Rapid #: -25280802

CROSS REF ID: **1723664**

LENDER: **GZN (University of Wisconsin - Milwaukee) :: Ejournals**

BORROWER: **UMC (University of Maryland) :: Main Library**

TYPE:	Article CC:CCG
JOURNAL TITLE:	Seminars in speech and language
USER JOURNAL TITLE:	Seminars in Speech and Language
ARTICLE TITLE:	Understanding How Dialect Differences Shape How AAE-Speaking Children Process Sentences in Real-Time
ARTICLE AUTHOR:	Arynn S. Byrd, Yi Ting Huang, Jan Edwards
VOLUME:	
ISSUE:	
MONTH:	7
YEAR:	2025
PAGES:	
ISSN:	0734-0478
OCLC #:	

Processed by RapidX: 9/22/2025 2:30:16 PM

Understanding How Dialect Differences Shape How AAE-Speaking Children Process Sentences in Real-Time

Arynn S. Byrd, Ph.D., CCC-SLP,[1] Yi Ting Huang, Ph.D.,[1,2,3] and Jan Edwards, Ph.D.[1,3]

ABSTRACT

Dialect differences between African American English (AAE) and Mainstream American English (MAE) impact how children comprehend sentences. However, research on real-time sentence processing has the potential to reveal the underlying causes of these differences. This study used eye tracking, which measures how children interpret linguistic features as a sentence unfolds, and examined how AAE- and MAE-speaking children processed "was" and "were," a morphology feature produced differently in MAE and AAE. Fifty-nine participants, ages 7;8 to 11;0 years, completed standardized measures of dialect density and receptive vocabulary. In the eye tracking task, participants heard sentences in MAE with either unambiguous (e.g., "Jeremiah") or ambiguous (e.g., "Carolyn May"), subjects and eye movements were measured to singular (image of one person) or plural referents (image of two people). After the onset of the auxiliary verb, AAE-speaking children were sensitive to "was" and "were" when processing sentences but were less likely than MAE-speaking children to use "was" as a basis for updating initial predictions of plural referents. Among African American children, dialect density was predictive of sensitivity to "was" when processing sentences. Results suggest that linguistic mismatch impacts how contrastive verb morphology is used to update initial interpretations of MAE sentences.

KEYWORDS: African American English, sentence processing, linguistic mismatch

[1]Department of Hearing and Speech Sciences, University of Maryland, College Park, College Park, Maryland; [2]Program in Neuroscience and Cognitive Science, University of Maryland, College Park, College Park, Maryland; [3]Maryland Language Science Center, University of Maryland, College Park, College Park, Maryland.

Address for correspondence: Arynn S. Byrd, Ph.D., CCC-SLP, University of Maryland, 0100 Samuel J. LeFrak Hall, 7251 Preinkert Dr., College Park, MD 20742 (e-mail: asbyrd@umd.edu).

Form, Content, and Use in Child AAE (B); Guest Editor, Monique T. Mills

Semin Speech Lang 2025;46:1–27.
DOI: https://doi.org/10.1055/a-2626-3292.
ISSN 0734-0478.

Learning Outcomes: As a result of this activity, the reader will be able to:

- Define the term linguistic mismatch and its potential impact on academic performance.
- Explain how linguistic differences impact how AAE-speaking children process MAE sentences.
- Identify the current gaps in knowledge regarding the role of linguistic mismatch in sentence processing and comprehension.

A large body of research has shown that children who speak African American English (AAE) have poorer performance on academic tasks that are in Mainstream American English (MAE), the primary dialect of instruction in classrooms (Charity et al., 2004; Gatlin & Wanzek, 2015; NP Terry et al., 2012; 2018). While there have been several hypotheses for why this relationship exists, the most prominent is the linguistic mismatch hypothesis. A linguistic mismatch can occur when a listener encounters a "contrastive linguistic feature," a dialect feature that is produced differently in one dialect relative to another dialect (Bühler, 2017; Charity et al., 2004; Pearson et al., 2013; Saiegh-Haddad et al., 2022; Terry et al., 2018). For example, stressed BIN (e.g., "She 'been' at the store.") is a contrastive dialect feature because it is present in AAE but not MAE (Beyer & Hudson, 2015; Green, 2002; Green & Sistrunk, 2015).

For AAE-speaking children, it is hypothesized that the phonological and morphosyntactic differences between AAE and MAE create a linguistic mismatch that adversely influences academic outcomes (Charity et al., 2004; Gatlin & Wanzek, 2015). Since prior work is primarily correlational, there is a need for more studies that explore "how" a linguistic mismatch directly influences performance on academic tasks. One approach to address that gap is to use eye-tracking methods to provide a more detailed account of how children interpret contrastive features as a sentence unfolds in real-time. This, in turn, may isolate specific cognitive processes that give rise to linguistic mismatch and inform the extent to which dialect differences cause achievement gaps.

This study investigates how linguistic mismatch influences children's interpretation of subject–verb agreement in a visual-world eye-tracking task. Since eye movements are closely linked to how an unfolding speech signal is parsed, an online sentence processing task provides a fine-grained approach to observing how the dialect a child speaks interacts with how they process the linguistic information they hear (Farris-Trimble & McMurray, 2013; Spivey et al., 2002). The focus on sentence processing also provides insight into what factors may drive linguistic mismatch in sentence processing, a cognitive process that supports how children comprehend and learn from others (Barker & Meyer, 2015; Bent, 2014; Harte et al., 2016).

Linguistic Mismatch and Spoken Language Comprehension

Thus far, phonological and morphological differences between AAE and MAE have been shown to cause a linguistic mismatch in spoken language comprehension at the word, phrase, and sentence levels. Edwards et al. (2014) explored how AAE- and MAE-speaking children, ages 4 to 8, interpreted words and phrases that could be perceptually ambiguous due to a phonological (i.e., final consonant clusters) contrast between AAE and MAE. For example, Edwards et al. (2014) presented children with consonant clusters, which can be optionally produced in AAE (e.g., gold can be produced as /gold/ or /gol/) but obligatory marked in MAE (e.g., only as /gold/ in MAE; Green, 2002), and asked children to select the image that best matched what they heard. AAE-speaking children were found to be less accurate at comprehending perceptually ambiguous words (i.e., "gold") than dialect-neutral words (i.e., "book") spoken in MAE. Furthermore, children's vocabulary size and dialect density, or the number of dialect features produced in spoken language on a standardized test, predicted their performance.

The linguistic mismatch has been found to occur with a range of contrastive verb morphology features, including third-person singular "-s" (De Villiers & Johnson, 2007), past tense

"-ed," contracted "-ll" (Beyer & Hudson-Kam, 2012), and subject–verb agreement (i.e., "was/were"; Byrd et al., 2023) in sentences. In each study, children completed a picture-matching task where they were presented with sentences that contained contrastive verb morphology (e.g., third-person singular "-s") or shared verb morphology, and were asked to select the image they felt best matched what they heard. De Villiers and Johnson (2007) investigated group differences in how MAE- and AAE-speaking children comprehended subject number in sentences that contained third-person singular "-s" (e.g., "The cat 'sleeps'") and found that by age 7, MAE speakers began to use third-person singular "-s" as a reliable cue, but AAE-speaking children did not. Beyer and Hudson-Kam (2012) found that MAE- and AAE-speaking children in first and second grade used shared verb morphology to comprehend MAE sentences. However, AAE-speaking children did not use contrastive verb morphology, like past tense "-ed," to interpret tense in MAE sentences, and there were no grade-related changes in their performance. Finally, Byrd et al. (2023) found that AAE-speaking children ages 6 to 10 did not use verb morphology ("was/were") optionally marked in AAE but not MAE to interpret subject numbers in ambiguous MAE sentences. Dialect density predicted African American children's performance on the task.

What Might Sentence Processing Reveal About Linguistic Mismatch?

While past comprehension studies suggest that AAE-speaking children are not sensitive to contrastive linguistic features (Beyer & Huson-Kam, 2012; Byrd et al., 2023; De Villiers & Johnson, 2007; Edwards et al., 2014) and may rely on other linguistic cues for comprehension (Byrd et al., 2023), it remains unclear what cognitive processes give rise to interpretative differences arise across AAE- and MAE-speaking children. Since the information in sentences unfolds on a word-by-word basis, successful sentence comprehension requires the listener to use morphological, semantic, and syntactic information to efficiently and accurately interpret sentences, a process known as sentence processing (Huang et al., 2013; Martin et al., 2022).

Sentence processing happens incrementally, which allows listeners to use linguistic features, such as morphemes, to understand or revise grammatical elements (i.e., tense, agreement, and aspect) to build out syntactical structures to derive meaning from the sentence (Allen et al., 2003; Farris-Trimble & McMurray, 2013; Huang et al., 2013; Huang & Snedeker, 2018; Marslen-Wilson & Tyler, 2007; Martin et al., 2022; Spivey et al., 2002). The grammatical elements listeners attend to or use for revision during sentence processing can be influenced by the language (e.g., Booth et al., 2020; Huang et al., 2013; Roberts, 2012) or dialect (Garcia et al., 2022; Weissler & Brennan; 2020) they speak, which means AAE-speaking children may use their knowledge of AAE morphology to determine what cues they should rely on for interpretation.

While there have been limited studies to investigate how AAE-speaking children process sentences in a different dialect from their own, past research on sentence processing in MAE-speaking children suggests two candidate processes that may drive linguistic mismatch in sentence processing. First, linguistic mismatch may be driven by how children weigh or are sensitive to what cues they should attend to for interpretation. Research has shown that the reliability and frequency of linguistic cues used in a child's language determines how they weigh those linguistic cues to make predictions during sentence processing (Bates & MacWhinney, 1989; MacWhinney et al. (1984); Huang et al., 2013). Since AAE-speaking children are exposed to spoken input where auxiliary verbs are optionally produced or zero-marked (Green, 2002; Newkirk-Turner & Green, 2015), they may have learned to weigh it less than other linguistic information that is more reliable, reducing their overall sensitivity to this dialect feature.

Work by Terry et al. (2022) provides some support for that hypothesis. Terry et al. (2022) found that AAE-speaking children had difficulty processing MAE sentences with third-person singular "-s," a zero-marked feature in AAE (Newkirk-Turner & Green, 2015). Since third-person singular "-s" is not within AAE

grammar, it could not be given semantic meaning to further support interpretation. While this study does not provide information on how the third-person singular was weighed as a cue, it does show that third singular "-s" not being produced in AAE made it an unreliable cue for AAE-speaking children to use during sentence processing.

The second possibility is that linguistic mismatch is driven by difficulty integrating linguistic cues to update initial interpretations of the sentence. Studies have shown that children have more difficulty updating an initial interpretation of a sentence when the signal is degraded, there are temporary ambiguities, or they experience a verb bias (Martin et al., 2022; Trueswell et al., 1999). Therefore, when AAE-speaking children encounter a contrastive linguistic cue it may not be informative enough to support updating of initial interpretations or lead to later integration of information than their MAE-speaking peers. Work done by Erskine (2023) provides some evidence for this by finding that in sentences with limited semantic information (i.e., sentences without a predictive verb as in "Find the book"), AAE-speaking children demonstrate patterns of late processing with peak looks to the target occurring later than their MAE-speaking peers. Results from this study may suggest that linguistic mismatch leads to later integration of linguistic cues when processing MAE sentences.

Studies by Terry et al. (2022) and Erskine (2023) provide some evidence that sensitivity to contrastive verb morphology (i.e., cue weighing) or how contrastive verb morphology is later integrated into sentence interpretation can lead to a linguistic mismatch in sentence processing, neither study explicitly examines those two possibilities. Therefore, it remains unknown if sensitivity, difficulty with updating initially parsing, or both lead to differences in sentence processing between AAE- and MAE-speaking children. Additionally, more insight is needed into what other linguistic cues AAE-speaking children rely on or how optionally marked verb morphology (i.e., is/are and was/were) that is produced in AAE and MAE but with different linguistic constraints are used during sentence processing. Investigating sensitivity to other types of verb morphology (i.e., zero or optionally marked) during sentence processing provides additional information on how frequently linguistic mismatch may impact sentence processing, and examining patterns of cue integration increases our understanding of what strategies children may deploy to accommodate language variation they hear.

The Current Study

This study examines how AAE- and MAE-speaking children use "was" and "were," to parse MAE sentences in an online processing task using the visual world paradigm. This study focuses on "was" and "were," because of their contrastive use in AAE and MAE. In AAE, the same verb form ("was") is used for both plural and singular subjects ("She was walking/They was walking"), while MAE differentiates between single and plural verb forms ("She was walking/They were walking"; Green, 2002; Green & Sistrunk, 2015; Newkirk-Turner et al., 2014). The use of "was" with 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). Additionally, the forms "was" and "were" are phonetically salient whole-syllable inflectional verb morphology features reliably used as comprehension cues by younger MAE-speaking children (Kouider et al., 2006; Lukyanenko & Fisher, 2016; Wood et al., 2009), which reduces the chances of our results being confounded by age-related or perceptual saliency issues (Bortolini et al., 2006; Leonard et al., 1997; 2014). The focus on the interpretation of MAE speech explores what AAE-speaking students may be experiencing in the classroom.

This study poses two research questions: (1) Are there group differences in how AAE- and MAE-speaking students use "was" and "were" to process MAE sentences, and (2) Does dialect density predict how AAE speakers use "was" and "were" to process MAE sentences? To examine these questions, participants heard control sentences with an unambiguous singular (e.g., "Jeremiah was baking a cake") or plural subject (e.g., "Carter and Joe were baking a cake.") or experimental sentences with a

perceptually ambiguous subject (e.g., "Carolyn May was baking a cake." or "Carolyn May were baking a cake.") that could be interpreted as singular or plural. Then, participants were shown a visual world paradigm with four images of one or two characters completing an action. For the unambiguous sentences, participants could use the subject as well as the auxiliary verb "was" or "were to" determine the subject number. By contrast, for the ambiguous sentences, participants had to rely only on the auxiliary verb "was" or "were" to determine the subject number. Thus, the ambiguous sentences provide a critical test case to determine if AAE-speaking children are sensitive to the auxiliary verb to determine the subject number or use it as a cue to update their initial interpretation of the subject number.

It is predicted there will be no group differences in how AAE- and MAE-speaking process sentences with unambiguous subjects because subject numbers can be derived from redundant information provided by the subject and auxiliary verb. However, group differences are predicted to emerge in how AAE- and MAE-speaking children use "was" and "were" to process MAE sentences with ambiguous subjects. We make different eye-gaze predictions based on our two different hypotheses, which are linguistic mismatch arises from (1) differences in sensitivity to "was/were" or (2) differences in how information from "was/were" is integrated to update an initial parse. If linguistic mismatch arises from differences in sensitivity, then we expect that in the ambiguous sentences, where children must rely on the auxiliary verb, AAE speakers would have more looks at the image that corresponded with their initial interpretation of the subject noun and would not revise their interpretation when they hear the auxiliary verb. For example, when AAE-speaking children hear a subject they interpret as plural, they have more looks to the image of two people. Those looks would continue to increase even when they heard "was," demonstrating a lack of sensitivity to the auxiliary verb and a reliance on the subject to derive the interpretation of the subject number. In contrast, we expect MAE-speaking children to increase their looks to the target after they hear the auxiliary verb because in MAE "was/were" is an indicator of subject number. For example, when MAE-speaking children hear a subject they interpret as plural paired with singular verb morphology ("was"), they would revise their interpretation and have more looks to the image of one person after they heard "was," indicating sensitivity to the auxiliary verb.

It is also predicted that participants with higher dialect densities will also be less sensitive to the auxiliary verb reflected in more looks to the image that reflects the initial interpretation of the subject and no revision if the auxiliary verb suggests another interpretation. This prediction is based on the idea participants' linguistic experience, as measured by the number of dialect features they produce, may shape what cues are used for sentence processing and comprehension (Byrd et al., 2023, Edwards et al., 2014).

Alternatively, if a linguistic mismatch occurs due to differences in how verb morphology is used in late integration, we expect that AAE- and MAE-speaking children would demonstrate different patterns of how they update an initial parse later in the sentence. In this case, when AAE speakers hear an ambiguous subject they perceived as plural and then heard "was", their looks at the image of two people would decrease; however, their looks at the image of one person would not increase above chance, demonstrating difficulty with later integration. In contrast, when MAE-speaking children hear an ambiguous subject they perceived as plural and then heard "was," their looks at the image of two people would decrease and their looks to the image of one person would increase above chance, demonstrating success integrating the cue to update an initial parse because "was/were" are more reliable indicators of subject number in MAE.

Analyses will be conducted on the subject and verb phrase time windows to determine speakers' sensitivity to the subject and auxiliary verbs during sentence processing. Additional analysis will occur at the end of the sentence time window to evaluate if eye-gaze patterns indicate any late emerging revision processes for either group.

METHODS

Participants

Fifty-nine participants, ages 7;8 to 11;0 years old, were recruited from the Maryland, DC, and Virginia areas through a university database, partnerships with three schools in Maryland, and distribution of fliers in local communities. Four participants were excluded because their parents reported they had a developmental delay, language delay, or Individualized Education Plan (IEP). Based on parent reports, all other participants had typical speech and language development. All participants passed a hearing screening at the beginning of testing. Parents provided informed consent. Families received compensation for their participation.

Table 1 provides demographic information and test scores for all participants. This study used two samples derived from the recruitment pool: (1) all participants were used to address the first research question about group differences ($n = 55$), and (2) all African American participants were used to address the second research question about dialect density ($n = 29$). Additional information about the relationship between participants' race, income, and dialect density can be found in Appendix A (available in the online version only).

Parent Survey

Parents completed a survey that collected demographic information such as race, parent education level, and total family income. The survey was 15 to 20 minutes long and administered asynchronously and virtually to parents. The survey was optional; parents could skip questions they did not want to answer or decline to complete. Approximately 92% of parents completed the parent survey.

Table 1 Participant demographics

	AAE-listeners	MAE-listeners
n	17	42
Female	11	20
Mean age (y)	9;4	9;4
Range	7;8–11;0	7;8–10;11
PPVT-5th edition		
Mean SS[a] (SD[b])	108 (17)	119 (17)
Range	91–153	92–160
Dialect density[c]		
Mean SS (SD)	0.35 (0.23)	0.04 (0.06)
Range	0.00–0.92	0.00–0.20
Race		
Asian	2	3
Black	14	16
Hispanic	1	2
White	0	21
Family income		
$20,000–40,000	0	1
$41,000–60,000	0	2
$61,000–100,000	3	5
$100,000–200,000	10	13
More than $200,000	1	17
Declined to report	5	6

[a]SS stands for standard score.
[b]SD stands for standard deviation.
[c]Dialect density was calculated by taking the number of nonmainstream features produced on the DELV-ST and dividing it by the total number of scorable items.

Standardized Language Measures

Participants were administered two standardized assessments. The "Peabody Picture Vocabulary Test, 5th edition" (PPVT-5; Dunn, 2019) is a standardized and norm-referenced measure of receptive vocabulary skills. The "Diagnostic Evaluation of Language Variation-Screener Test: Part 1" (DELV-ST; Seymour et al., 2003) is a screening test designed to describe dialectal variation from MAE by evaluating the production of contrastive features between MAE and AAE. The DELV-ST Part 1 provides an age-referenced criterion score that identifies if a participant is a: (1) MAE speaker, (2) has some variation from MAE, or (3) strong variation from MAE. This criterion score was used to identify if a student spoke a nonmainstream or mainstream dialect and assign participants to groups. For this study, criterion scores of "some variation from MAE" or "strong variation from MAE" were combined into a single category of nonmainstream dialect speakers (i.e., AAE) since these criterion scores indicated they used some nonmainstream features in production.

A dialect density score was calculated based on how many AAE features a speaker uses on the DELV-ST, which was used as a continuous measure of dialect. This score was calculated by dividing the number of nonmainstream features produced by the number of scorable items (Terry & McDonald Connor, 2012; Terry et al., 2012). Therefore, a student who used only MAE features would score a 0, and a participant who used only AAE features would score a 1. While the DELV-ST does measure if a student uses "was" and "were" participants were not individually coded for their use of "was/were," but for their overall production of AAE features.

Sentence Processing Task: Materials

AUDITORY STIMULI

This study used the same auditory stimuli as an offline sentence-processing task by Byrd et al. (2023), which were MAE sentences. Byrd and colleagues (2023) conducted auditory norming and piloting to find a conjoined name (e.g., "Julianne Rose," "Carolyn May," etc.) that could be perceived as one or two people to isolate how children use verb morphology for sentence processing. Initial piloting with children showed a two-person bias with conjoined names. MAE-speaking children interpreted most ambiguous sentences with conjoined names as two people regardless of the auxiliary verb. To counteract this two-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 because 67% of adult participants interpreted this 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' responses indicated that they used "was" and "were" to determine subject numbers even though they were not from regions where this conjoined first name is typically used. Norming procedures, results, and piloting information can be found in Appendix B (available in the online version only).

The exact token of "Carolyn May" used in the norming procedure was used in the experimental audio. Two items were manipulated in each sentence: (1) whether the name was ambiguous or unambiguous, and (2) whether the sentence contained the auxiliary verb "were" or "was." All sentences were presented with one of three names: "Jeremiah" (singular noun phrase, male), "Carter and Joe" (conjoined noun phrase, male), and "Carolyn May" (ambiguous between singular or plural conjoined noun phrase, female). The unambiguous sentences had names where the subject number could be easily determined based on the names heard (i.e., "Jeremiah, Carter and Joe"). The ambiguous sentences contained the perceptually ambiguous conjoined name "Carolyn May" paired with either the singular auxiliary verb "was" or the plural auxiliary verb "were." Sentences with unambiguous names were used as control trials, and sentences with ambiguous names were critical trials since both groups had to attend to the auxiliary verb to determine the subject number. Samples of auditory stimuli can be found at https://go.umd.edu/listenlearnproject.

VISUAL STIMULI

The visual stimuli consisted of layered clip art images corresponding to the experimental and control sentences. Each image showed the same action being completed by one girl (lower-right: "Carolyn May"), two girls (lower-left: "Carolyn May"), one boy (upper-left: "Jeremiah"), and two boys (upper-right: "Carter and Joe"). The presentation of the images in the visual world paradigm was fixed to reduce task demands (see Fig. 1). The images were identical except for the identity of the character completing the action.

Sentence Processing Task: Procedure

PRACTICE TRIALS

The task was programmed in Experiment Builder version 2.3.38 and administered on an automatic EyeLink 1000 Plus or an EyeLink Portable Duo eye tracker at a sampling rate of 60 Hz. Before beginning the sentence processing task, participants were given a story introducing them to the characters: "Jeremiah, Carter and Joe, and Carolyn May" who were introduced with the image of one girl and then again with an image of two girls. Participants were asked to complete two sets of practice trials before beginning the task. The first four practice trials trained participants to associate the characters' names with an image representing the character, and the second set asked participants to touch the image that best matched the sentence they heard to provide training on the task. 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 eight practice trials correctly before beginning the experiment but were not provided any feedback that increased their attention to the auxiliary verbs.

EXPERIMENTAL TRIALS

Participants heard 56 sentences that contained 14 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), which ensured that each participant was exposed to every condition while preserving the novelty of the ambiguous names. Items were counterbalanced using a Latin Square design to prevent order effects, and pseudo-randomization was used to produce four lists that differed in the order in which each item was presented so that names were not heard more than two times in a row. All trials were time-locked, so the participant could not select an image until the sentence ended to prevent participants from selecting an image before they heard the auxiliary verb.

Data Cleaning and Preparation

The data was cleaned using *r*-package VWP Preprocessing for SR Eyelink Data (Porretta et al., 2016). The time series data was aligned to the start time of the sentence audio. Based on the data sampling rate of 500 Hz, a bin size of 50 ms was used, which resulted in 25 observations per bin. Areas of interest (AOI), the quadrant in which one of the four images appeared, were predefined in Experiment Builder by the boundaries of the four images on the display screen. All samples were evaluated for excessive amounts of track loss (e.g., blinks and looks off-screen). Overall, only 2.77% of trials were looking off the screen, which resulted in track loss. Trials were removed if there was more than 50% track loss within the time window of analysis. This cleaning resulted in 1.5% (46/3,077) of trials being dropped from analyses. All participants had track loss of less than 25%, so no participants were removed from analyses. After cleaning, the average track loss per participant in the remaining trials was less than 6%, which did not differ by dialect group (F [1, 53] = 2.14, $p = 0.15$).

RESULTS

Offline Accuracy

Accuracy in experimental trials based on children's pointing to the touch screen was investigated to examine potential group differences in sentence comprehension. Two

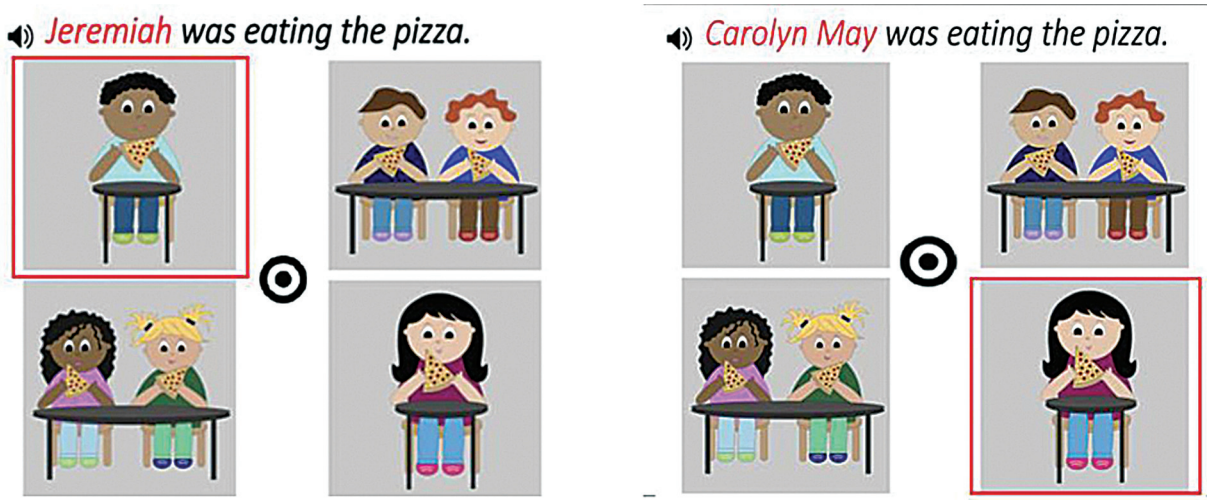

Figure 1 An example of the visual and auditory stimuli. The written version of the auditory stimuli was not presented on the screen but is presented here for purposes of illustration. The image outlined in red was the target response for the auditory stimuli provided.

logistic mixed-effects models were fitted to trial-level data, one for unambiguous and one for ambiguous sentences. In both models, target accuracy was regressed on dialect group (AAE and MAE), verb type ("was" and "were"), and age (centered). Target accuracy is a dichotomous variable where "0" indicates an image that was not the target selected and "1" indicates that a target image was selected. The model included a by-participant random intercept, and the fixed effects were leveled so that dialect group AAE was the reference group and verb type "was" the reference condition. A summary of model parameters for statistical analyses and a figure of results can be found in Appendix D (available in the online version only).

In the unambiguous sentences, there was a main effect of verb type ($\beta = 4.34$, $p < 0.01$), indicating that the reference group, AAE speakers, were more accurate in selecting the target image in unambiguous sentences that contained the auxiliary verb "were" than "was." There was also a significant interaction between dialect group and verb type ($\beta = -4.30$; $p < 0.05$), which indicates that AAE speakers had fewer accurate responses after hearing "was" than "were." Error patterns revealed that 0.7% of responses by AAE speakers were incorrect, which likely contributed to the observed interaction. Appendix Fig. D1 (available in the online version only) demonstrates the small percentage of errors in AAE- and MAE-speaking children's responses in the unambiguous condition were above chance, indicating they understood the task.

In the ambiguous sentences, there was a main effect of verb type ($\beta = 3.17$, $p < 0.01$), which indicates that the reference group, AAE speakers, were more likely to select the correct target image after hearing "were" than "was." There was a main effect of Age ($\beta = 0.72$, $p < 0.001$), which indicates that as age increased, AAE-speaking children had more looks to the target in sentences that contained "was." Lastly, there was a statistically significant dialect group by verb type interaction ($\beta = -1.17$, $p < 0.01$), which indicates the effect of the auxiliary verb on the target accuracy responses for AAE speakers was smaller than for MAE speakers. That is, AAE speakers were less likely to select the correct target image after hearing "was" and "were" than their MAE-speaking peers.

Eye-Tracking Analyses: Group Differences

To evaluate the extent to which "AAE- and MAE-speaking students differentially processed auxiliaries in an online processing task," we conducted analyses of the eye-tracking data over three-time windows: (1) subject noun phrase (e.g., from the onset of the subject noun phrase to the auxiliary verb), (2) verb phrase (e.g., from the onset of the auxiliary verb to the offset of the direct object), and (3) end-of-sentence (e.g., from the offset of the last word in the sentence to after 1,300 ms of silence after the sentence ended). All time windows were shifted 200 ms to account for eye saccades. Since all sentences are time-locked, each sentence ends within this time frame, ensuring that eye-gaze patterns and statistical analyses capture processing after the sentence has been played.

In each time window, linear mixed-effects models were fitted to trial-level data to evaluate proportion of looks to the target versus the verb distractor for unambiguous and ambiguous sentences. Target looks were operationalized as fixations to the image corresponding to the sentence's MAE interpretation, and looks to the verb distractor are fixations to the image of the same gender, but the incorrect plurality. For example, the looks to target for "Jeremiah was baking a cake" would be eye fixations to the image of one boy. The verb distractor is an image that corresponds with a character of the same gender but differs in the number of subjects presented in the image. The verb distractor for "Jeremiah was baking a cake" would be fixations to the image of two boys completing an action. Analyses occurred between two image options that corresponded with the subject's gender. This decision was motivated by visual analysis, which showed that as soon as participants heard the male (i.e., Jeremiah/Carter and Joe) or female (i.e., Carolyn May) names, they began looking at the images that matched that gender.

To analyze group differences, each model evaluated if a dialect group (AAE or MAE) by

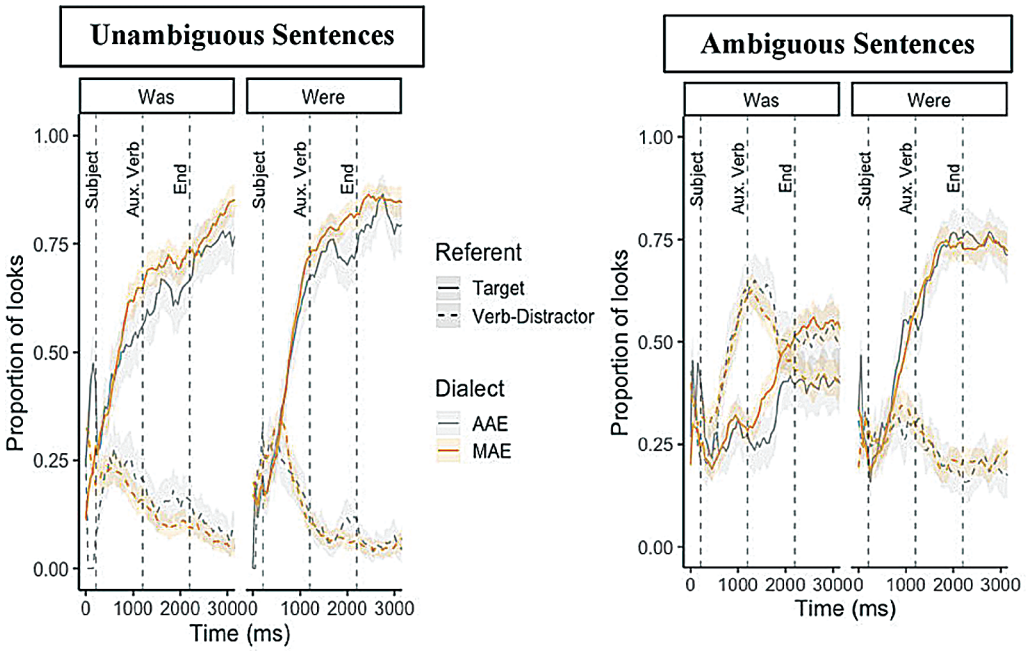

Figure 2 Proportion of looks to target versus proportion of looks to the verb-distractor for AAE and MAE speakers in unambiguous and ambiguous sentences.

verb type ("was" vs. "were") interaction predicted fixations to the target. Participants' ages (centered) and vocabulary (centered) were included in all models as fixed effects. Models included a by-participant random intercept, and the fixed effects were leveled so that dialect group AAE and verb type "was" were the reference group. Models were built using a forward stepwise elimination process to find the best-fitting model with the lowest AIC value. The initial variables selected to be included in the model-building process were informed by previous literature showing that age and vocabulary size can predict performance on sentence-processing tasks (Byrd et al., 2023; De Villiers & Johnson, 2007; Edwards et al., 2014). Models were fitted using the lme4 package (version 1.1-21) in R (version 3.6.1) using the restricted maximum likelihood estimation. No observations were excluded or replaced in analyses. Models were built to evaluate the research questions of interest and did not include all possible interactions. Data sets and *R*-scripts used can be found at https://go.umd.edu/listenlearnproject.

Unambiguous Sentences

Unambiguous sentences were evaluated to ensure that participants understood the task and results in the ambiguous sentence can be attributed to differences in how the auxiliary verb was used and not task design. Fig. 2A (left panel) first examined looks to target versus looks to the verb distractor in the unambiguous sentences. In the singular condition (i.e., was), AAE and MAE speakers demonstrated more looks to the target as early as 200 to 300 ms after the onset of the subject noun phrase, which demonstrates that both groups use the name Jeremiah to look more at the image of one boy completing an action. In the plural condition (i.e., were), AAE and MAE speakers demonstrated more looks to the target than the verb distractor around 500 to 600 ms after the onset of the subject noun phrase. Both groups use the conjoined noun phrase to look more at the image of two boys completing an action.

In both conditions, the proportions of looks to the target continued to increase after the onset of the auxiliary verb. Statistical analyses were completed in each time window. There was a main effect of verb type for

AAE-speaking children in the verb phrase ($b = 0.09$, $p < 0.01$) and end of sentence ($b = 0.06$, $p < 0.05$) regions. The main effects may indicate that AAE-speaking children generally preferred plural referents. However, there were no significant interactions that indicated group differences in the use of the subject noun or auxiliary verb. Therefore, the remainder of the analyses will focus on ambiguous sentences. A summary of model parameters for statistical analyses of unambiguous sentences can be found in Appendix C (available in the online version only).

Ambiguous Sentences

SUBJECT NOUN PHRASE

Fig. 2B (right panel) demonstrates that in the singular condition (i.e., "was"), MAE- and AAE-speaking children experience a two-person bias and had more looks to the verb distractor (i.e., two girls) than the target (i.e., one girl). In the plural condition (i.e., "were"), both groups had more looks to the target (i.e., two girls) than the verb distractor (i.e., one girl). Fig. 3A illustrates fixations to the target within the subject noun time window in the ambiguous sentences. Results show a significant main effect of verb type ($b = 0.09$, $p < 0.05$), meaning that AAE speakers, the reference group, had more looks to the target when the verb type was plural (were) than singular (was). There were no other significant main effects or dialect group interactions, meaning there were no group differences in how AAE- and MAE-speaking children used the subject as a cue during the subject phrase. See Table 2 for parameter estimates for the ambiguous sentences.

VERB PHRASE

Fig. 2B (right panel) shows the looks to target versus looks to the verb distractor in ambiguous sentences. In the singular (i.e., was) condition, AAE and MAE speakers exhibit more looks to the verb distractor beginning at the onset of the subject noun phrase. By the end of the verb phrase, MAE speakers' looks to the target increase above chance, and their looks to the verb distractor decrease below chance. AAE speakers' looks at the verb distractor also decreased at the onset of the auxiliary verb; however, their looks at the verb distractor never decreased below chance during the verb phrase. In the plural condition (i.e., were), both groups had a greater proportion of looks to the target in the subject phase and sustained those looks to the target through the duration of the verb phrase.

Fig. 3B illustrates the proportion of looks to target AAE- and MAE-speaking children in the verb phrase of ambiguous sentences. There was a significant main effect of verb type ($b = 0.37$, $p < 0.001$): AAE speakers had a greater proportion of looks to the target for the plural auxiliary verb relative to the singular. There were no significant main effects of Age, vocabulary, or dialect group, and there was no interaction between dialect group and verb type, meaning that AAE- and MAE-speaking children had similar proportions of looks to the target when they heard "was" and "were." A summary of model parameters can be found in Table 3.

END OF SENTENCE

Fig. 2B (right panel) demonstrates that in the singular condition (i.e., "was"), MAE speakers' looks to the target increased and remained above chance after the sentence ended, while their looks to the verb distractor decreased and remained below chance. Conversely, AAE-speaking children's proportion of looks to the target did not increase beyond an average of 0.30 to 0.40, and their looks to the verb distractor remained at chance. In the plural condition (i.e., "were"), AAE- and MAE-speaking children had a greater proportion of looks to the target at the end of the sentence region.

Fig. 3C shows that MAE-speaking children were more likely to use the auxiliary verb "was" to update sentence interpretations than AAE-speaking children. There was a main effect of dialect group ($b = 0.13$, $p < 0.05$), meaning MAE speakers had more looks to the target for "was" than AAE-speaking children. There was a main effect of verb type ($b = 0.34$, $p < 0.001$): there were more looks to the target in ambiguous sentences that had verb type "were" that was for the reference group,

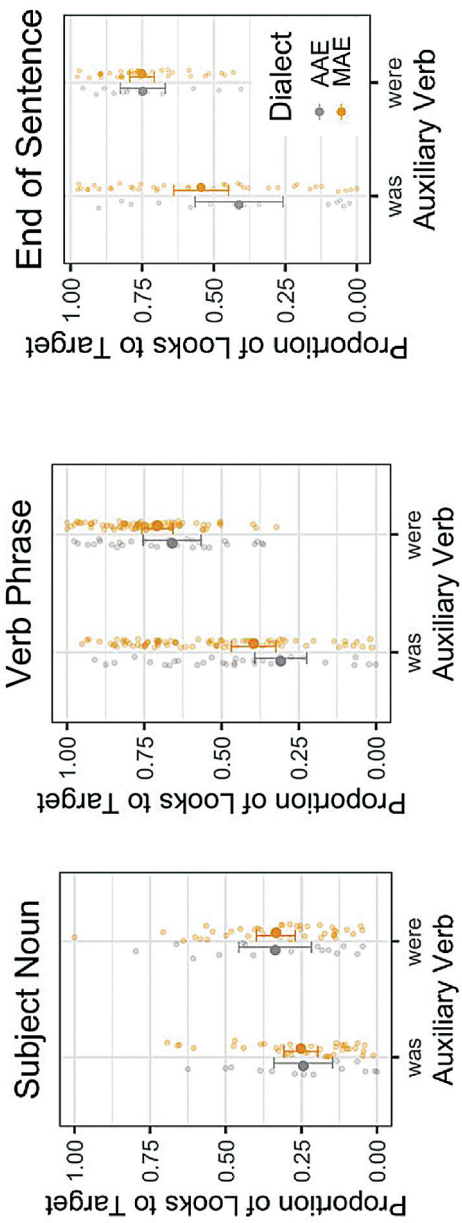

Figure 3 Time window analysis of the proportion of looks to target in the subject, verb, and end of sentence phrases in ambiguous sentences. Group means are shown by the colored circle between the error bars. Error bars show ±1 standard error, and dots show individual data points.

Table 2 Summary of parameter estimates for the mixed-effects model fit the gaze data in ambiguous sentences for the subject phrase time window

Fixed effects	*b*	*SE*	*t*
Intercept	0.23	0.04	6.22***
Vocabulary	−0.01	0.02	−0.62
Age	0.01	0.02	0.69
Dialect group: MAE	0.01	0.04	0.31
Verb type: Were	0.09	0.04	2.35*
Dialect group × Verb type	−0.03	0.05	−0.65
Random effects			
Parameter	Variance		SD
Subject (intercept)	0.01		0.09
Residual	32.56		5.71

Significance of related p-values: ***$p < 0.001$, **$p < 0.01$, and *$p < 0.05$.

Table 3 Summary of parameter estimates for the mixed-effects model fit the gaze data for ambiguous sentences in the verb phrase time window

Fixed effects	*b*	*SE*	*t*
Intercept	0.31	0.04	8.91***
Vocabulary	0.02	0.02	1.61
Age	0.03	0.02	1.59
Dialect group: MAE	0.08	0.04	1.80
Verb type: Were	0.37	0.04	10.37***
Dialect group × Verb type	−0.07	0.04	−1.59
Random effects			
Parameter	Variance		SD
Subject (intercept)	0.01		0.08
Residual	53.15		7.30

Significance of related p-values: ***$p < 0.001$, **$p < 0.01$, and *$p < 0.05$.

AAE speakers. Furthermore, there was a statistically significant interaction between verb type and dialect group ($b = -0.13$, $p < 0.001$). There is less of an effect of verb type for MAE-speaking children than their AAE-speaking peers. A summary of model parameters can be found in Table 4.

Eye-Tracking Analyses: Dialect Density and Auxiliary Verb Use

To answer the second research question, "Does dialect density predict how AAE speakers use 'was' and 'were' to process MAE sentences in an online task?," dialect density in the speech of African American participants was examined to see if it predicted eye gaze fixations in the verb phrase of ambiguous sentences. Dialect density is a continuous measure of the number of AAE dialect features a speaker produces. The relationship between eye-tracking patterns and dialect density was examined only in African American participants ($n = 29$) because there was a larger range of features produced ($M = 0.00$–0.92) in comparison to their European American peers ($M = 0.0$–0.20). A linear mixed effects model examined if the proportion of looks to target in the verb phrase was predicted by a verb type by dialect density interaction. Vocabulary (continuous variable centered) was also included as a fixed effect. The model included a by-participant random intercept, and fixed effects were leveled so that the verb type "was" was the reference group.

Table 4 Summary of parameter estimates for the mixed-effects model fit the gaze data in ambiguous sentences for the end-of-sentence time window

Fixed effects	*b*	*SE*	*t*
Intercept	0.40	0.05	8.33***
Vocabulary	0.02	0.02	0.87
Age	0.03	0.02	1.44
Dialect group: MAE	0.13	0.06	2.24*
Verb type: Were	0.34	0.04	9.87***
Dialect group × Verb type	−0.13	0.04	−3.32*
Random effects			
Parameter	Variance		SD
Subject (intercept)	0.02		0.15
Residual	66.78		8.17

Significance of related p-values: ***$p < 0.001$, **$p < 0.01$, and *$p < 0.05$.

Figure 4 Proportion of looks to target for AAE speakers in the singular (was) and plural (were) conditions for the ambiguous sentences.

Fig. 4 illustrates mean looks to target during the verb phrase as a function of dialect density for the singular and plural verb conditions in the ambiguous sentences. There was a significant main effect of dialect density ($b = -0.07$, $p < 0.001$), demonstrating that as dialect density increased, there were fewer looks to the target for "was." There was also a main effect of verb type ($b = 0.22$, $p < 0.001$): there were more to the target looks in the plural ("were") verb condition than the singular ("was") verb condition in the ambiguous sentences as dialect density increased. There was also a significant interaction between verb type and dialect density ($b = -0.07$, $p < 0.01$). That is, as dialect density increased, verb type had less effect on looks to the target. This suggests that African American participants with higher dialect densities were less sensitive to the auxiliary verb than those with lower dialect densities. There was no statistically significant effect on vocabulary. Model parameters can be found in Table 5.

Table 5 Summary of parameter estimates for the mixed-effects model fit dialect density to gaze data in verb phrase time window in ambiguous sentences

Fixed effects	*b*	*SE*	*t*
Intercept	0.43	0.02	18.25***
Vocabulary	0.03	0.02	1.67
Dialect density	−0.07	0.02	−3.47***
Verb type: Were	0.22	0.03	7.96***
Dialect density × Verb type	−0.07	0.02	−3.16**
Random effects			
Parameter	Variance		SD
Subject (intercept)	0.00		0.06
Residual	55.83		7.47

Significance of related p-values: ***$p < 0.001$, **$p < 0.01$, and *$p < 0.05$.

DISCUSSION

This study aimed to evaluate group differences in how "was" and "were," a contrastive morphological feature, is used in sentence processing and if individual variables, like dialect density, influenced performance. Furthermore, this study explored hypotheses that linguistic mismatch occurred in sentence processing due to either differences in AAE- and MAE-speaking children's sensitivity to verb morphology or how verb morphology was integrated to update initial interpretations. Investigating whether sensitivity or later integration was impacted provided insight into how AAE-speaking children leveraged their linguistic knowledge when processing sentences with contrastive verb morphology.

One of our original hypotheses was that AAE-speaking children would not be sensitive to singular/plural verb morphology (i.e., "was/were") in ambiguous sentences, which were our critical sentences because they isolated how children used the auxiliary verb. Instead, they would rely on the subject to determine the subject number. This hypothesis was not confirmed. Instead, it was observed that AAE- and MAE-speaking children decreased their looks to the verb distractor (i.e., an image of two girls) after the onset of "was," demonstrating that both groups were sensitive to the verb morphology. All children presented with a two-person bias caused by the subject in the ambiguous condition and both groups used "was" to revise their initial interpretation.

This result argues against the hypothesis that AAE-speaking children are less accurate at comprehending MAE sentences because they are not sensitive to MAE contrastive verb morphology (see Beyer & Hudson Kam, 2012; Byrd et al., 2023; De Villiers & Johnson, 2007). Instead, this result suggests that AAE-speaking children, like their MAE-speaking peers, at least by the later grades of elementary school, are sensitive to number information in verb morphology and can use it as a cue for revision. It should be noted that the children in this study were older (7–11 years) than children in many of the previous studies. Therefore, this result may not be surprising because, by age 7, AAE-speaking children have been exposed to MAE from their teachers for at least 2 to 3 years.

The results of this study also did not support our hypothesis that AAE-speaking children would weigh or be more sensitive to the subject in ambiguous sentences with singular verb morphology. Both dialect groups had a similar proportion of looks to the target during the subject noun phrase time window. This suggests that although "was" is produced with singular and plural subjects in AAE, that doesn't make the subject alone a more reliable cue.

Group differences emerged in how singular verb morphology was used to update initial interpretations of ambiguous sentences. MAE-speaking children used the information provided by "was" to revise and update their interpretation of the subject number. This

demonstrates sensitivity to "was" and that it was an informative cue. For AAE-speaking children, they used "was" to revise sentence interpretations, but by the end of this sentence, they were still at chance on whether they thought the subject number was singular or plural. This shows sensitivity to the auxiliary verb but difficulty using the information to update initial interpretations. It is possible that "was" provides probabilistic information that must be confirmed by other linguistic cues in the sentences (e.g., subject or semantic information), which decreases the informativeness of the cue because it is produced with both singular and plural subjects. Research studies have shown adults have difficulty interpreting phrases with probabilistic linguistic cues, or cues that can predict several other elements, than those with deterministic linguistic cues (Isbilen & Christiansen, 2022; Van den Bos et al., 2012). This hypothesis is consistent with the fact that AAE-speaking children's look to the target never increased above chance, which may indicate they were waiting for other additional informative linguistic cues. These results confirmed our second hypothesis that linguistic mismatch may arise from differences in later cue integration.

Offline measures of comprehension (i.e., pointing responses) reflected how difficult it was for AAE-speaking children to use singular verb morphology to update their initial interpretations. AAE-speaking children were 50% accurate at comprehending ambiguous sentences with singular verb morphology as one person. This finding replicated the findings of Byrd et al. (2023), which found that AAE-speaking children were less likely to use the auxiliary verbs "was" and "were" to comprehend subject numbers in MAE sentences where subject information is perceptually ambiguous. In addition, it provided a direct connection between AAE-speaking children's difficulty updating interpretations in real-time and their performance in comprehension.

It is important to note that sensitivity to the auxiliary verb can depend on children's dialect density or the number of AAE features they produce. Analyses of dialect density revealed that for African American children with higher dialect densities (i.e., use more AAE-like features, scores closer to 1), the singular auxiliary verb was not an informative cue to help parse ambiguous sentences. For children with lower dialect densities (i.e., more MAE-like features, scores closer to 0), the auxiliary verb was an informative cue for determining the subject number. This finding is aligned with the results of studies by Byrd et al. (2023) and Edwards et al. (2014) and that found dialect density was predictive of performance on sentence comprehension tasks. The more dialect features a child speaks, the more likely they are to rely on their linguistic knowledge to guide what cues are reliable and informative to parse sentences (Beyer et al., 2015; Beyer & Hudson-Kam, 2012; Byrd et al., 2023). These results continue to highlight a symmetry between production rates of dialect features and how they are used as comprehension cues.

Lastly, it is essential to highlight that there were no differences in performance in the unambiguous sentences where both groups of children could use the subject and auxiliary verb. Furthermore, there were no group differences in performance in ambiguous sentences with plural verb morphology (i.e., were). The lack of group difference demonstrates that in linguistic contexts with redundant information or salient confirmatory cues, like "were," the impacts of linguistic mismatch are mitigated in sentence processing. This raises the question of how often AAE-speaking children experience linguistic mismatch in naturalistic contexts like the classroom, where there are often visual and verbal redundancies to support comprehension (Berman et al., 2013; King, 2019; Knowlton & Gomes, 2022; Weatherhead et al., 2021; Yu & Ballard, 2007).

Limitations

One limitation was despite stimuli norming, there was a two-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). In addition, most of our participants came from households where their parents made $100,000 a year or more or declined to self-report their income. This makes it difficult to ascertain how socioeconomic status, a factor that can influence

dialect use, would have impacted the results of this study. Lastly, our study did not individually code for if participants produced "was" according to the morphological rules of AAE but instead coded their overall production of AAE features. This information would have helped further strengthen claims that the production of AAE features determines how you leverage your linguistic knowledge when processing MAE sentences.

CONCLUSION AND FUTURE IMPLICATIONS

These results prove that linguistic mismatch can impact sentence processing and demonstrate that linguistic mismatch is more likely to arise from differences in how contrastive linguistic cues are used to update initial interpretations of sentences, especially in linguistic contexts where redundant or informative cues are obscured. Furthermore, it shows that participants' dialect density, or the number of AAE features produced, influences their sensitivity to contrastive verb morphology to process sentences. These findings continue to show a connection between linguistic experiences, as measured by dialect features produced, and how linguistic knowledge is used to process and comprehend MAE sentences (Byrd et al., 2023; De Villiers & Johnson, 2007; Edwards et al. 2014; Erskine, 2023; Newkirk-Turner & Green, 2015; Terry et al., 2022). This study also raises additional questions about whether linguistic mismatch in sentence processing leads to short-term effects that are resolved in natural contexts where there are visual and verbal cues that can aid processing (e.g., Berman et al., 2013; Erskine, 2023; King, 2019; Knowlton & Gomes, 2022; Yu & Ballard, 2007), or if there are long-term impacts related to aspects of learning. More work is needed to distinguish between those possibilities and determine if differences in sentence processing have broader connections to learning and academic performance.

FUNDING

A.S.B. reports support for this study from the Institute of Education Sciences (R2054170139), National Science Foundation (NSF #1449815 and NSF #2234811), and American Speech Hearing Foundation.

CONFLICT OF INTEREST

None declared.

ACKNOWLEDGMENT

The authors thank the Institute of Education Sciences (R2054170139), National Science Foundation (NSF #1449815, NSF #2234811), and American Speech Hearing Foundation for partially funding this work. They would also thank Allison Choi, Sierra Hall, and Priyal Dhingra for their recruitment and data collection support. Finally, the authors thank the school partnerships and families who made this research possible.

REFERENCES

Allen, M., Badecker, W., & Osterhout, L. (2003). Morphological analysis in sentence processing: an ERP study. *Language and Cognitive Processes, 18*(4), 405–430

Barker, B. A., & Meyer, L. M. (2015). Influence of foreign accent on preschoolers' word recognition and story comprehension. *Applied Psycholinguistics, 36*, 1111–1132

Bates, E., & MacWhinney, B. (1989). Functionalism and the competition model. The crosslinguistic study of sentence processing, 3, 73–112

Bent, T. (2014). Children's perception of foreign-accented words. *Journal of Child Language, 41*, 1334–1355

Berman, J. M., Graham, S. A., Callaway, D., & Chambers, C. G. (2013). Preschoolers use emotion in speech to learn new words. *Child Development, 84* (5), 1791–1805

Beyer, T., Edwards, K. A., & Fuller, C. C. (2015). Misinterpretation of African American English bin by adult speakers of standard American English. *Language & Communication, 45*, 59–69

Beyer, T., & Hudson Kam, C. L. (2012). First and second graders' interpretation of Standard American English morphology across varieties of English. *First Language, 32*(3), 365–384

Bortolini, U., Arfé, B., Caselli, C. M., Degasperi, L., Deevy, P., & Leonard, L. B. (2006). Clinical markers for specific language impairment in Italian: the contribution of clitics and non-word repetition. *International Journal of Language & Communication Disorders, 41*(6), 695–712

Bühler, J. C. (2017). Neural mechanisms of linguistic mismatch in adults and children based on dialect familiarity and the impact of speaking Swiss German dialect on early reading and spelling acquisition (Doctoral dissertation, University of Zurich)

Byrd, A. S., Huang, Y. T., & Edwards, J. (2023). The impact of dialect differences on spoken language comprehension. *Applied Psycholinguistics, 44*(4), 610–633

Booth, P., Clenton, J., & Van Herwegen, J. (2020). *L1–L2 semantic and syntactic processing: The influence of language proximity*. In First Language Influences on Multilingual Lexicons (pp. 35–52). Routledge

Charity, A. H., Scarborough, H. S., & Griffin, D. M. (2004). Familiarity with school English in African American children and its relation to early reading achievement. *Child Development, 75*(5), 1340–1356

Craig, H. K., & Washington, J. A. (2004). Grade-related changes in the production of African American English. *Journal of Speech, Language, and Hearing Research: JSLHR, 47*(2), 450–463

De Villiers, J. G., & Johnson, V. E. (2007). The information in third-person /s/: acquisition across dialects of American English. *Journal of Child Language, 34*(1), 133–158

Dunn, D. M. (2019). Peabody Picture Vocabulary Test (5th ed.) [Measurement instrument]. Bloomington, MN: NCS Pearson

Edwards, J., Gross, M., Chen, J., MacDonald, M. C., Kaplan, D., Brown, M., & Seidenberg, M. S. (2014). Dialect awareness and lexical comprehension of mainstream American English in African American English-speaking children. *Journal of Speech, Language, and Hearing Research: JSLHR, 57*(5), 1883–1895

Erskine, M. E. (2023). Isolating Effects of Perceptual Analysis and Sociocultural Context on Children's Comprehension of Two Dialects of English, African American English and General American English (Doctoral dissertation, University of Maryland, College Park)

Farris-Trimble, A., & McMurray, B. (2013). Test-retest reliability of eye tracking in the visual world paradigm for the study of real-time spoken word recognition. *Journal of Speech, Language, and Hearing Research: JSLHR, 56*(4), 1328–1345

Garcia, F. M., Shen, G., Avery, T., Green, H. L., Godoy, P., Khamis, R., & Froud, K. (2022). Bidialectal and monodialectal differences in morphosyntactic processing of AAE and MAE: evidence from ERPs and acceptability judgments. *Journal of Communication Disorders, 100*, 106267

Gatlin, B., & Wanzek, J. (2015). Relations among children's use of dialect and literacy skills: a meta-analysis. *Journal of Speech, Language, and Hearing Research: JSLHR, 58*(4), 1306–1318

Green, L. J. (2002). African American English: a linguistic introduction. Cambridge University Press

Green, L. J., & Sistrunk, W. (2015). Syntax and Semantics in African American English. In The Oxford Handbook of African American Language

Harte, J., Oliveira, A., Frizelle, P., & Gibbon, F. (2016). Children's comprehension of an unfamiliar speaker accent: a review. *International Journal of Language & Communication Disorders, 51*, 221–235

Huang, Y. T., & Snedeker, J. (2018). Some inferences still take time: prosody, predictability, and the speed of scalar implicatures. *Cognitive Psychology, 102*, 105–126

Huang, Y. T., Zheng, X., Meng, X., & Snedeker, J. (2013). Children's assignment of grammatical roles in the online processing of Mandarin passive sentences. *Journal of Memory and Language, 69*(4), 589–606

Isbilen, E. S., & Christiansen, M. H. (2022). Statistical learning of language: a meta-analysis into 25 years of research. *Cognitive Science, 46*(9), e13198

Knowlton, T., & Gomes, V. (2022). Linguistic and non-linguistic cues to acquiring the strong distributivity of each. *Proceedings of the Linguistic Society of America, 7*(1), 5236–5236

King, J. P. J. (2019). Beyond words: non-linguistic signals and the recovery of meaning

Kouider, S., Halberda, J., Wood, J., & Carey, S. (2006). Acquisition of English number marking: the singular-plural distinction. *Language Learning and Development, 2*(1), 1–25

Leonard, L. B. (2014). Children with specific language impairment. MIT Press

Leonard, L. B., Eyer, J. A., Bedore, L. M., & Grela, B. G. (1997). Three accounts of the grammatical morpheme difficulties of English-speaking children with specific language impairment. *Journal of Speech, Language, and Hearing Research: JSLHR, 40*(4), 741–753

Lukyanenko, C., & Fisher, C. (2016). Where are the cookies? Two- and three-year-olds use number-marked verbs to anticipate upcoming nouns. *Cognition, 146*, 349–370

MacWhinney, B., Bates, E., & Kliegl, R. (1984). Cue validity and sentence interpretation in English, German, and Italian. *Journal of Verbal Learning and Verbal Behavior, 23*(2), 127–150

Marslen-Wilson, W. D., & Tyler, L. K. (2007). Morphology, language and the brain: the decompositional substrate for language comprehension. Philosophical Transactions of the Royal Society of London. *Series B, Biological Sciences, 362*(1481), 823–836

Martin, I. A., Goupell, M. J., & Huang, Y. T. (2022). Children's syntactic parsing and sentence comprehension with a degraded auditory signal. *The Journal of the Acoustical Society of America, 151*(2), 699

Newkirk-Turner, B. L., Oetting, J. B., & Stockman, I. J. (2014). BE, DO, and modal auxiliaries of 3-year-

old African American English speakers. *Journal of Speech, Language, and Hearing Research: JSLHR, 57* (4), 1383–1393

Newkirk-Turner, B. L., & Green, L. (2016). Third person singular-s and event marking in child African American English. *Linguistic Variation, 16*(1), 103-130

Pearson, B. Z., Conner, T., & Jackson, J. E. (2013). Removing obstacles for African American English-speaking children through greater understanding of language difference. *Developmental Psychology, 49*(1), 31–44

Porretta, V., Kyröläinen, A., van Rij, J., & Järvikivi, J. (2016). "VWPre: Tools for Preprocessing Visual World Data." Version 1.2.4, updated 2020–11–28, https://CRAN.R-project.org/package=VWPre

Roberts, L. (2012). Individual differences in second language sentence processing. *Language Learning, 62*, 172–188

Saiegh-Haddad, E., Laks, L., & McBride, C. (2022). Handbook of literacy in diglossia and in dialectal contexts. *Springer, 1007*, 978–983

Seymour, H. N., Roeper, T., de Villiers, J., & de Villiers, P. A. (2003). Diagnostic Evaluation of Language Variation: Screen-ing Test (DELV-ST). The Psychological Corporation

Spivey, M. J., Tanenhaus, M. K., Eberhard, K. M., & Sedivy, J. C. (2002). Eye movements and spoken language comprehension: effects of visual context on syntactic ambiguity resolution. *Cognitive Psychology, 45*(4), 447–481

Terry, N. P., & McDonald Connor, C. (2012). Changing nonmainstream American English use and early reading achievement from kindergarten to first grade. *American Journal of Speech-Language Pathology, 21*(1), 78–86

Terry, N. P., Connor, C. M., Petscher, Y., & Conlin, C. R. (2012). Dialect variation and reading: is change in nonmainstream American English use related to reading achievement in first and second grades? *Journal of Speech, Language, and Hearing Research: JSLHR, 55*(1), 55–69

Terry, N. P., Gatlin, B., & Johnson, L. (2018). Same or different: how bilingual readers can help us understand bidialectal readers. *Topics in Language Disorders, 38*(1), 50–65

Terry, J. M., Thomas, E. R., Jackson, S. C., & Hirotani, M. (2022). African American English speaking 2nd graders, verbal-s, and educational achievement: event related potential and math study findings. *PLoS One, 17*(10), e0273926

Trueswell, J. C., Sekerina, I., Hill, N. M., & Logrip, M. L. (1999). The kindergarten-path effect: studying on-line sentence processing in young children. *Cognition, 73*(2), 89–134

Van den Bos, E., Christiansen, M. H., & Misyak, J. B. (2012). Statistical learning of probabilistic nonadjacent dependencies by multiple-cue integration. *Journal of Memory and Language, 67*(4), 507–520

Washington, J. A., & Craig, H. K. (2002). Morphosyntactic forms of African American English used by young children and their caregivers. *Applied Psycholinguistics, 23*(2), 209–231

Weatherhead, D., & White, K. S. (2021). Toddlers link social and speech variation during word learning. *Developmental Psychology, 57*(8), 1195

Weissler, R. E., & Brennan, J. R. (2020). How do listeners form grammatical expectations to African American Language?

Wood, J. N., Kouider, S., & Carey, S. (2009). Acquisition of singular-plural morphology. *Developmental Psychology, 45*(1), 202–206

Yu, C., & Ballard, D. H. (2007). A unified model of early word learning: integrating statistical and social cues. *Neurocomputing, 70*(13–15), 2149–2165