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The old, the new, and the in-between: Preadolescents' use of stylistic variation in speech in projecting their own identity in a culturally changing environment

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Abstract

Cultural learning begins early, with infants' and young children's initial imitations of group-specific local behaviors. Comparatively little is known about cultural development in older children, whose more advanced socio-cognitive skills can moderate their decisions about adherence to the established cultural conventions and acceptance of new norms. Focusing on the acquisition of a regional dialect, the current study was conducted in a small community in western North Carolina, whose rich Appalachian heritage grew from distinctive cultural and living traditions. The region has gradually opened up to outside influences and the local culture is now shifting toward mainstream American socio-cultural norms. The study sought to determine how preadolescents positioned themselves in this socio-culturally changing environment. Using detailed acoustic analysis to measure stylistic variation in speech in 9–12-year-olds and perceptual ratings to verify its salience, we examined the pronunciation of the vowel /ai/ to test children's adherence to the old Appalachian identity marker (the monophthong) and their acceptance of the modern American society (the diphthong). As an innovation, children created an intermediate phonetic variant that reduced the pronunciation differences between the old and modern patterns. Demonstrating the ability to adapt speech style to context, they increased the degree of diphthongization in this /ai/-variant in careful speech (reading), and reduced it in casual conversations. Girls' productions were more diphthongal than were boys' in reading but not in conversations. The new variant in children represents regional dialect levelling, and likely results from their accommodation to the changing environment, which promotes reduction of old marked forms.

1 | INTRODUCTION

Over the past few decades, research in developmental psychology has increasingly recognized the important role of culture in the child's learning environment. Culture can be defined as 'group-typical behavior patterns shared by members of a community that rely on socially learned and transmitted information' (Laland & Hoppitt, 2003, p. 151). Although the notion of culture may be simple to understand, the concept of learning one's culture, better known as *cultural learning*, has provoked intense interdisciplinary debates across distinct scientific paradigms of cultural psychology, social anthropology, and sociology (cf. Cole, 1996; Lave & Wenger, 1991; Prout & James, 1997; Rogoff, 2003; Schieffelin & Ochs, 1986; Shweder & LeVine, 1984; Tomasello, Kruger & Ratner, 1993; Vygotsky, 1986; Whiting & Whiting, 1975). The complexity of cultural learning is reflected in diverse theoretical perspectives on two basic processes: the transmission of human culture (involving teaching practices), and cultural acquisition strategies (e.g. imitation, collaboration), whose distinguishing characteristics vary across groups and populations (Boyd & Richerson, 1985; Tomasello et al., 1993).

Several earlier models established the importance of cultural context in a child's development. In particular, learning is 'situated' in social interactions and collaborations, enabling the child to move eventually from the periphery of the community to its center as her knowledge about community practices and beliefs progresses (Lave & Wenger, 1991). Children develop as active participants in their own cultural communities, engaging in cultural practices and contributing to changes across generations and variations within communities (Rogoff, 1990, 2003). Furthermore, the cultural aspects of parenthood in non-western societies differ from the nature of parental strategies in the western world, reflecting varied cultural beliefs about child development in relation to the local community values (LeVine, Miller, & West, 1988; LeVine et al., 1994).

Cultural transmission over generations is a fundamental aspect of cultural learning. As a rapidly growing body of research in developmental and cognitive science has documented, children learn to conform to the normative expectations of their cultural group by imitation, instruction and collaboration, actively taking part in creating and displaying their group identity and affiliation (Carpenter, 2006; Otto & Keller, 2014; Tomasello, 2016). Much of what is known about children's imitative strategies comes from research with young children, ranging from infants to 6-year-olds (Legare, Wen, Herrmann, & Whitehouse, 2015; Scott & Henderson, 2013). To ensure cultural transmission, children's choices must represent a conformist bias toward adopting those traits that are most common in a population, reflecting the majority behavior (Boyd & Richerson, 1985). Selecting and copying markers of a group seems fundamental to children's understanding of cultural similarity among the members of that group, and to their decisions to adopt relevant traits in the shared environment.

However, imitation alone does not allow for cultural change, and innovation is crucial for this to occur. It has been proposed that imitation and innovation 'work in tandem as dual engines of cultural learning' (Legare & Nielsen, 2015). Early childhood innovations are often inconsistent and irregular, and it is typically the start of formal schooling that modifies children's unprompted conclusions about when (and whom) to imitate and when (and how) to innovate (Carr, Kendall, & Flynn, 2015; Koenig & Sabbagh, 2013; Wood, Kendal, & Flynn, 2013). However, research studies into cultural learning in later childhood and preadolescence are still relatively rare, and little is known about how either formal instruction in school or more sophisticated socio-cognitive skills begin to moderate older children's selective learning. Presumably, as preadolescents mature socially and interact with a wider range of adults and peers, their cultural development becomes more decision-based and less dependent on faithful imitation of parental behaviors.

The purpose of the current study was to learn more about cultural development in late childhood. We focus here on language as the prominent dimension of human cognition and learning that supports cultural transmission (Legare, 2017; Tomasello et al., 1993). Specifically, our interests are in the acquisition of a regional dialect as an element of culture and a basic and significant marker of cultural identity. As sociolinguists point out, 'in marking social identity through dialect, the precise regional distribution of dialect forms may not be nearly as important as how strongly particular features figure in people's social construction of community' (Wolfram & Schilling-Estes, 2006, p. 164). The main question of this study is how preadolescents position themselves in a socio-culturally changing community by manipulating the social meaning of local dialect forms across different speaking styles. A culturally changing (as opposed to stable) environment creates a challenge for a child who must learn the meaning of extensive inter-speaker variation in the local community in order to project her own cultural identity. But what if community norms are changing? Does the child conform to the old forms, adopt the new forms, or utilize a combination of the two? How does the child adjudicate between when to imitate the old pronunciation and when to innovate by

RESEARCH HIGHLIGHTS

- Research into cultural development in late (as opposed to early) childhood is limited. The current study asks how preadolescents accommodate to a culturally changing environment. Focusing on the acquisition of a regional dialect as a basic marker of cultural identity, variation in pronunciation patterns was analyzed acoustically in 9–12-year-old American English-speaking children who were born into a small socio-culturally changing Appalachian community in western North Carolina.
- The Appalachian children positioned themselves 'in-between' the old (local) and the new (mainstream General American) patterns, not yet adopting the new variants as the norm but not entirely discounting the local dialect. Children rejected only the most archaic local variants; they innovated by creating intermediate pronunciation forms that do not exist either in the local dialect or the mainstream variety.
- Demonstrating the ability to adapt speech style to context, children used variable phonetic realizations of the intermediate variants systematically as they deemed appropriate in careful (reading) and casual (conversational) speech. Girls produced more of the modern forms in reading but did not differ significantly from boys in conversations, approximating the local forms with greater frequency.
- From a sociolinguistic perspective, the current study contributes new evidence for contact-driven dialect levelling in American English-speaking children, which also involves suppression of locally marked variants. The intermediate phonetic forms in children likely result from their accommodation to the changing environment, reflecting both their belonging to the local area and their fitting in the mainstream American society.

producing the word in a new way? Are her choices consistent across speaking contexts?

1.1 | Acquisition of sociolinguistic competence

In the field of sociolinguistics, the acquisition of socio-cultural variation in children has been of interest at least since Labov (1964), although it is only relatively recently that social dimensions and cultural values shared by communities have been considered an integral part of knowledge about the language variant to be learned by a child. The emerging field of cognitive sociolinguistics (Kristiansen & Dirven, 2008) seeks to bridge the gap between psychology research and traditional sociolinguistics, and explore how children's knowledge about language is moderated by the interactions among members of a common cultural group, particularly their speech community (Labov, 2014).

It needs to be underscored that the speech community is central in shaping sociolinguistic competence, that is, the knowledge of language forms and their use in culture-specific social contexts (Labov, 2010). Communities of speakers maintaining group identity by sharing a common set of linguistic features can be of various sizes. They can be defined geographically to include islands, small towns, specific regions, or even span many states such as in the American South (Labov, 1963; Labov, Ash, & Boberg, 2006). Communities in large cities can be formed by social networks (or ties) between individual group members, and the types of socio-cultural contexts and network densities will moderate the use of distinctive linguistic markers and regional features (cf. Chambers, 1995; Cheshire, Fox, Kerswill, & Torgersen, 2008; Milroy, 1980; Milroy & Milroy, 1992).

The exact course of acquisition of sociolinguistic competence by children is still being debated. There is an agreement in the literature that the developmental path begins with a faithful transmission of the adult system (Kerswill, 1996; Labov, 1989; Roberts, 2002). The acquisition of adult patterns of variation begins perhaps as early as 2–3 years of age (Foulkes, Docherty, & Watt, 1999; Roberts, 1997; Smith, Durham, & Richards, 2013) and continues into preadolescence (Chevrot, Beaud, &Varga, 2000; Foulkes, Docherty, & Watt, 2005; Smith, Durham, & Fortune, 2007). But the ability to produce language must be preceded by the development of perceptual word recognition abilities in infancy. Importantly, phonological constancy (manifested as the ability to cope with unfamiliar accents) emerges no earlier than by 19 months (Best, Tyler, Gooding, Orlando, & Quann, 2009). However, despite their ability to recognize words across dialects, monolingual toddlers and young children prefer informants who speak with a native accent rather than with a foreign accent (Kinzler, Corriveau, & Harris, 2011; Kinzler, Dupoux, & Spelke, 2007; Nazzi, Mersad, Sundara, Iakimova, & Polka, 2014). This preference, still manifested in advanced perceptual abilities in older children (Jacewicz & Fox, 2014), indicates that they can associate accent with members of a particular group.

The challenge in tracking the acquisition of sociolinguistic knowledge in early childhood stems in large part from the difficulty in disentangling children's productions that are developmental in nature from those that are socially motivated. It becomes difficult to establish when children start to acquire *systematic* patterns of variation in speech. This can be due to a number of interacting factors such as the complexity of socio-cultural contexts or the number of different linguistic variables that can be studied (Kerswill & Williams, 2000). Variability in the caregiver speech, particularly differences in the use of context-dependent linguistic forms in different speaking styles across caregivers, is another contributing factor (Smith et al., 2013). Also, linguistic norms in a community as a whole may vary within individual social subgroups (Chevrot et al., 2000). These groups (whether peer or friendship) have a great influence on sociolinguistic development as they moderate the nature and frequency of social interactions among their members (Cheshire et al., 2008; Nardy, Chevrot, & Barbu, 2014; Payne, 1980).

In much sociolinguistic research, the progress of the acquisition of sociolinguistic variation has typically been assessed on the basis of style-shifting (Bell, 1984; Eckert & Rickford, 2001), a linguistic behavior reflecting a child's capacity to address different people in different, and socially appropriate, ways. There are two kinds of stylistic variation, *intra-speaker* (in the speech of an individual) and *inter-speaker* (across social groups) (Schilling-Estes, 2002). Intra-speaker variation includes shifts in usage of forms associated with different varieties of the same language (regional vs. mainstream). It also includes shifts associated with particular contextual situations (registers) such as formal and less formal 'casual' styles (e.g. *swimming* vs. *swimmin'*). Formal styles (as opposed to less formal) are often viewed as carrying social meaning such as more intelligent/educated, more articulate, and of higher socioeconomic status (Labov, 1966; Trudgill, 1974). The patterns of intra-speaker and inter-speaker variation interact in the community, creating a challenge for a child to link language forms to the provision of social information in a specific cultural context. As children's socio-cultural experience and knowledge about stylistic variability in their speech community broadens, they learn to adjust their use of language forms and pronunciation patterns across different speaking situations, including making sense of register variation (Wagner, Greene-Havas, & Gillespie, 2010).

In the early stages of socio-cultural learning, style-shifting in children's speech mirrors the type of style-shifting found in caregiver speech (Smith et al., 2013), suggesting a faithful imitation of interactions within the family/caregiver environment. Labov (2001, p. 437) views the early acquisition of stylistic variation as resulting from transmission of variation on the formal/informal dimension: 'formal speech variants are associated by children with instruction and punishment [teaching and discipline], informal speech with intimacy and fun'. However, the ability to evaluate socially motivated style, interpret local dialect forms, and make stylistic choices in different communicative contexts develops later, between 9 and 12 years of age (Barbu, Martin, & Chevrot, 2014; Buson & Billiez, 2013; Kinzler & DeJesus, 2013). At this age, preadolescents seem to have the necessary socio-cognitive maturity allowing them to start projecting their own position within their speech community.

1.2 | The Appalachian community in western North Carolina

The current study was conducted in a small community in the southern Appalachian mountain range in western North Carolina. The heart of Appalachia, linguistically a part of the Inland South on the geographic map of North American English (Labov et al., 2006), spans a broader region including southern West Virginia, southwestern Virginia, eastern Kentucky, eastern Tennessee, and western North Carolina. Within this broad region, there is substantial variation from one community of practice to another, and the term 'Appalachian' truly denotes a range of local dialects of Appalachian English, a variety that diverges from both mainstream American English and other varieties of Southern American English spoken in the southern states (Wolfram & Christian, 1976). The distinctiveness of Appalachian English is mostly attributable to the language and cultural values brought by Scotch-Irish emigrants, who dominated the settlement pattern and community formation in the early 19th century (Montgomery, 2017). For another century, before the advent of modern roads, the mountains served as an effective physical barrier against mobility and outside cultural influences, contributing to the socio-cultural demarcation between mainstream America and Appalachia. Settlements formed at the forks of streams and rivers, and communities in much of the region were often loose and highly dispersed, and some of them grew in time into towns. Typically, uplands were settled a generation after the bottomlands as the population grew and spread. This type of community formation fostered preservation of the local Appalachian dialect and cultural traditions as families were large and interconnected through marriages, and children typically did not leave the area (Clark & Hayward, 2013); to date, it is not unusual to find families with four generations living close by.

The rich cultural heritage of the community in western North Carolina grew from blending of local traditions of Cherokee Indians with those of Scotch-Irish settlers, and resulted in distinctive folklore, crafts, music, agriculture, and the tradition of story telling. The traits of the local Appalachian culture also include hospitality, sense of humor, loyalty, love of the beauty of the mountains, and the favorite outdoor activities hunting and fishing. In recognition of the richness of the local culture and distinctive living traditions, western North Carolina was designated in 2003 the Blue Ridge National Heritage Area (as one of 49 National Heritage Areas in the United States designated by the US Congress).

Notwithstanding heritage preservation efforts, the region has gradually opened up to outside influences and the local culture is now shifting toward mainstream American socio-cultural norms. The changes started in 1883 with the arrival of railroads, which invited tourism, business, and rapid development of educational institutions (Williams, 1987). Of relevance, Cullowhee Academy, what would become Western Carolina University, was founded in 1889 (with Bachelor's degrees first awarded in 1931), and its continued growth brought students and professionals from the outside. The Great Smoky Mountains National Park, established in 1934, attracted millions of visitors from other parts of the US. However, the socio-economic and cultural revolution came with the advent of four-lane highways in the late 1960s, which not only boosted mobility and travel, but opened the region for in-migration and immediate contact with mainstream varieties of American English. Florida residents, now living hours away, found the area particularly attractive as the favorite summer getaway spot, and a second home in the mountains offered escape from heat, hurricanes, and higher property taxes. In response, the locals started selling their land to Floridians and outside home builders by thousands of acres, transforming mountaintops into second-home communities (Starnes, 2005).

The cultural change in western North Carolina is particularly apparent in younger generations, and today's modern lifestyle, education, urbanization, and mobility have brought about notable changes in pronunciation patterns. Yet, although mainstream America reached the region, the strong sense of community and the Appalachian pride has remained in local families. Admittedly, 'many people in the [Jackson] county respect the past and draw emotional and cultural support from the family and community traditions of the area. In many ways, the people of the county have been quite fortunate; they have had the opportunity to adapt their lives to exciting changes in transportation, communications, and economics while retaining the personal values associated with the rural past' (McKinney, 1987, p. 426). Clearly, this challenging environment presents richness of choices, stimulating our current interest in preadolescents' abilities to learn the social meaning of variable dialect forms.

1.3 | The socio-cultural value of /ai/-monophthongization

We selected monophthongization of the diphthong /ai/ to [a:] as the dependent variable to examine the acquisition of a regional dialect. Pronunciation of words such as 'side' as 'sa:d' is the defining and the most widely stereotyped feature of Southern American English, including Appalachian English (Labov et al., 2006). As 'one of the principal caricatures of southern US speech' (Plichta & Preston, 2005, p. 107), this feature represents an important cultural symbol for older generations and an Appalachian identity marker (Greene, 2010). Studying a different small Appalachian community in eastern Tennessee, Reed (2016) found that speakers with stronger affinity toward the local community, those more rooted in the local culture, used only the stigmatized monophthongal variant whereas those with less-localized place-based identity produced more of the diphthongal forms. The rootedness metric used in that study allowed for a measurable comparison of *localized attachment* across individuals, often expressed by the locals throughout Appalachia as 'home voice', 'identity as an Appalachian', or 'our speech *is* home' (Clark & Hayward, 2013; emphasis in original). Importantly, the locals with the strongest attachment produced the most archaic form of the monophthonal /ai/, before a voiceless consonant ('pra:s' for 'price', 'ra:t' for 'right'). This pronunciation (as opposed to monophthongization in pre-voiced contexts,

'pra:z' for 'prize') is viewed by sociolinguists as highly restricted, setting Appalachia apart from the rest of the South (Irons, 2007; Labov et al., 2006; Thomas, 2003; Wolfram & Christian, 1976).

Although the monophthongal variant is still salient and widely used by older speakers in western North Carolina, it is fading among young speakers, particularly in the pre-voiceless context. Children are thus at a cultural crossroad in terms of either rejecting the local variant as old-fashioned and accepting the mainstream diphthongal form of /ai/, or conforming to community values and rejecting the modern pronunciation. At this late developmental stage, we expect the 9–12-year-olds to begin to 'perform' their identity, that is, to utilize their current understanding of the relation between the local and the global features and approximate their own place within their community.

However, there is also a third possibility. It could be that the change from the old form to the new is more gradual, and that children introduce modern features into their speech in more subtle ways, not yet adopting the new pronunciation as the norm but not entirely discounting the old variant. Research in sociolinguistic dialectology shows that new intermediate 'interdialect' forms are not uncommon and occur in dialect contact situations when linguistic accommodation takes place between speakers of two different varieties (cf. Britain, 2009, 2017; Foulkes & Docherty, 1999; Kerswill, 1994; Kerswill & Williams, 2000; Trudgill, 1986, 2004). European studies have repeatedly identified these contact-driven changes as 'levelling' (Trudgill, 1986), which indicates that marked (strictly local, uncommon) variants become less noticeable (reduced) in the local speech. While levelling occurs when two linguistic systems come into contact, cognitive socio-cultural and identity-based factors contribute greatly to this process (Watt, 2000, 2002). It is possible that levelling takes place in the Appalachian community in western North Carolina as a result of interactions with newcomers, pressures on the education system to adhere to standardization, increased mobility, and the influence of media, all of which have increasingly connected the locals with the mainstream society and promoted General American English as the modern lingua franca.

1.4 | Testing paradigm and predictions

In the current study, we adopted an established sociolinguistic style-shifting paradigm to elicit systematic variation in pronunciation patterns, expecting an increased occurrence of standardized (or prestigious) forms in more formal styles (Labov, 1966). The shift of speaking styles with increasing formality is typically achieved by varying experimental tasks to obtain speech samples in spontaneous conversations, read sentences, and in a word list, respectively.

Using this paradigm, we expected to elicit variable productions of /ai/, predicting that the new diphthongal variant will occur more often in formal than in conversational speech. If the children understand the social meaning of stylistic variation and have cultural knowledge of their changing environment, we expect them to produce the full diphthong more often in single words and read sentences rather than in conversations. Also, we expect the diphthongal variant to occur more often in stressed words than in unstressed words. Stressed words increase a speaker's attention-to-speech as they require more careful articulatory planning to denote semantic focus or other discourse-related emphasis, and careful speech tends to decrease the frequency of marked forms (Labov, 1972).

Finally, our testing paradigm controlled for phonetic context effects and examined the production of /ai/ in both pre-voiced and pre-voiceless contexts. Should children conform to older traditional community patterns, they are expected to produce the monophthongal variant in both contexts. However, their use of a diphthong in the pre-voiceless context and a monophthong in the pre-voiced will suggest their departure from the archaic Appalachian feature. That is, their understanding of the changing environment may prompt them to avoid the pre-voiceless monophthongization as old-fashioned whereas producing the monophthong in pre-voiced contexts may still be acceptable, perhaps motivated by a sense of loyalty to the local community.

Alternatively, if the contact-driven levelling takes place in this community, children may produce an intermediate variant, somewhere between [aɪ] and [a:]. The current study will verify whether the degree of diphthongization of this intermediate variant varies predictably as a function of style, emphasis, and consonant voicing.

2 | METHODS

2.1 | Participants

2.1.1 | The children

Nineteen children aged 9–12 years participated, 10 boys (M = 10.5 years, SD = 1.3) and 9 girls (M = 10.9 years, SD = 1.1). All children were born to and raised by local families in western North Carolina (henceforth NC), geographically spread over three adjacent counties: Jackson, Swain, and Haywood. Although the sample may appear modest, the children were part of a larger study which examined changes in vowel production over several generations of local speakers in this community. This cross-generational focus constrained the number of participating children because our interest was also in recording several other members of the same family, and those who were able and willing to participate did not always have children or grandchildren within the 9–12 age range.

While choosing this age range, we presumed that the children had developed the ability to adapt speech style to context, and that stylistic variation in their speech reflected their understanding of style shifting. Children's reading ability was also a concern. The experimental protocol involved reading a word list, a set of 120 prosodically structured sentences, and engaging in a free conversation, all of which had to be completed in a one-hour session. The reading tasks required the participants to be fluent readers, and children younger than 9 years old do not always meet this criterion. The upper age limit was set at 12 to ensure pre-pubertal voice production for the purposes of acoustic analysis. The children were

TABLE 1 Control participants

	Older adults			Younger adults			Children		
Baseline	***n***	**Sex**	**Age**	***n***	**Sex**	**Age**	***n***	**Sex**	**Age**
Monophthong (NC)	9	M	72.8 (6.4)	10	M	41.9 (5.4)			
				10	F	43.5 (2.5)			
Diphthong (OH)	9	M	72.0 (6.1)	10	M	41.7 (6.3)	10	M	9.9 (1.0)
				10	F	41.0 (4.1)	10	F	10.5 (1.4)

Note. Group characteristics of participants whose productions established baselines for the local monophthong in western North Carolina (NC) and for the mainstream diphthong /ai/ in central Ohio (OH). Older adults were all male (M); data from these participants are displayed in Figure 2. Younger adults and control OH children were both male and female (F); their productions are shown in Figure 3. Mean ages (with standard deviations) are in years.

pre-screened in a phone interview at recruitment and all selected participants met these criteria. All children attended local elementary schools.

2.1.2 | Control participants

Children's productions of /ai/ were assessed relative to two baselines representing the old (local) monophthong and the new (mainstream) diphthong. We used data from the local adults, born and raised in this community, to obtain the baseline for the monophthong. Since the cross-generational study was also conducted with participants in central Ohio (henceforth OH) representing the mainstream General American English (Clopper, Levi, & Pisoni, 2006), we utilized those data to establish the baseline for the degree of diphthongization in the full diphthong. The advantage of doing this was that all participants in NC and OH produced the same stimulus set and followed a common experimental paradigm, which reduced uncontrolled effects of phonetic, prosodic, and situational contexts on the acoustic measurements of their vowels.

Productions of older NC males were chosen for measurement of the traditional monophthong. In addition, we measured the monophthong in younger adults representing the parents' generation, to depict the variant the children could have been exposed to at home. Although not all of these local adults were the actual parents of the children, they could potentially interact with the children in public places or at family gatherings.

The diphthong was measured in the corresponding age-matched participants born and raised in central OH, who lived in Columbus and suburbs. The participants included older males, younger adults, and 9–12-year-old OH children for a direct comparison with NC data. Further characteristics of all control participants are presented in Table 1.

2.1.3 | Listeners

NC children's productions of /ai/ were perceptually evaluated by 17 young adult listeners from central OH (M = 21.7, SD = 2.6; 9 male). All listeners spoke General American English, had at least two years of college education, and had no reported hearing loss.

2.2 | Materials and procedures

The speech materials were constructed for a larger project and only a subset of the data pertaining to the /ai/-vowel is the current focus. In the Word Task (WT), each child read a word in the hVd-frame, containing one of the 14 American English vowels. The words were presented in random order, one at a time, on a computer monitor. This task was intended to elicit the most careful production type,

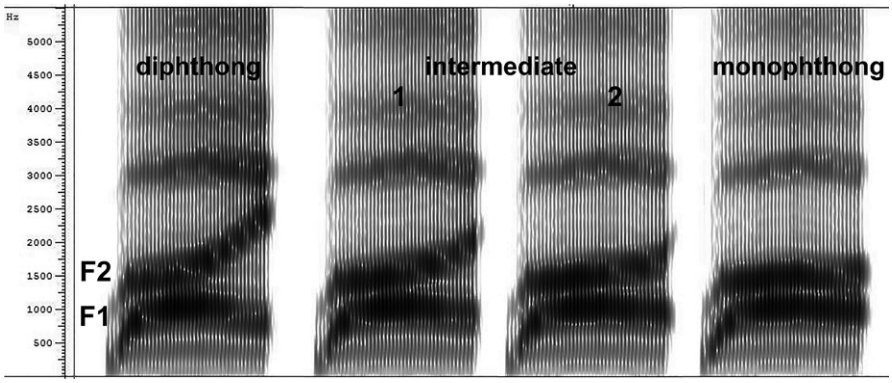

FIGURE 1 Representative spectrograms showing formant trajectories in the word 'bye' (of relevance, F1 and F2) in the full diphthong /ai/, in the monophthong [a:], and in two 'in-between' variants with relatively greater (1) and smaller (2) F2 change, reflecting a more and a less diphthongized vowel, respectively

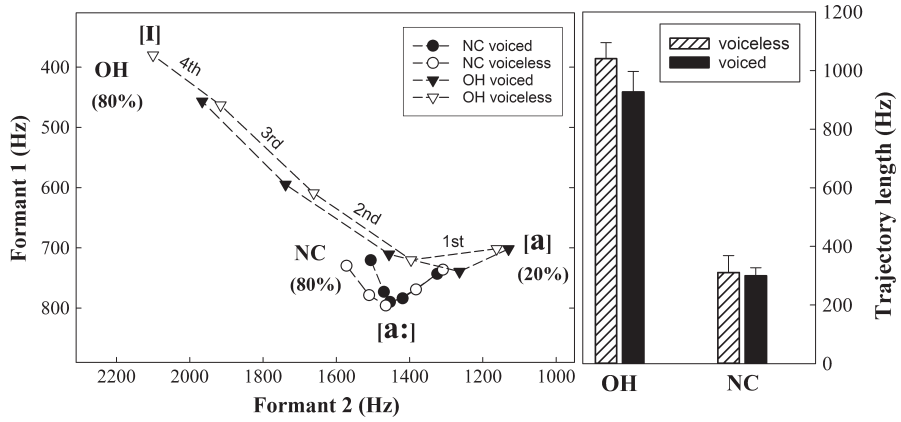

FIGURE 2 Left panel: Average formant frequencies (F1/F2) measured at five equidistant time points in a stressed vowel (20-35-50-65-80%), controlled for consonantal context; the connecting lines approximate formant movement (spectral change). Shown is the traditional local monophthongal [a:]-variant in old male adults in western North Carolina (NC) relative to the full /ai/-diphthong in old male adults in Ohio (OH). Right panel: A measure of spectral change, *trajectory length* (TL) derived from the four vowel sections

representing a formal speaking style. Three repetitions of *hide* from each child were analyzed in this study (N = 57).

In the Sentence Task (ST), each child read 120 sentences. We elicited the variation in stress using a contrastive stress paradigm so that each target word containing the /ai/-vowel in pre-voiced and pre-voiceless context, either *bides* or *bites*, occurred in variable positions in a sentence as in the following examples: *JANE thinks the small bites are deep. No! SUE thinks the small* ***bites*** *are deep* (the capitalized word in the second sentence was produced with more emphasis and the bolded target word was emphasized less). *Sue thinks the small CUTS are deep. No! Sue thinks the small* ***BITES*** *are deep* (the capitalized word in the second sentence also carried the main sentence stress and was thus produced with greater emphasis). Only the second sentences in the set were analyzed because children's productions tended to be less fluent in the first sentence. One sentence set at a time was presented to the child on a computer monitor (none of the words were in boldface but those carrying the main sentence stress were capitalized as in the examples above). The child first read the sentence set silently and then read it aloud. Each child produced six exemplars of /ai/ in *bides* and 6 in *bites* (N = 228). The productions were recorded directly onto a hard drive and the experiment was conducted using a custom program in MATLAB (release 2014a, MathWorks, Natick, MA).

In the spontaneous Talk Task (TT), each child told a story or talked about their families, friends, hobbies, pets, and school events. Ten words containing the /ai/-vowel were analyzed from each child, five stressed (if possible, carrying primary sentence stress) and five unstressed (N = 190). The selected words were not constrained to have a specific consonantal context due to the great variability of speech material. However, the postvocalic consonant choices were controlled for each child to ensure that the /ai/-vowel was followed by both voiced and voiceless consonants. In each task (WT, ST, TT), the child spoke to a head-mounted microphone.

Recordings were completed at university facilities in Western Carolina University in Cullowhee. Two adults were present in the testing room, the experimenter and the child's parent (as required by the Institutional Review Board, a parent accompanied the child and signed a consent form). The experimenter was a middle-aged female who had moved from a northern state and had lived in the area for 22 years, working as a speech-language pathologist for the local school district. Although she spoke General American English, she 'fitted in' as she lived the local life and was fascinated by the local dialect, its people, and the culture. She interacted with the child during the testing session, administered the tasks, and served as an interlocutor in the conversations.

2.3 | Data analysis

2.3.1 | Acoustic analysis

Acoustic measurements included vowel duration and the frequencies of the first two formants, F1 and F2, which were sampled at five equidistant temporal locations in the vowel, at 20-35-50-65-80%-points, capturing the nature of formant change. Spectrograms in Figure 1 illustrate the F1/F2 change in a full diphthong, a monophthong, and in variants 'intermediate' between these two. The F1/F2 values were extracted automatically using a custom MATLAB program. An autocorrelation linear prediction (LP) algorithm with 14 coefficients was used and a 25-ms Hanning window was centered at each temporal point. A reliability check on all measurement was done using TF32 speech analysis program (Milenkovic, 2003), which allowed for the manual adjustment of analysis parameters, including the analysis bandwidth and LP filter order. To assess the amount of formant movement (degree of diphthongization), a derived measure trajectory length (TL) was then calculated in MATLAB (Fox & Jacewicz, 2009; Jacewicz, Fox, & Salmons, 2011). Figure 2 shows the consecutive steps in the calculations using average group data from control participants, the old males from NC and OH. In their productions, the target vowel was followed by either a voiced consonant (*bides*) or a voiceless consonant (*bites*), and occurred in stressed and unstressed positions in a sentence.

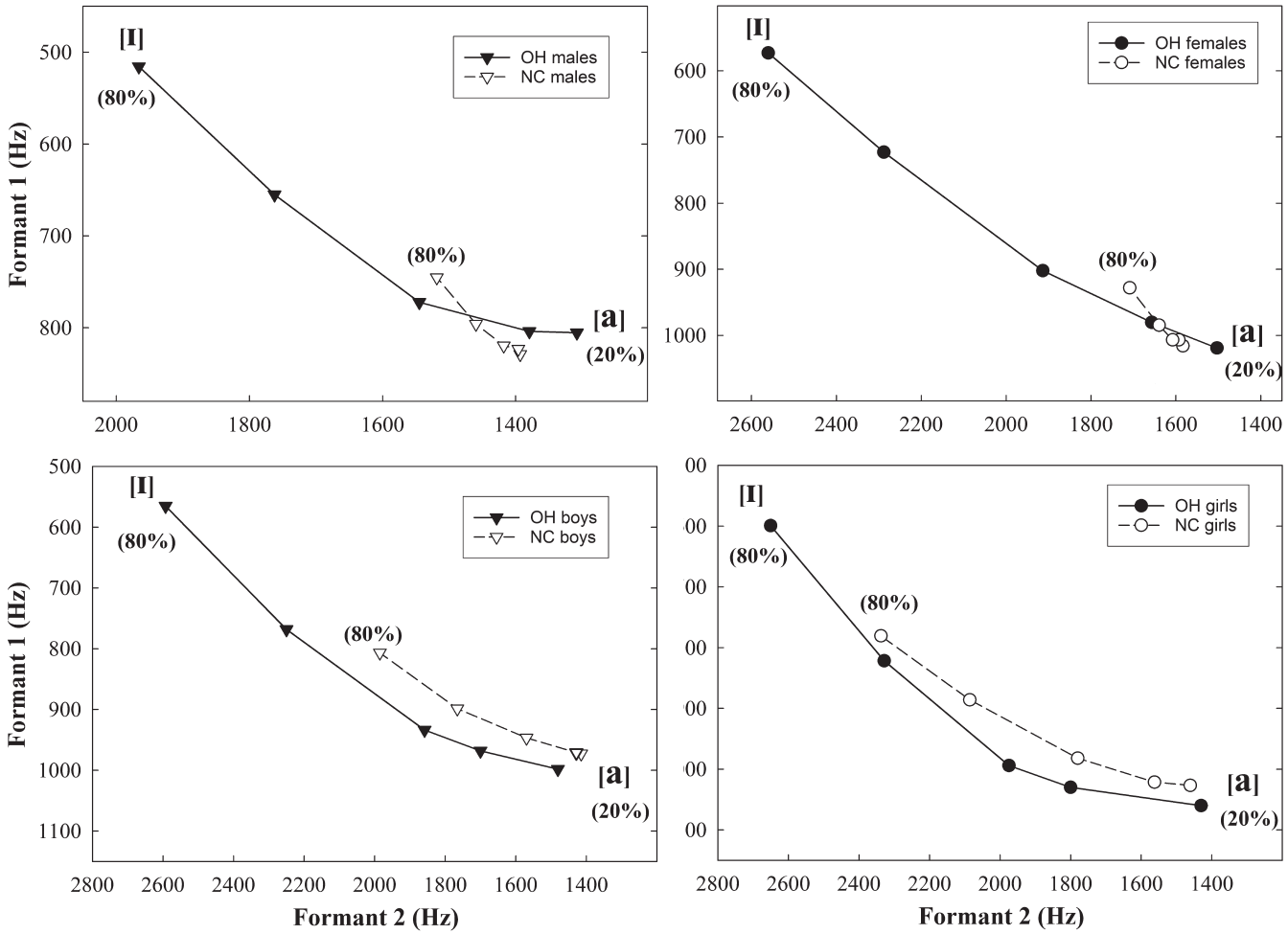

FIGURE 3 Average formant frequencies (F1/F2) in the word 'hide' produced by age-matched young adults (upper panels) and children (lower panels) in North Carolina (NC) and Ohio (OH) in a Word Task. Shown are the monophthongal variants (in NC adults) and the 'intermediate' variants (in NC children) relative to the full OH diphthongs in male speakers (left panels) and in female speakers (right panels)

The left panel illustrates how the TL measure was derived. The overall formant TL was defined as a sum of lengths of four vowel sections in the F1 × F2 plane, obtained from the five formant measurements between 20% (following the vowel's onset) and 80% (preceding the vowel's offset), where the length of one vowel section (*VSL*) is:

$$VSl_n = \sqrt{(F1_n - F1_{n+1})^2 + (F2_n - F2_{n+1})^2}$$

Vowel margins (0%–20% and 80%–100%) were excluded since these portions are most affected by consonant transitions into and out of neighboring consonants.

The right panel shows the calculated overall TLs for the OH and NC /ai/-variants occurring before voiceless and voiced stops. There is an obvious and measurable difference between the full diphthong in OH and the monophthong in NC. Furthermore, consonantal context has a differential effect on the amount of formant movement of the full diphthong, which is greater before a voiceless stop than a voiced stop. There is no context-depended variation for NC monophthong (compare the positions of the terminal 80%-points) and the slight differences in TL represent negligible variation. It is also of relevance that temporally reduced unstressed /ai/-variants will have comparatively less formant movement than the stressed vowels shown in Figure 2 (Fox & Jacewicz, 2009).

These two radically different types of production define the 'old' local variant and the 'new' non-local form. Undeniably, NC children have been exposed to a wide range of variation in formant dynamics coming from diverse linguistic and socio-cultural sources, including segmental and prosodic influences on /ai/-production, stylistic variation, speech tempo, and generational differences in pronunciation patterns. Our goal in this investigation was to determine if children associate the amount of formant dynamics with their understanding of socio-phonetic patterns of /ai/-production as representing local versus more 'modern' non-local forms.

2.3.2 | Perceptual analysis

In addition to the acoustic analyses, NC children's productions of /ai/ were rated by listeners on a 5-point scale (from very diphthongal to very monophthongal) to measure the association between the amount of formant change in production and the degree of perceived

diphthongization. The goal of the perceptual analysis was to verify that the acoustic variations were actually perceived by listeners, as the direct correspondence between production and perception cannot be assumed on the basis of acoustic measurements alone.

The rating task was administered under laboratory conditions. Each listener was seated in a sound-attenuating booth in front of a computer monitor. All 475 /ai/-tokens edited out of words from all 19 children (N = 57 [WT] + 228 [ST] + 190 [TT]) were presented in two blocks, one token at a time, over Sennheiser 640 headphones. All stimuli were amplitude equalized and presented in random order. Using the 5-point rating scale, the participant chose the rating which she thought best characterized the token she heard. The task was controlled and answers were recorded by a custom MATLAB program.

3 | RESULTS

3.1 | Acoustic analysis

We first established the baseline productions in adults and children in the Word Task. Figure 3 displays formant dynamics of the full diphthong in OH and the corresponding NC variant. The difference between these two variants in young adults (upper panels) is striking, and demonstrates that NC speakers produce the monophthongal variant even in careful speech. Of relevance, their monophthong is raised and backed in the acoustic space (compare the position of the 'archaic' variant in older NC adults in Figure 2). Possibly, NC young adults have initiated the sound change by creating a raised 'base' for the diphthongal production, and women (upper right) seem to be at its forefront.

NC children (lower panels) clearly depart from the monophthong and their variant is not only diphthongized—more so in girls (right) than in boys (left)—but the raised onset of the vowel is even slightly higher than that of age-matched OH children. This new diphthongized variant is thus different from either the old local monophthong or the mainstream diphthong, placing the NC children's productions 'in-between' these two. This result suggests that the phonetically intermediate variant is a new creation in this community, most likely representing contact-driven levelling of the two dialect forms.

Figure 4 shows average smoothed formant trajectories (from 20- to 80%-point) of this new variant produced by NC children in all three tasks (WT, ST, and TT). We observe reduced amounts of formant movement with decreasing formality in speaking style. Also, boys' productions are comparatively more 'monophthongal', particularly in read speech, although both groups seem to converge in spontaneous talks. The corresponding degree of diphthongization in these productions, using the TL measure, is shown in Figure 5. The TLs of NC children were analyzed statistically using linear mixed-effects models in IBM SPSS Statistics (version 24, 2016, International Business Machines Corp., Armonk, NY). The best-fitting model was chosen using forward selection (hierarchical approach), adding one predictor at a time starting with a baseline model that only included the intercept. The model was constructed with task (ST, TT), sex, stress, voicing and their interactions as fixed effects. WT was not included in the models because the effects of the phonetic variables (stress,

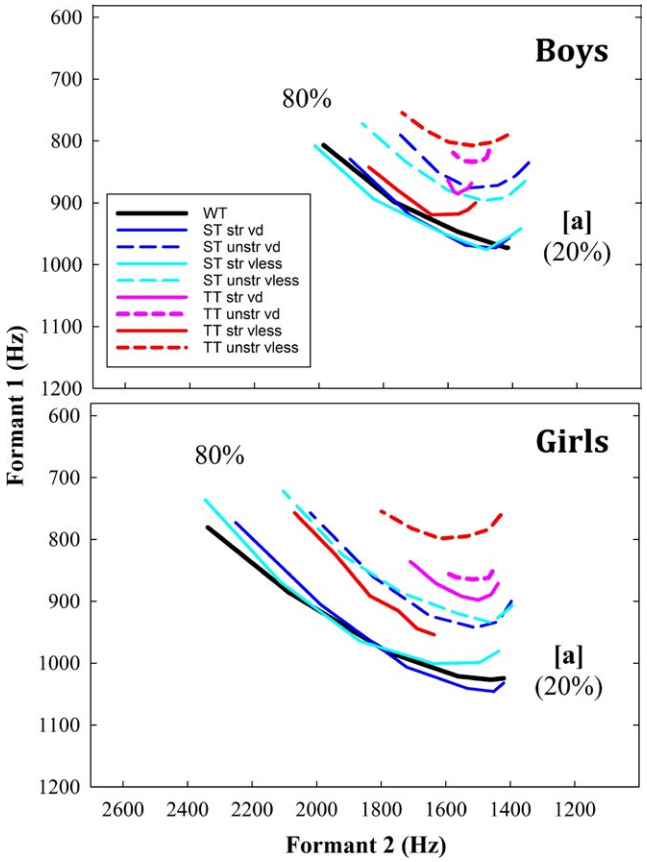

FIGURE 4 Average smoothed F1/F2 trajectories of the 'intermediate' diphthong /ai/ in North Carolina boys (upper panel) and girls (lower panel) as a function of task formality (WT = isolated words, ST = sentences, TT = talks) and stimulus type (str = stressed, unstr = unstressed, vd = followed by a voiced consonant, vless = followed by a voiceless consonant). The vowel is more diphthongized in careful speech (WT and ST), and less diphthongized in casual productions (TT)

voicing) could not be predicted; also, compared with ST, information in WT was redundant (mean TLs: 797 Hz [WT] and 796 Hz [ST], stressed words). Participant was a random effect. Log-likelihood comparisons were used to determine the statistical significance of the fixed effects and interactions in each model. The model summary is presented in Table 2.

The main effect of task (χ^2 (1) = 99.85, p < 0.001) indicated significantly greater diphthongization (measured in Hz) in sentences (M = 694.52) than in talks (M = 304.24). The main effects of stress (χ^2 (1) = 17.12, p < 0.001) and voicing (χ^2 (1) = 28.22, p < 0.001) indicated that diphthongization was significantly greater in stressed words (M = 569.48) than in unstressed (M = 438.91), and in pre-voiceless contexts (M = 579.61) than in pre-voiced (M = 428.78).

The model also revealed three significant interactions. A significant sex by task interaction (χ^2 (2) = 18.22, p < 0.001) arose because the difference between girls and boys was significant for sentences (p = 0.004) but not for the talks (p = 0.195). A significant task by stress interaction (χ^2 (1) = 5.17, p = 0.020) again showed a significant difference for sentences (p < 0.001) but not for the talks (p

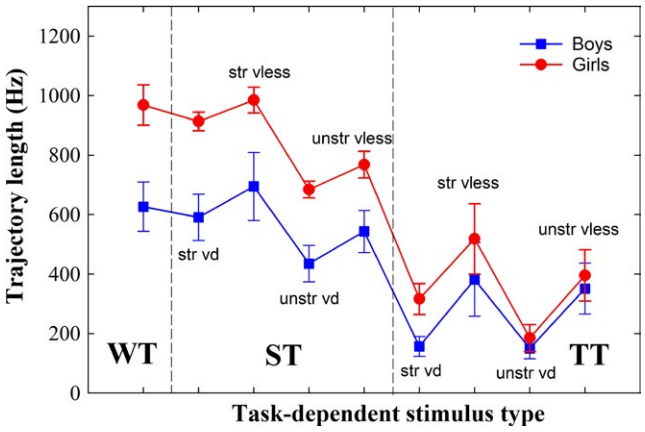

FIGURE 5 Average trajectory lengths for North Carolina children derived from formant frequencies in the 'intermediate' diphthong /ai/ in Figure 4. Shown is the amount of diphthongal change in formal contexts (WT and ST) and in casual speech (TT) in boys and girls as a function of stress and consonant voicing. Error bars indicate standard errors of the means

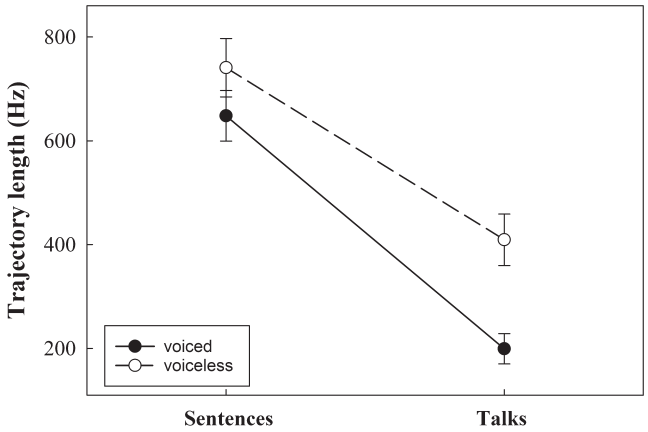

FIGURE 6 A significant task by voicing interaction revealed that a greater diphthongization of the vowel in the pre-voiceless contexts relative to pre-voiced was enhanced in casual speech, suggesting children's departure from the archaic 'marked' Appalachian feature

TABLE 2 Summary of the best-fitting model for NC children's productions

Parameter	Estimate	*SE*	*df*	*t*	*p*
Fixed effects					
(Intercept)	423.66	55.20	39	7.68	<0.001
Task (ST)	367.00	50.39	133	7.28	<0.001
Stress (stressed)	70.02	35.14	133	1.99	0.048
Voicing (voiceless)	−209.90	35.14	133	−5.97	<0.001
Sex (males)*Task (ST)	−271.77	67.95	25	−4.00	<0.001
Sex (males)*Task (TT)	−94.02	67.95	25	−1.38	0.179
Task (ST)*Voicing (voiceless)	117.21	49.70	133	2.36	0.020
Task (ST)*Stress (stressed)	116.45	49.70	133	2.34	0.021
Random effects	Variance				
Participant (intercept)	16001.82				
Residual	23467.37				

= 0.053). A significant task by voicing interaction (χ^2 (1) = 5.45, p = 0.020), graphed in Figure 6, arose because the difference due to consonant voicing in sentences was significantly smaller than in the talks (p = 0.045). None of the other main effects or interactions were significant.

In summary, the best-fitting model revealed that the children produced more of the diphthongal forms in careful (sentences) than casual (talks) speech. Also, girls showed greater diphthongization than the boys in sentences but these sex-related differences were minimized in casual speech. In terms of the phonetic variables, stressed vowels were more diphthongized than unstressed vowels in sentences but differences due to stress were minimized in casual speech. However, as Figure 6 illustrates, increased diphthongization in pre-voiceless contexts not only persisted in casual speech, but it also increased the difference between the pre-voiced and pre-voiceless variants when compared with careful productions.

3.2 | Perceptual analysis

3.2.1 | Inter-rater reliability

Intra-class correlation (ICC) analysis was used to assess the inter-rater reliability of rating scores. ICC coefficient for average measures was strong and significant (r = 0.946, p < 0.001), indicating high inter-rater reliability. ICC coefficient for single measures (i.e. for one, typical, single rater) was also significant (r = 0.523, p < 0.001). This analysis established high agreement among the listeners, whose responses were further analyzed for the effects of the variables of interest.

3.2.2 | Listeners' ratings

Average ratings of NC children's productions are shown in Figure 7. We observe a close correspondence between the TL pattern in Figure 5 and listeners' ratings of these productions in Figure 7. The ratings data were analyzed in the same way as the production data. The best-fitting model was constructed with task (ST, TT), sex, stress, voicing and their interactions as fixed effects. Participant was a random effect. Model summary is presented in Table 3.

The model revealed significant main effects of task (χ^2 (1) = 35.04, p < 0.001) and voicing (χ^2 (1) = 27.91, p < 0.001). Vowels rated

as more diphthongal were those produced in sentences rather than in talks (2.54 vs. 3.11) and in pre-voiceless contexts than in pre-voiced (2.60 vs. 3.05). A significant sex by task interaction (χ^2 (2) = 25.16, $p < 0.001$) arose because girls' productions were rated as significantly more diphthongal in sentences ($p = 0.004$) but the difference between girls and boys was not significant for the talks ($p = 0.059$). Finally, a significant task by stress interaction (χ^2 (2) = 6.70, $p = 0.040$) indicated that stressed vowels were rated as more diphthongal than unstressed vowels in sentences ($p < 0.044$) but the stress-related differences were eliminated in the talks ($p = 0.150$). None of the other main effects or interactions were significant.

The close correspondence between the two models in perception and production is noteworthy and the small discrepancies do not detract from an overall interpretation of the study's results. In particular, as a predictor, stress was not as strong in perception as it was in production; however, the locus of a significant task by stress interaction was common to both. Also, a lack of a significant task by voicing interaction in perception indicated that the increased diphthongization in pre-voiceless contexts in casual productions (see Figure 6) was not perceived as such. Rather, vowels in pre-voiceless contexts were perceived as more diphthongal than vowels in pre-voiced contexts in both tasks. We conclude that, overall, listeners were able to perceive the acoustic variation in diphthongization, validating the perceptual salience of formant dynamics produced by NC children.

4 | DISCUSSION

4.1 | Summary and discussion of main findings

Focusing on the acquisition of a regional dialect, the current study examined cultural knowledge in older children who were born into a socioculturally changing and increasingly heterogeneous environment. We focused on the /ai/-variable to test both children's adherence to the old Appalachian identity marker (the monophthong) and their acceptance of the modern mainstream American society (the diphthong). The results demonstrate that children position themselves 'in-between' these two, not yet adopting the new variant as the norm but not entirely rejecting the monophthongal production. Their slightly diphthongized /ai/ emerged as a new pronunciation bridging the two worlds; it did not exist in the local dialect and it is still considerably less diphthongal than the mainstream General American English variant. It appears that the foundation for this intermediate form was already laid by an earlier generation of local speakers who, based on their age, could be the children's parents. The monophthong of these younger adults was raised in the acoustic space when compared with the old local variant, approximating the onset position of the mainstream /ai/-diphthong. Building on this raised monophthong, the children created their new slightly diphthongized variant.

The 9–12-year-olds demonstrated the ability to adapt speech style to context, indicating that they have learned to adjust their pronunciation of /ai/ across different speaking conditions. They used variable phonetic forms systematically during the same experimental session—unprompted by either the interlocutor or the parent—as they deemed appropriate in formal (reading) and informal (conversational) speech. Adjusting the degree of diphthongization, they associated the more diphthongal pronunciation with careful speech (isolated words and sentences) and the more monophthongal variants with laid-back discourse such as when telling a story or talking about fishing, hunting, and other local activities involving family members and friends.

Importantly, these stylistic adaptations were not the only source of adjustments in the degree of diphthongization. As predicted, linguistic

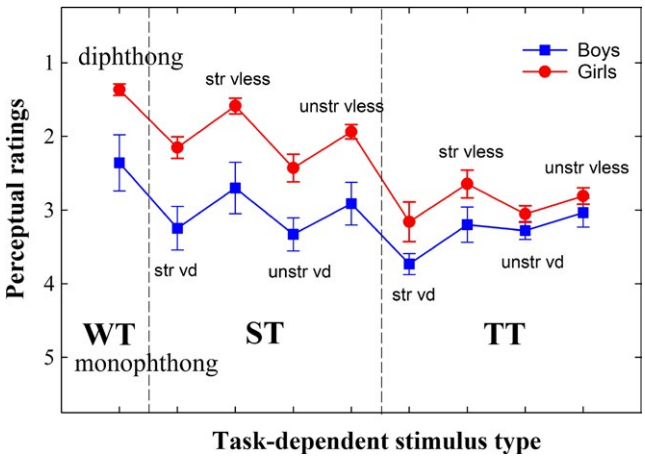

FIGURE 7 Average perceptual ratings of North Carolina children's productions. There is a close correspondence between the perceived diphthongization and the magnitude of formant movement (trajectory length) in Figure 5. Error bars indicate standard errors of the means

TABLE 3 Summary of the best-fitting model for perceptual ratings of NC children's productions

Parameter	Estimate	*SE*	*df*	*t*	*p*
Fixed effects					
(Intercept)	3.07	0.17	31.26	17.59	<0.001
Task (ST)	−0.70	0.13	133	−5.45	<0.001
Voicing (voiceless)	−0.44	0.07	133	−6.08	<0.001
Sex (males)*Task (ST)	1.02	0.22	24	4.56	<0.001
Sex (males)*Task (TT)	0.39	0.22	24	1.76	0.091
Task (ST)*Stress (stressed)	−0.23	0.10	133	−2.19	0.030
Task (TT)*Stress (stressed)	0.15	0.10	133	1.44	0.151
Random effects	Variance				
Participant (intercept)	0.19				
Residual	0.20				

stress also influenced children's productions, most likely increasing their attention-to-speech when they emphasized a specific word in a sentence (Labov, 1972). However, although their vowels were more diphthongal in stressed words than in unstressed words, these differences were significant only in reading and the effects of stress were minimized in casual speech. Irrespective of style and emphasis, increased diphthongization was also found in pre-voiceless contexts when compared with pre-voiced contexts. The systematic effects of consonant voicing indicate children's departure from the strongest Appalachian feature, the archaic pre-voiceless monophthongization. Based on the acoustic analysis, it is tempting to speculate that children's avoidance of this marked form—even in conversational speech—is a type of hypercorrection. However, perceptual ratings of these casual productions do not support this interpretation, suggesting that, in conversational speech, acoustic differences as a function of consonant voicing were perceptually less salient.

The study also found sex-related differences in children's use of diphthongization in reading but not in casual speech. Acoustic and perceptual analyses were consistent in revealing that, in careful productions, vowels produced by girls were more diphthongal than those produced by boys. However, girls did not differ significantly from boys in conversations, and both groups produced spectrally reduced variants approximating the local forms with greater frequency. Only the results for careful speech are consistent with previous studies with adults showing that, in the case of changing pronunciation patterns, women typically lead the sound change in progress (Cheshire, 2002; Eckert, 2000, 2012). The current findings indicate that this trend emerges already in late childhood. Possibly, girls imitate women rather than men in their use of more prestigious forms in reading (Coats, 1993). Viewed from the opposite angle, boys seem to contribute more to the maintenance of regional accents by using the regional features more profusely than girls, which was also found in another study with 10–11-year-olds in the French Alps (Barbu et al., 2014).

4.2 | Children's position in the changing socio-cultural environment

Predicting the use of the old and new forms on the basis of style-shifting, we also considered the possibility of dialect levelling in the local Appalachian community. The current results lead us to conclude that the intermediate /ai/-variant may indeed represent a contact-driven change and, as shown in British studies (Kerswill, 2002, 2003), regional identity may be a factor in this levelling. The new variant in children likely results from their accommodation to the changing environment, which promotes reduction of old marked variants and adaptation of new forms. From a cultural perspective, the new intermediate variant reflects convergence of Appalachian pride and mainstream America, and children's acceptance of both. As modern Appalachians, they may display their belonging to the local area when conversing with family and friends, and their fitting in the mainstream society when talking to teachers, visitors and other newcomers. The intermediate /ai/-variant can be used in both casual and formal productions, and children's choice of context-appropriate forms may be regulated by their maturing sociolinguistic competence acquired in the local Appalachian culture.

As stated at the outset of the current study, cultural transmission over generations is a fundamental aspect of cultural learning, and both imitation and innovation are involved in cultural change (Legare & Nielsen, 2015). We see the intermediate /ai/-variant in children as emerging from phonetic elements representing faithful imitation of the adult system (the acoustically raised monophthong in younger adults) and those belonging to the mainstream dominant variant (the full diphthongal transitions). Children innovate by enhancing the spectral change in the monophthong, producing formant dynamics in the direction of the full diphthong. This intermediate diphthong thus represents a sound change in this community coming from dialect contact and socio-cultural accommodation.

Although sound changes in American English have been viewed as resulting from incrementation (Labov, 1994), a process 'in which successive cohorts and generations of children advance the change beyond the level of their caretakers and role models, and in the same direction over many generations' (Labov, 2007, p. 346), there are also reports of contact-driven dialect levelling in the United States (e.g. Anderson, 2002; Thomas, 1997). The current study contributes new evidence for a contact-driven levelling in children, which also involves suppression of locally marked variants. While the acquisition of variable pronunciation patterns begins in early childhood (Roberts, 2002), the current findings suggest that at a certain point in cultural learning, children reject selected marked features as outdated and associated with older people in the community (e.g. the traditional monophthong, the pre-voiceless /ai/-monophthongization) and replace them with new ones. Only longitudinal data can clarify whether the phonetically intermediate /ai/-variant stabilizes in children or whether it is short-lived, and will eventually evolve into the mainstream General American diphthong in their adult years.

4.3 | Future directions

The current study examined children's pronunciation pattern as a basic marker of cultural identity. Future studies could include qualitative and quantitative measures analyzing not only other linguistic markers (e.g. phonological, lexical, syntactic, pragmatic or discourse), but also non-linguistic behavior of children related to other aspects of socio-cultural cognition. The novel intermediate pronunciation forms found in this study may not reflect an isolated behavior specific to language. Rather, they may be associated with other 'inter-cultural' innovations introduced by children as a general strategy underlying their adaptive learning in a changing environment. Some of the variables of future interest may be related to their changing food preferences, leisure activities, personal relationships, choice of music, attitudes toward fashion, travel, foreign cultures, or the types of social interactions in their daily lives.

Future studies will need to extend the current findings to other socio-culturally changing communities and to children younger than 9 years old. Cognitive decision-making in relation to stylistic variation in speech is likely to begin earlier, perhaps in 6–8-year-olds, when children begin their formal education in school and are provided with a greater variety of models so as to learn stylistic flexibility in speech.

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