trials that asked participants to touch the picture that was associated with the character's name presented auditorily. The second set of practice trials had four trials that asked participants to touch the image that best matched the sentence they heard to train participants on the task itself. The sentences in the second set of practice trials used the auxiliary verbs *is* and *are* and contained a corresponding reflexive pronoun at the end (e.g., Carter *and Joe are cutting the paper themselves*) to encourage participants to attend to other cues outside of the subject name, particularly for the ambiguous name *Carolyn May*. Participants had to answer all of the practice trials in both sets of practice trials correctly before they could begin experimental trials. In the experimental trials, participants heard a sentence and selected an image. All experimental trials were time-locked so that the participant could not select an image until the sentence ended. The PVT and the DELV-ST were administered after the sentence processing task. Some study materials cannot be publicly shared (PVT and DELV-ST) because these materials are copyrighted by the publisher.

Results

The analyses were designed to answer the two experimental questions: (1) are there differences in the use of auxiliary verb (*was* vs. *were*) for the critical sentences, and (2) does dialect density predict the use of the auxiliary verb for ambiguous sentences? Both logistic mixed-effects and logistic linear regression models were used to test the predictive value of each independent variable

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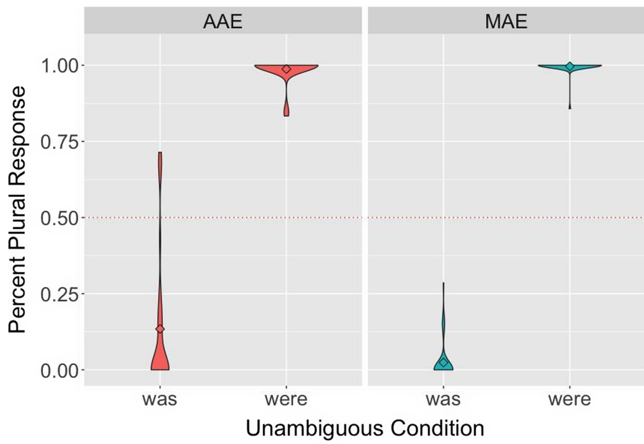

Figure 2. Percent of Plural Responses by Dialect Group and Verb Type for unambiguous sentences. Group means are shown by the black diamond. The violin plot demonstrates where the distribution of responses occurs within the group.

(Fitzmaurice et al., 2011). Logistic mixed-effects models were built using the buildmer package (version 2.8; Voeten, 2020). Buildmer uses stepwise elimination to find the largest possible regression model that will converge. Final predictor variables were selected based on the result of the buildmer model, and previous literature that has shown that variables like vocabulary or dialect are predictive of sentence processing outcomes in AAE-speaking children (Beyer & Hudson Kam, 2012; De Villiers & Johnson, 2007; Edwards, et al., 2014). Each model was tested to ensure it did not violate parametric assumptions. Both dialect density, a continuous variable, and vocabulary scores were centered because the distributions were skewed. Models were fit using the lme4 package (version 1.1-21; Bates et al., 2015) in R (version 3.6.1) using the restricted maximum likelihood estimation. No observations were excluded or replaced in analyses. Standardized parameter estimates are provided. The data and analysis code can be found here.

Understanding plurality in the unambiguous condition. First, a logistic mixed-effects model was used to analyze if AAE and MAE speakers could determine how many subjects were completing an activity in the unambiguous sentences. In this model, Plural Responses were regressed on Participant Dialect (AAE vs. MAE) and Verb Type (*was* vs. *were*). Plural Responses is a dichotomous variable where "0" represented a participant selecting a 1-person image and "1" indicated the selection of a 2-person image. A positive coefficient indicates an increase in the log odds of plural responses relative to the reference levels, which were AAE speakers and *were* Verb Type. A negative coefficient indicates a decrease in the log odds of plural responses relative to the reference levels. Vocabulary scores were included as a covariate within the model. The R code for this model can be found in Appendix C.

Figure 2 illustrates that both AAE and MAE speakers were more likely to select a 2-person image after hearing *were* than *was*. There was no effect of vocabulary, suggesting that overall language development did not impact an AAE speaker's

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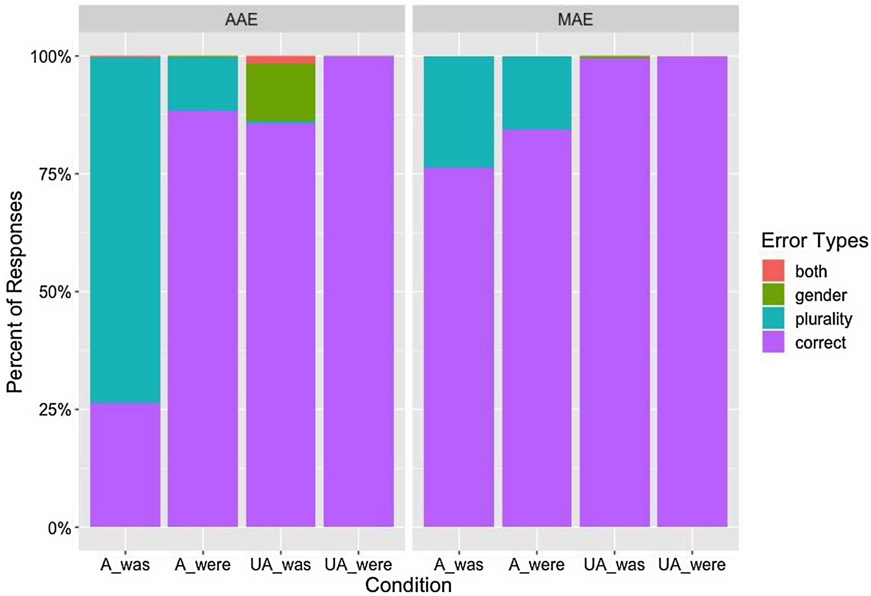

Figure 3. Types of errors in ambiguous and unambiguous conditions for AAE and MAE speakers. Condition names with "A" before them are ambiguous Verb Types, and condition names with "UA" before them are unambiguous Verb Types.

likelihood to select 2-person image after hearing *were*. There was an effect of Verb Type ($p < 0.01$, $d = -3.19$), which indicates that AAE speakers were less likely to select a 2-person image after hearing the Verb Type *was* than *were*. However, there was also no effect of Participant Dialect, meaning there was no statistically significant difference between AAE and MAE speakers' likelihood to select a 2-person image after hearing sentences with *were*. There is also a significant Participant Dialect by Verb Type interaction indicating that there was less of an effect of Verb Type on the number of plural responses AAE speakers chose than MAE speakers ($p < 0.01$, $d = -0.35$).

Interestingly, it appears that errors in the unambiguous condition were unrelated to subject–verb agreement. When we examined the error types produced by both groups to understand why there were more errors for the *was* Verb Type for AAE speakers relative to the MAE speakers. Figure 3 illustrates that for AAE speakers, the primary error type was selecting the incorrect gender, suggesting that they understood that Jeremiah was a singular noun but thought that it could be female rather than male (this is despite the fact that they had correctly responded in all training trials). Nevertheless, both groups had a significant and relatively large difference between the number of plural responses for the two verb types, indicating that they understood the task. See Table 2 for model coefficients.

Group differences in auxiliary use: Likelihood to select a 2-person image. To analyze if there were group differences in how AAE and MAE speakers used inflectional verb morphology for comprehension, a logistic mixed-effects model was used to evaluate if Participant Dialect (AAE vs. MAE) and Verb

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Table 2. Fixed effects (Speaker Group × Verb Type) from the logistic mixed-effects group for the unambiguous sentences

		CI		
	OR	LL	UL	*p*
(Intercept)	157.66	1.29	19,288.13	<0.01
Vocabulary Standard Scores	1.00	0.96	1.05	0.95
Speaker Group MAE	3.31	0.25	43.60	0.36
Verb Type was	0.00	0.00	0.00	<0.01
Speaker Group MAE × Verb Type was	0.04	0.00	0.67	<0.05

Note. The reference groups for the model are AAE speakers for Speaker Group and *were* for Verb Type. *OR* = odds ratio, *CI* = confidence interval, *LL* = lower limit, *UL* = upper limit.

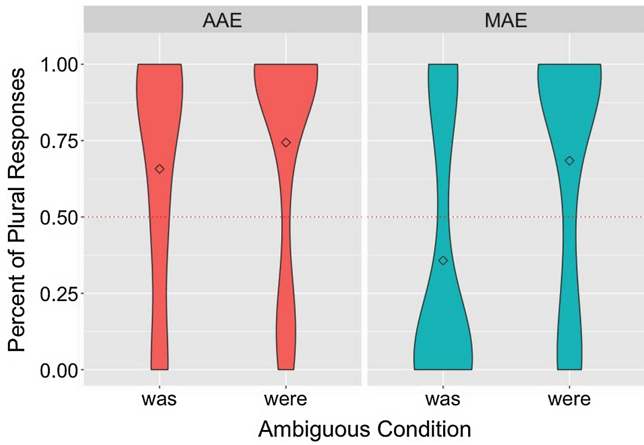

Figure 4. Percent of Plural Responses by Dialect Group and Verb Type for ambiguous sentences. Group means are shown by the black diamond. The violin plot demonstrates where the distribution of responses occurs within the group.

Type (*was* vs. *were*) were predictive of how likely a participant was to select a 2-person image. Participants' race and vocabulary were included as covariates within the model. The likelihood of selecting a 2-person image is a dichotomous variable where "0" represented a participant selecting a 1-person image and "1" indicated the selection of a 2-person image. Speaker Group was leveled so that AAE participants were the reference group, and Verb Type was leveled so that singular (*was*) was the reference group. The covariate Race was leveled so that Black participants were the reference group. Participant were modeled as random slopes to account for individual differences. In this model, a positive coefficient indicates an increase in the log odds of plural responses relative to the reference levels, which were AAE speakers and *was*. A negative coefficient indicates a decrease in the log odds of plural responses relative to the reference levels. Only responses to ambiguous sentences were included in this model. The R code for this model can be found in Appendix C.

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Table 3. Fixed effects (Speaker Group × Verb Type) from the logistic mixed-effects models for the ambiguous sentences

		CI		
	OR	*LL*	*UL*	*p*
(Intercept)	3.50	0.54	22.46	0.19
Race Asian/White	3.23	0.38	27.83	0.29
Vocabulary Standard Scores	0.87	0.30	2.52	0.79
Speaker Group MAE	0.04	0.00	0.44	<0.05
Verb Type were	2.90	1.32	6.38	<0.05
AAE speaker × Verb Type were	9.95	3.50	28.31	<0.01

Note. The reference groups for the model are Black participants for Race, AAE speakers for Speaker Group, and ambiguous *was* for Verb Type.
OR = odds ratio, *CI* = confidence interval, *LL* = lower limit, *UL* = upper limit.

Figure 4 illustrates that MAE speakers were more likely to select 2-person images after hearing *was* than *were*, indicating sensitivity to the Verb Type. However, AAE-speaking participants selected 2-person images after both *was* and *were*. The logistic mixed-effects model demonstrated there was no effect of participant Race, meaning there was no statistically significant difference between the likelihood that Asian/White and Black participants would select a 2-person image after hearing the Verb Type *was*. Furthermore, there was no effect of Vocabulary, meaning that vocabulary scores were not predictive of AAE speakers' likelihood to select a 2-person image after hearing the Verb Type *was*. There was an effect of Participant Dialect for MAE speakers ($p < 0.05$, $d = -0.75$), which indicated that MAE speakers, as compared to AAE speakers, were less likely to select a 2-person image after hearing the Verb Type *was*. In addition, there was an effect of the Verb Type *were* ($p < 0.05$, $d = 0.17$), meaning that AAE speakers were more likely to select a 2-person image with the Verb Type *were* than *was*. There was a significant interaction between Participant Dialect and Verb Type ($p < 0.01$, $d = 0.38$), which suggests there was more of an effect of Verb Type on the likelihood of selecting a 2-person image for MAE speakers relative to AAE speakers. MAE speakers were more likely to select a 2-person image for *were* and not *was* verbs, whereas AAE speakers were more likely to select a 2-person image for both *was* and *were* verbs. See Table 3 for model coefficients.

Effect of dialect density on auxiliary verb use. A logistic linear regression was performed to evaluate if dialect density (as a continuous measure) was predictive of how Black participants used the Verb Type (*was* or *were*) to comprehend ambiguous sentences. This analysis was performed only with Black participants because there was little variation in dialect density for the Asian/White participants (dialect density range .08 to .93 for Black relative to 0 to .36 for Asian/White participants). Dialect density was calculated by taking the number of non-mainstream features produced on the DELV-ST and dividing by the total number of scorable items. For example, a student who used only MAE features would score a 0, and a participant that used only AAE features would score a 1. Vocabulary was included in the model as a covariate to control for differences in language knowledge, and Age was

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Table 4. Logistic linear regression for Dialect Density and Verb Type in Black participants

	β	*SE*	*t*	*p*
(Intercept)	0.44	0.21	2.13	<0.05
Dialect Density	0.15	0.03	5.44	<0.01
Verb Type *were*	0.23	0.04	5.27	<0.01
Vocabulary Standard Scores	0.03	0.02	1.34	0.18
Age	0.00	0.00	–0.02	0.98
Dialect Density × Verb Type *were*	–0.12	0.04	–3.15	<0.01

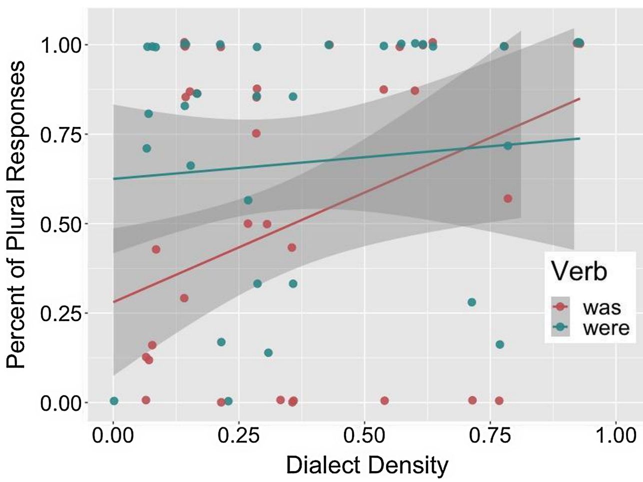

Figure 5. Percent of plural responses as a function of Dialect Density for the two verb conditions in Black participants.

included as a covariate to control for developmental differences in performance. A positive coefficient indicates an increase in the log odds of plural responses relative to the reference levels, which were ambiguous *was*, and a negative coefficient indicates a decrease in the log odds of plural responses relative to the reference level. The R code for this model can be found in Appendix C.

Figure 5 illustrates that lower dialect density for Black participants was associated with greater sensitivity to the auxiliary verb, whereas higher dialect density was associated with less sensitivity to the auxiliary verb. There was an effect of Dialect Density ($p < 0.01$, $d = 0.08$), which indicates that as dialect density increased so did the likelihood of plural responses for ambiguous *was*. In addition, there was an effect of Verb Type *were* ($p < 0.01$, $d = 0.13$) meaning there were more plural responses in ambiguous *were* than *was*. There were no effects of Vocabulary or Age. Lastly, there was an interaction between Dialect Density and Verb Type ($p < 0.01$, $d =$ -0.07), indicating that Black participants with lower dialect density had a greater difference between the number of plural responses they selected for *was* and *were*, while Black participants with higher dialect differences had smaller

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differences between plural responses they selected for *was* and *were*. The results demonstrated that dialect density is predictive of how the auxiliary verb is used to comprehend MAE sentences. See Table 4 for model coefficients.

Discussion

The purpose of this study was to evaluate if there were differences in how AAE- and MAE-speaking children used a more phonetically salient contrastive feature to comprehend MAE sentences. The results revealed that even when the contrastive feature had greater phonetic saliency relative to morphological cues used in past studies, AAE speakers did not use it as a comprehension cue to differentiate between singular and plural nouns. This supports previous inferences that AAE-speaking children are not reliably sensitive to MAE morphology that are zero or optionally marked within their dialect (Beyer et al., 2015; De Villiers & Johnson, 2007; Edwards et al., 2014) and suggest that the linguistic mismatch between features of MAE and AAE may impact spoken language comprehension, regardless of the phonetic saliency of the feature.

In AAE, subject–verb agreement is variably produced and *was* is used with both plural and singular subjects. Thus, plurality must be derived from the subject, not the verb which explains why Black AAE speakers may be less sensitive to the auxiliary verb in the ambiguous sentences (Green, 2002; Newkirk-Turner et al., 2014). The results from this study suggest that children who use AAE features in production, which is how participants were classified as MAE or AAE speakers, are also likely to also use these same dialect features in comprehension (e.g., optionally marked subject–verb agreement). On average, AAE speakers chose the 2-person image about 75% of the time for the verb *was* and about 95% of the time for the verb *were* in the ambiguous sentences. These results suggest that AAE speakers were not sensitive to verb number as a cue and instead relied on a general preference to interpret *Carolyn May* as a conjoined noun phrase in the ambiguous sentence. The pattern of selecting a 2-person image regardless of the verb aligns with how *was* is used in production for AAE speakers.

Moreover, differences in dialect density did predict how Black participants used the auxiliary verb to determine subject number. The results from the current study are in line with the results from Edwards et al. (2014), which found that dialect density predicted how AAE-speaking children used contrastive features as comprehension cues to interpret MAE words and phrases beyond vocabulary size (language experience). Despite there being a general decline in the production of AAE features as AAE-speaking children progress through school, it appears that how a contrastive feature is used for comprehension is influenced by the predominant dialect the speaker produces. Black participants who had a higher dialect density (i.e., AAE speakers) consistently used AAE in their productions on the DELV-ST *and* used their grammatical knowledge of AAE to interpret the MAE sentences. By contrast, the Black participants who had a lower dialect density (i.e., MAE speakers) primarily used MAE in their productions on the DELV-ST and used their grammatical knowledge of MAE to interpret the MAE sentences. Overall, changes in dialect density suggests that participants' linguistic experiences, as measured by the dialect features they produce, may shape what cues are used for comprehension.

This study suggests that even with increased phonetic saliency, there are difference in how AAE- and MAE-speaking children use the auxiliary verb to comprehend MAE sentences and that dialect density is predictive of sensitivity to the auxiliary verb. Furthermore, this study suggests that participants' linguistic experiences are influential in how children comprehend dialects that differ from the dialect they predominantly speak or are exposed to at home, which was demonstrated with the AAE speakers. These results suggest that researchers should take into consideration how children's linguistic experiences influence how they process sentences in MAE (Childs & Mallinson 2004; Cukor-Avila, 2001; Grieser, 2015; Major et al., 2005; Mallinson & Childs, 2004; Rickford et al., 2015; Wolfram & Beckett, 2000; Wolfram & Kohn, 2015). Furthermore, these findings raise additional questions as to how observed differences between AAE- and MAE-speaking children's performance in spoken language comprehension tasks may impact academic performance. It is possible that linguistic mismatch in spoken language (1) is resolved in naturalistic contexts where there are additional prosodic, visual, and repetition cues that improve comprehension (DeDe, 2010; Spivey et al., 2002) or (2) adversely affects AAE speakers by causing perceptual processing costs that impact other cognitive processes such as working memory (Mainela-Arnold et al., 2012; Montgomery, 2000; Terry et al., 2010, 2022). However, additional work is needed to examine if these observed differences lead to fine-grained differences in how students parse MAE sentences and how that connects to academic performance.

Limitations and suggestions

There were several limitations to this study. One limitation was the virtual recruitment and administration of the study. Although the virtual administration of this study allowed for a diverse sample, it limited the experimenter's ability to evenly match the number of AAE and MAE speakers because linguistic variation was established after participants consented to participate in the study. Likewise, the virtual administration allowed for more accessibility for participants to complete the study but limited the experimenters control over the testing environment. Although participants were encouraged to find a quiet room and use headphones during the study, distractions (e.g., noise, internet connections, etc.) could not be controlled. In addition, despite stimuli norming, there was a 2-person bias for the ambiguous name *Carolyn May*, even for the MAE speakers in the *was* condition in ambiguous sentences (though not in unambiguous sentences).

Conclusions

To date, there has been limited research on how AAE-speaking children use features that are marked in MAE but not in AAE to understand MAE sentences. This study added to this body of work by demonstrating that regardless of phonetic saliency, AAE-speaking children are less sensitive to MAE morphological features that are zero or optionally marked within their dialect. This work improves our knowledge about how linguistic variation can influence what cues children find relevant and reliable to comprehend sentences within another dialect. Furthermore, the results from this study demonstrate that linguistic mismatch, which has been primarily studied in reading and writing, also impacts what auxiliary verbs AAE-speaking children are sensitive to during spoken language comprehension. These findings help us better understand how linguistic mismatch may shape listening comprehension experiences, which will allow for the development of strategies to mitigate these effects as advocacy continues for linguistic inclusivity within the classroom.

Acknowledgments. We would like to thank the Institute of Education Sciences (R2054170139) and the National Science Foundation (NSF #1449815) for partially funding this work. We would also like to thank Ritwika Das, Max Scribner, and Rickey Sokel for their support in the development of the web-based listening comprehension task. Finally, we thank the families who made this research possible by virtually opening their homes to us during the pandemic. This research would not be possible without your participation.

Replication package. Replication data and materials for this article can be found at https://osf.io/w7jhs. Standardized assessments (PVT and DELV-ST) cannot be publicly shared because these materials are copyrighted by the publisher. The PVT can be accessed through the NIH Toolbox app, which can be purchased through the Apple App Store. More information on accessing the NIH Toolbox can be found at https://www.nihtoolbox.org/get-the-toolbox/. The DELV-ST can be purchased through Ventris Learning. More information on accessing the DELV-ST can be found at https://www.ventrislearning.com/delv/.

Note

1 In some instances, *were* may be used by adolescent or adult AAE speakers with plural subjects, but that depends on the linguistic environment and if this feature is within the speaker's linguistic repertoire (Green, 2002; Green, 2010).

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Appendix A. Age of acquisition (in year) for verb and direct object

Sentences (verb phrases)	Age of acquisition for verb	Age of acquisition for direct object
. . . eating a pizza	2.78	4.67
. . . baking a cake	3.45	3.26
. . . walking a dog	3.45	2.8
. . . washing a car	4	3.37
. . . reading a book	4.11	3.68
. . . kicking a ball	4.47	2.9
. . . riding a horse	4.67	4.15
. . . pulling a wagon	4.79	5.22
. . . folding a blanket	4.95	3.61
. . . climbing a tree	5.3	3.57
. . . touching the frog	5.16	4.32
. . . holding the basket	4.67	5.67
. . . building the sandcastle	4.45	6.42
. . . painting the wall	4.45	3.79
. . . jumping the fence	2.84	6.28
. . . moving the box	4.62	4.3
. . . drinking the milkshake	3.47	4.4
. . . hugging the teddy bear	3.47	4.21
. . . picking the apples	5.4	4.15
. . . planting the flowers	3.87	3.11
. . . throwing the baseball	4.14	4.83
. . . hanging the clothes	6.68	3.11
. . . blowing the bubbles	4	3.79
. . . sweeping the floor	4.2	4.44
. . . fixing the bike	5	4.79
. . . pushing the cart	4.26	6.16
. . . brushing the cat	3.78	3.68
. . . feeding the rabbit	4.17	3.94
. . . watching a movie	4.33	3.56
. . . cleaning a table	3.89	4.39

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Appendix B. Amazon Mechanical Turk results for name norming. Table shows the percent of people who perceived the name as 1, 2, 3, or 4 people

Subject name	Predicate	% perceived as 1 person	% perceived as 2 people	% perceived as 3 people	% perceived as 4 people	Total n of listeners
Alexander	baked cookies	1.00	0.00	0.00	0.00	27
Alexander	listened to music	1.00	0.00	0.00	0.00	18
Alexander	made a pie	1.00	0.00	0.00	0.00	18
Alexander	sang a song	1.00	0.00	0.00	0.00	9
Carolyn May	baked cookies	0.67	0.33	0.00	0.00	27
Carolyn May	listened to music	0.22	0.78	0.00	0.00	9
Carolyn May	made a pie	0.50	0.50	0.00	0.00	18
Carolyn May	sang a song	0.56	0.44	0.00	0.00	18
Carter and James	baked cookies	0.00	1.00	0.00	0.00	27
Carter and James	listened to music	0.06	0.94	0.00	0.00	18
Carter and James	made a pie	0.11	0.89	0.00	0.00	18
Carter and James	sang a song	0.11	0.89	0.00	0.00	9
Carter, Jackson, and Allie	listened to music	0.00	0.11	0.89	0.00	9
Carter, Jackson, and Allie	sang a song	0.06	0.33	0.61	0.00	18
Ellen Grace	baked cookies	0.44	0.56	0.00	0.00	18
Ellen Grace	listened to music	0.33	0.67	0.00	0.00	9
Ellen Grace	made a pie	0.67	0.33	0.00	0.00	18
Ellen Grace	sang a song	0.67	0.33	0.00	0.00	27

(*Continued*)

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(*Continued*)

Subject name	Predicate	% perceived as 1 person	% perceived as 2 people	% perceived as 3 people	% perceived as 4 people	Total n of listeners
Janice, Don, Carol, and John	baked cookies	0.00	0.00	0.00	1.00	9
Janice, Don, Carol, and John	listened to music	0.06	0.11	0.06	0.78	18
Janice, Don, Carol, and John	made a pie	0.00	0.00	0.00	1.00	18
Janice, Don, Carol, and John	sang a song	0.04	0.04	0.00	0.93	27
Jerimiah	baked cookies	1.00	0.00	0.00	0.00	27
Jerimiah	listened to music	1.00	0.00	0.00	0.00	9
Jerimiah	sang a song	1.00	0.00	0.00	0.00	18
Joanne Grace	baked cookies	0.50	0.50	0.00	0.00	18
Joanne Grace	listened to music	0.33	0.67	0.00	0.00	9
Joanne Grace	sang a song	0.59	0.41	0.00	0.00	27
Joanne Lee	baked cookies	0.83	0.17	0.00	0.00	18
Joanne Lee	listened to music	0.56	0.44	0.00	0.00	9
Joanne Lee	made a pie	0.71	0.29	0.00	0.00	17
Joanne Lee	sang a song	0.70	0.30	0.00	0.00	27
Joe, Susan, Andy, and Molly	baked cookies	0.00	0.00	0.00	1.00	9
Joe, Susan, Andy, and Molly	listened to music	0.06	0.00	0.00	0.94	18
Joe, Susan, Andy, and Molly	sang a song	0.00	0.00	0.00	1.00	17
Julianne Rose	baked cookies	0.50	0.50	0.00	0.00	18

(*Continued*)

https://doi.org/10.1017/S0142716423000243 Published online by Cambridge University Press

(*Continued*)

Subject name	Predicate	% perceived as 1 person	% perceived as 2 people	% perceived as 3 people	% perceived as 4 people	Total n of listeners
Julianne Rose	listened to music	0.48	0.52	0.00	0.00	27
Julianne Rose	made a pie	0.44	0.56	0.00	0.00	18
Julianne Rose	sang a song	0.22	0.78	0.00	0.00	9
Kerriane Lee	baked cookies	0.22	0.78	0.00	0.00	18
Kerriane Lee	listened to music	0.17	0.83	0.00	0.00	18
Kerriane Lee	made a pie	0.22	0.78	0.00	0.00	9
Kerriane Lee	sang a song	0.22	0.78	0.00	0.00	27
Lianne Grace	baked cookies	0.44	0.56	0.00	0.00	18
Lianne Grace	listened to music	0.50	0.50	0.00	0.00	8
Lianne Grace	made a pie	0.41	0.59	0.00	0.00	27
Lianne Grace	sang a song	0.39	0.61	0.00	0.00	18
Lillian Grace	baked cookies	0.11	0.89	0.00	0.00	18
Lillian Grace	listened to music	0.00	1.00	0.00	0.00	9
Lillian Grace	sang a song	0.33	0.67	0.00	0.00	18
Marian Page	baked cookies	0.15	0.85	0.00	0.00	27
Marian Page	listened to music	0.11	0.89	0.00	0.00	9
Marian Page	made a pie	0.33	0.67	0.00	0.00	18
Marian Page	sang a song	0.22	0.78	0.00	0.00	18
Marian Rose	baked cookies	0.28	0.72	0.00	0.00	18
Marian Rose	listened to music	0.06	0.94	0.00	0.00	18

(*Continued*)

https://doi.org/10.1017/S0142716423000243 Published online by Cambridge University Press

(*Continued*)

Subject name	Predicate	% perceived as 1 person	% perceived as 2 people	% perceived as 3 people	% perceived as 4 people	Total n of listeners
Marilyn Grace	baked cookies	0.56	0.44	0.00	0.00	18
Marilyn Grace	listened to music	0.56	0.44	0.00	0.00	18
Marilyn Grace	made a pie	0.22	0.78	0.00	0.00	9
Marilyn Grace	sang a song	0.56	0.44	0.00	0.00	27
Noah, James, and May	baked cookies	0.00	0.00	1.00	0.00	9
Noah, James, and May	listened to music	0.00	0.06	0.94	0.00	18
Noah, James, and May	made a pie	0.17	0.11	0.72	0.00	18
Noah, James, and May	sang a song	0.04	0.22	0.74	0.00	27
Rachel and May	baked cookies	0.00	1.00	0.00	0.00	18
Rachel and May	listened to music	0.00	1.00	0.00	0.00	18
Rachel and May	made a pie	0.11	0.89	0.00	0.00	9
Rachel and May	sang a song	0.11	0.89	0.00	0.00	27

Appendix C. R code for logistic mixed-effects models and linear regression model

(1) *R model formula for plurality in unambiguous condition*
glmer(Plural Responses ~ Vocabulary + Participant Dialect*Verb Type+(1|Participant), family = "binomial")

(2) *R model formula for Group differences in auxiliary use: Likelihood to select a 2-person image*
glmer(Plural Responses ~ Race + Vocabulary + Participant Dialect *Verb Type+(1|Participant), family = "binomial").

(3) *R model formula for Effect of Dialect Density on auxiliary verb use*
lm(Plural Responses ~Vocabulary + Age + Dialect Density*Verb Type, family = "binomial").

Cite this article: Byrd, AS., Huang, YT., and Edwards, J. (2023). The impact of dialect differences on spoken language comprehension. *Applied Psycholinguistics* **44**, 610–633. https://doi.org/10.1017/S0142716423000243