

Session: 1850

Location: CC/330 ABC

Regional Variation in African American English

Yolanda Feimster Holt

Saturday, November 23

11:30-12:30



Speaker Disclosure

I have no relevant financial or nonfinancial relationship(s) within the products or services described, reviewed, evaluated or compared in this presentation.

I am employed as a faculty member at East Carolina University and the university supported my presence here today.



Learner Outcomes

1. Describe vowel change as it relates to changes in progress in the United States
2. Describe the interaction of regional community membership and socio-ethnic racial identity on dialect variation in African American English
3. Describe the relationship between Southern American English and African American English

Plan for today

1. Broad general description of nonlinear phonology
2. Broad general description of African American English
3. Vowel changes in progress
4. Experiment data analysis and results

Regional Variation in African American English

- Non-linear models suggest the prosodic structure of language is acquired before phoneme boundaries are learned.
- Bernhardt (1992) suggested that when children are ready to learn words
 - They learn the rules of association for the segmental elements (sounds)
 - Those segments are slotted into a representational framework the child uses for decoding and encoding information.

Regional Variation in African American English

- The representational framework incorporates syllabic (prosodic level) and segmental level information.
- The child comes to the language learning process primed with expected syllable structures and an expected segmental inventory of features.
- Specifically the child has an expectation of both the prosody and range of syllable shapes of a language as they begin word learning

Regional Variation in African American English

Theories of non-linear phonology propose a hierarchical organization of components (Bernhardt & Stoel-Gammon, 1994)

- Words
- Syllables
- Segments
- Features

Regional Variation in African American English

Craig et al., (2003) described variation in word shape for child speakers of African American English including

mou for *mouth* postvocalic consonant reduction

waitin' for *waiting* ng dropping/substitution of /n/ for /ng/

dis for *this* substitution for theta and eth

birfday for *birthday*

Regional Variation in African American English

- The examples of word shape changes for AAE child speakers described by Craig et al., (2003) are indicative of changes in
- Syllable shape the *CVC mouth* becomes the *CV mou*
- The feature fricative in *this* becomes a stop in *dis*

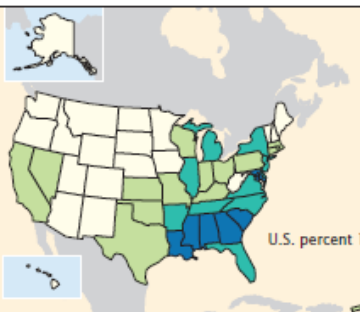
But what is African American English(AAE)?

- AAE is a dialect of American English used primarily by people of historical African descent [not by recent immigrants from the continent]
- AAE has been shown to vary systematically from local White American English (WAE) and from network speech or General American English (GAE) (Lanehart, 2015)

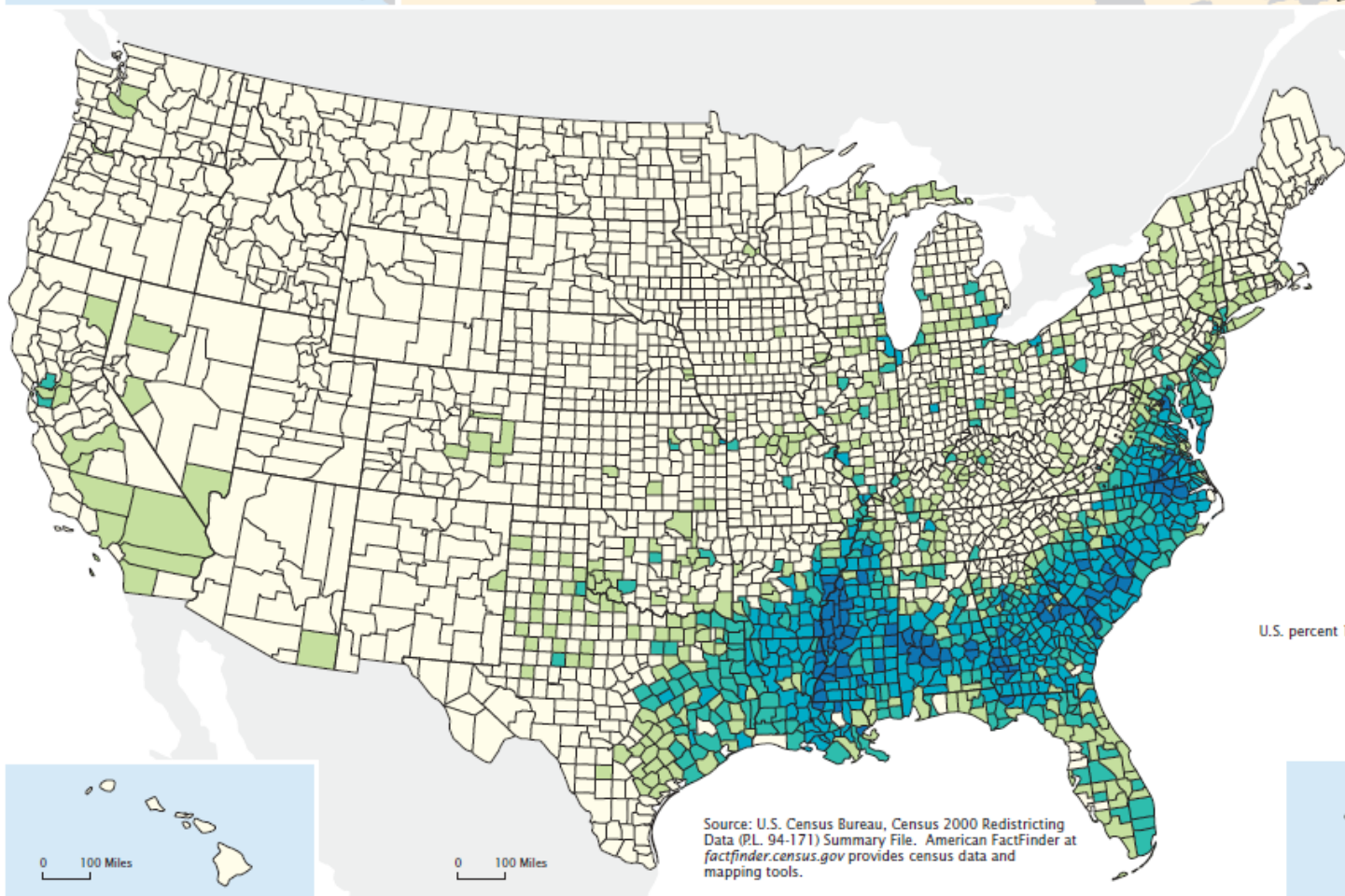
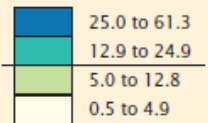


Figure 3.
Percent Black or African American Alone or In Combination: 2000

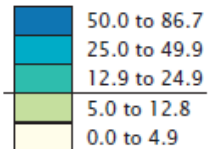
(For information on confidentiality protection, nonsampling error, and definitions, see www.census.gov/prod/cen2000/doc/pl94-171.pdf)



People indicating one or more races including Black or African American as a percent of total population by state



People indicating one or more races including Black or African American as a percent of total population by county



U.S. percent 12.9

Source: U.S. Census Bureau, Census 2000 Redistricting Data (PL 94-171) Summary File. American FactFinder at factfinder.census.gov provides census data and mapping tools.



Regional Variation in African American English

AAE in New York
Labov (1966)

AAE in Detroit
Wolfram (1969)

AAE in Iowa
• Hinton & Pollock (2000)

AAE and WAE vowels in
Pittsburgh
• Eberhart (2009)

AAE in North Carolina
Wilmington Thomas(1989)
Hyde County (Wolfram & Thomas,
2002)
Texana (Childs & Mallinson, 2004)

AAE and WAE

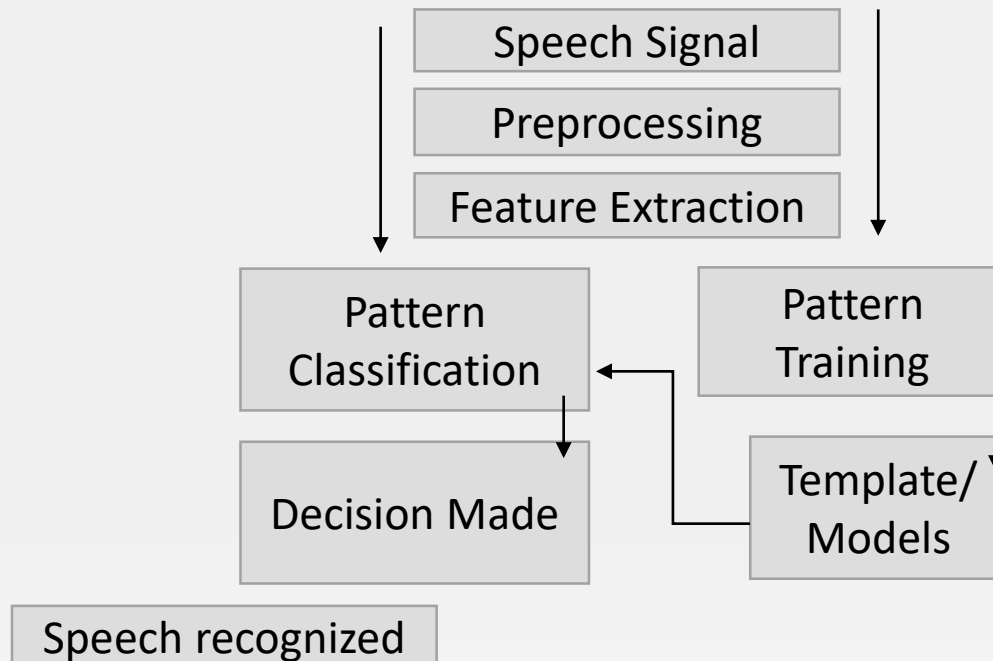
- While the previous research has completed some comparisons of AAE and WAE; there is limited research that BOTH compares the acoustic phonetic variation in AAE to local WAE AND to geographically distant AAE.
- The research I present here today compares AAE to WAE within and across socio-ethnic and geographic communities.

AAE and WAE

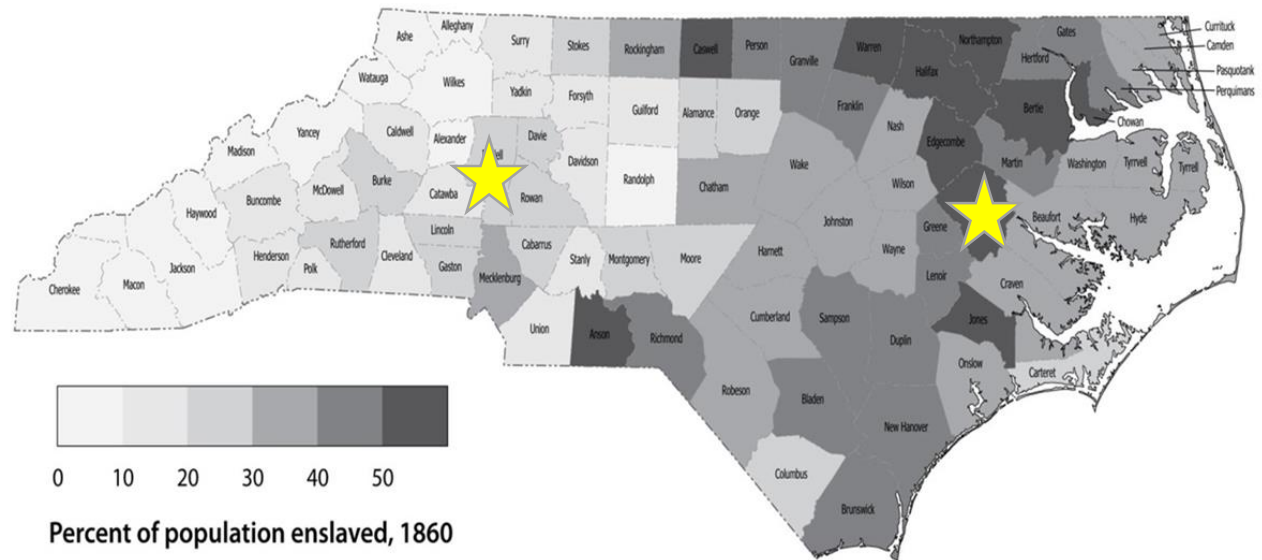
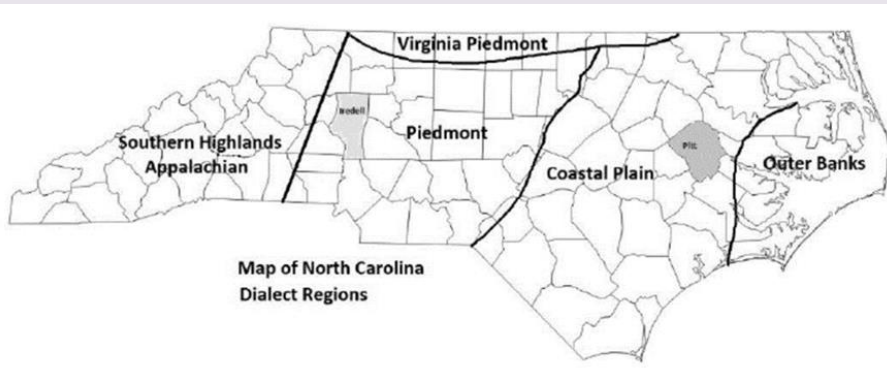
- It is important to quantify similarity and difference between AAE and WAE within and across communities
- To understand the transmission of phonological variation across generations and geographically
- To understand the relationship of AAE to WAE for the identification of speech sound difference from disorder in non-white groups of speakers
- To quantify the acoustic-phonetic variation within and between AAE and WAE to understand the operation of the phonological rules of the variety

AAE and WAE

- These data will be useful to researchers designing speech recognition algorithms for public (Siri, Alexa, Google Voice etc.,) and educational (reading miscue analysis) purposes



















Regional Variation and vowel change











Speech Samples

Western North Carolina

-  
-  
-  
-  
-  
-  
-  
-  

Speech Samples

Western North Carolina

- Older AAE men 
- Older WAE men 
- Older AAE women 
- Older WAE women 
- Younger AAE men 
- Younger WAE men 
- Younger AAE women 
- Younger WAE women 

Socio-phonetic Acoustic analysis of AAE

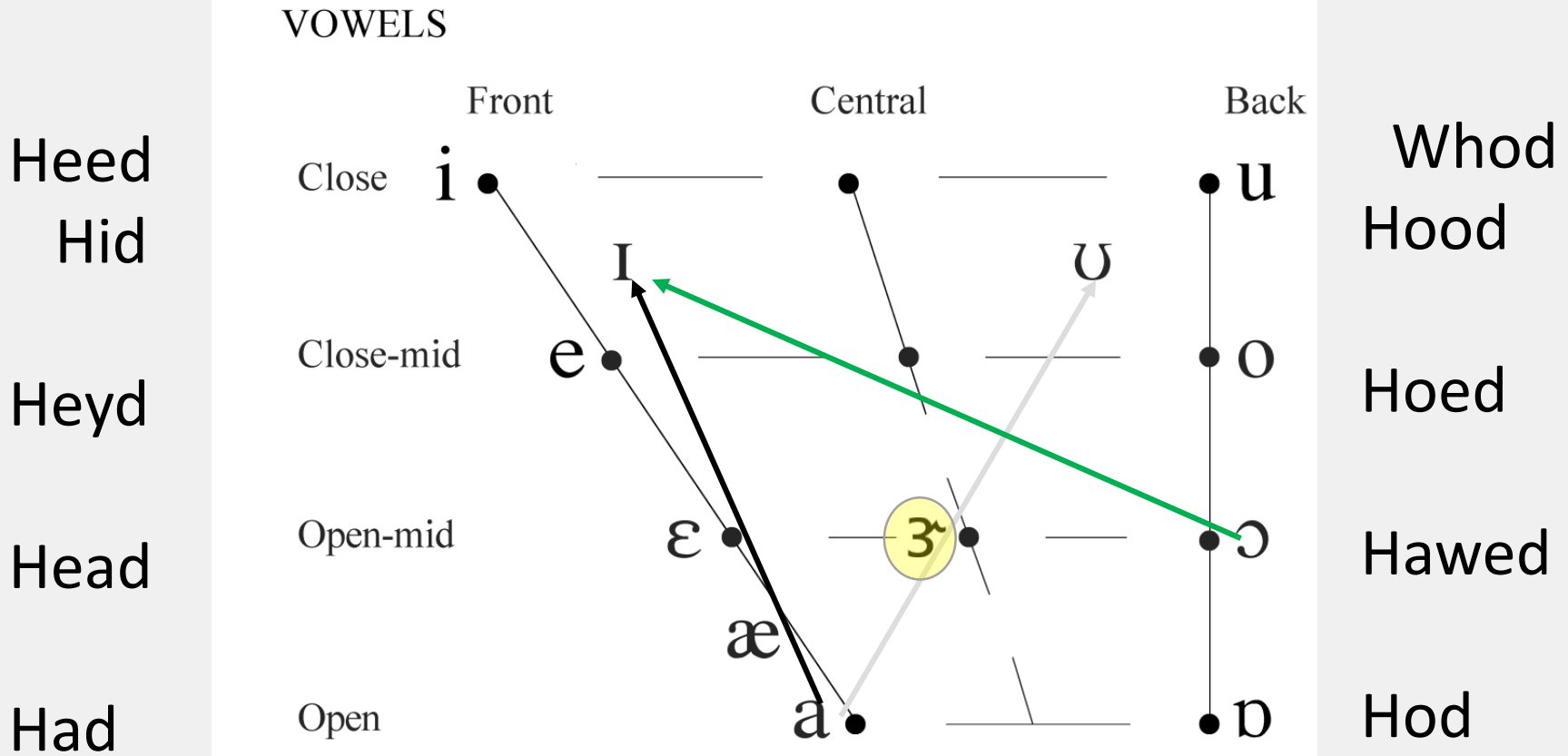
- Previous research
 - Western NC AAE and WAE men and women
 - Eastern NC and Western NC AAE and WAE men
- Current research
 - Eastern NC and Western NC AAE and WAE women

Broad
Research
Question

Do African American English (AAE) speaking women in east and west North Carolina show greater alignment in vowel production to each other or to the WAE speaking women in their local community?

Cardinal Vowel Space

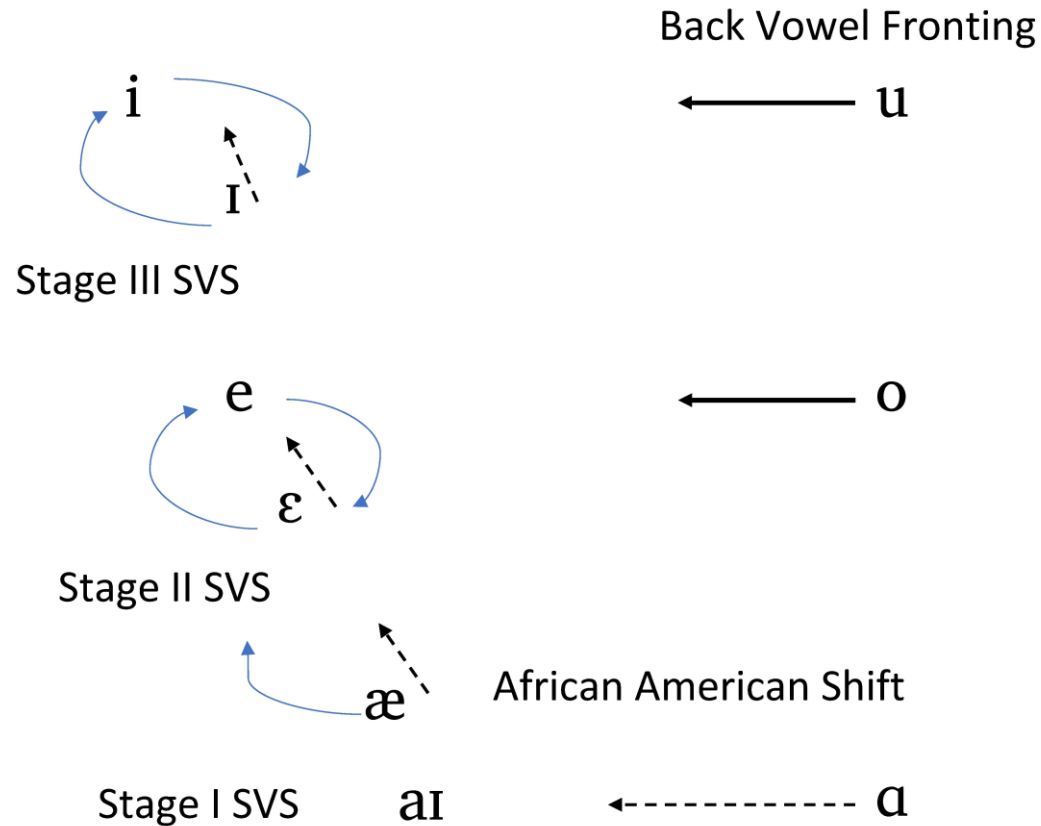
American English Vowels



Hide, Howed, Hoyed, **Heard**

Vowel Shifting

Southern Vowel Shift & African American Shift



Previous results for male AAE speakers
from the same communities

West North Carolina

Black (AAE) and White (WAE)

East North Carolina

Black (AAE) and White (WAE)

- Vowel duration
- Tense/Lax distinction
- Trajectory/Length
- Spectral Rate of Change (SROC)

Data presented here today

Vowel Duration

- In American English vowel duration is not contrastive however there are aspects of vowel duration that are expected as part of the phonology
 - Vowels are shorter preceding voiceless consonants than their voiced counterparts (House and Fairbanks 1953; House 1961; Tauberer and Evanini 2009)
 - In the tense/lax vowel pair the tense member is longer than its lax counterpart (House, 1961)

Trajectory Length

Formant trajectory length (TL) represents a measure of formant movement in F1 by F2 plane and is an indication of the amount of formant change over the course of a vowel's production. The general assumption is that a larger TL corresponds to a greater magnitude of formant movement.

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

The formant TL was then defined as a sum of trajectories of four vowel sections:

$$TL = \sum_{n=1}^4 VSL_n$$

Spectral Rate of Change

SROC is a measure of the magnitude of change in formant movement over 60% of the vowel's duration and is calculated using the formula below.

$$TL_{roc} = \frac{TL}{0.60 \times \underline{v} \text{ dur}}.$$

Information gained

- Vowel duration provides information on similarity or difference in temporal domain, length of vowel production
- Trajectory length provides information on the amount of frequency change in the F1 by F2 plane over the course of the vowel's duration. How much movement occurred.
- SROC provides information on the magnitude of frequency change. How quickly movement occurred.

Specific Research Questions

1. Is the tense/lax distinction diminished for the vowel pairs [*heed/hid; heyd/head; whod/hood*] for AAE women in both west and east NC?
2. Is there similarity in Trajectory Length(TL) for AAE women in west and east NC or between AAE and WAE women within the geographic region?
3. Is there similarity in Spectral Rate of Change (SROC) for AAE women in west and east NC or between AAE and WAE women within the geographic region?

Methods

- IRB approval
- 52 women between the ages of 19–53 (average 37)
- Word List: *heed, hid, heyd, head, had, hod, whod, hood, hoed, heard, hawed, hide, howed, hoyed*
- representing the American English vowels /i ɪ e ε æ ɑ u ʊ o ə ɔ a/ and the diphthongs / aɪ aʊ ɔɪ / three times each for a total of 42 vowels per participant.
- 26 AAE (test group) and WAE (control group) women were recorded
- 18 AAE and WAE in the west and 8 AAE and WAE in the east
- All recordings were completed in either a sound-treated booth or a quiet room with an ambient noise level below 30dB as indicated by a table-top sound level meter in the quiet room
- Each participant read the previously listed words aloud as they appeared one at a time on a computer screen via a customized MATLAB presentation and recording program.
- The speech was digitally recorded to the hard drive of computer at 44.1 kHz using the installed sound card.
- Each recording was down-sampled to 11.025 kHz prior to acoustic analysis.

Analyses

- A series of repeated measures Analysis of Variance was completed comparing AAE and WAE productions of the 14 American English vowels as produced in the words *heed, hid, heyed, head, had, hod, whod, hood, hoed, hawed, hide, howed, hoyed, heard*
- Vowel Duration was compared for all 14 vowels by dialect and geographic community

Analyses

- Only the vowel pairs *heed, hid; heyed, head; whod, hood* and *head/had* [vowels of the African American Shift] were evaluated to assess similarity and differences in vowel production by socio-ethnic dialect and community.
 - Tense/Lax
 - Trajectory Length
 - Spectral Rate of Change (SROC)

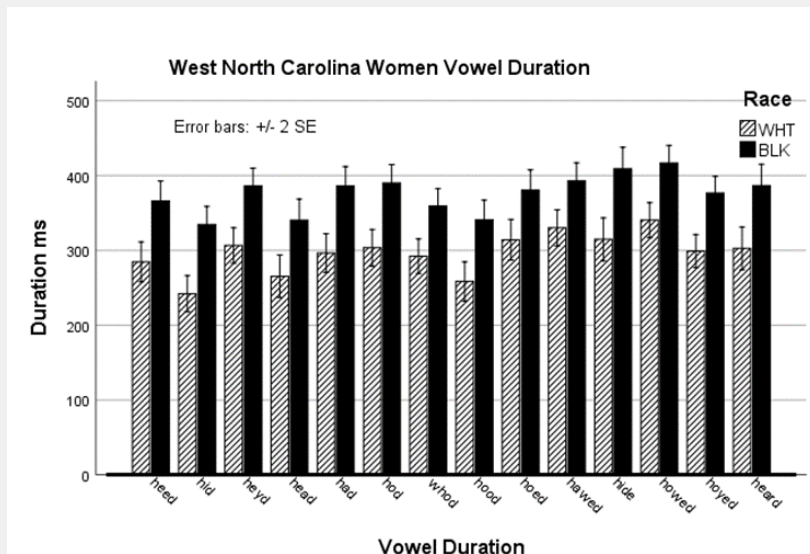
Results

- Vowel duration
- Analysis of variance was evaluated for the within subject factor Vowel (N= 14) and the between subject factors Race (AAE, WAE) and Community (West, East)
 - As expected, there was a significant difference in mean vowel duration.
 - There was also a main effect of race on vowel duration.

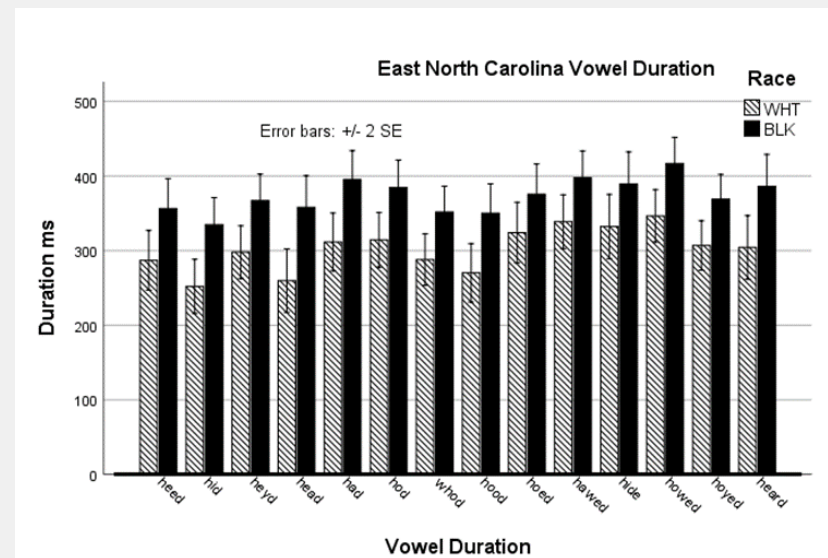
Vowel Duration

Hypothesized: AAE duration > WAE duration overall and by region

West North Carolina Women



East North Carolina Women



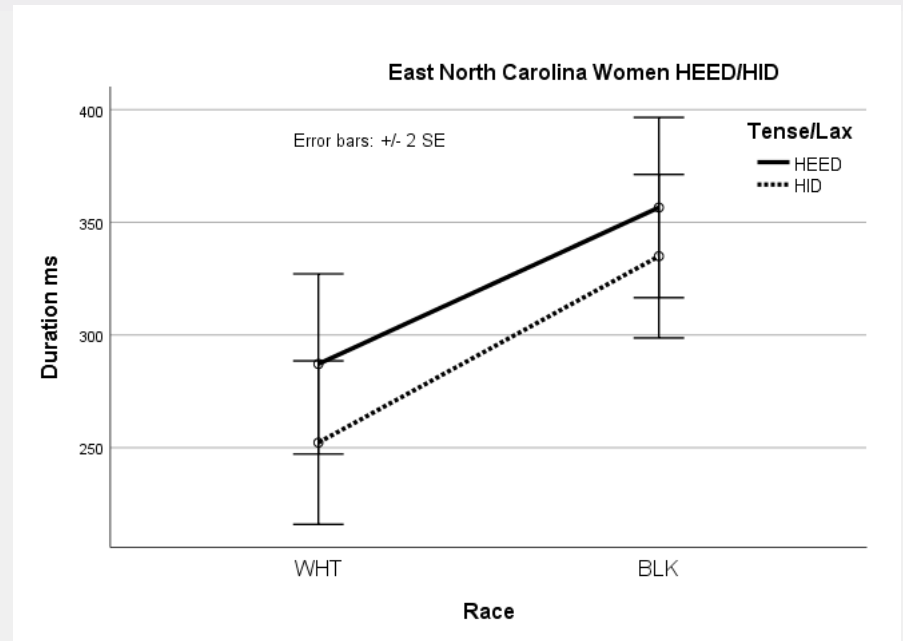
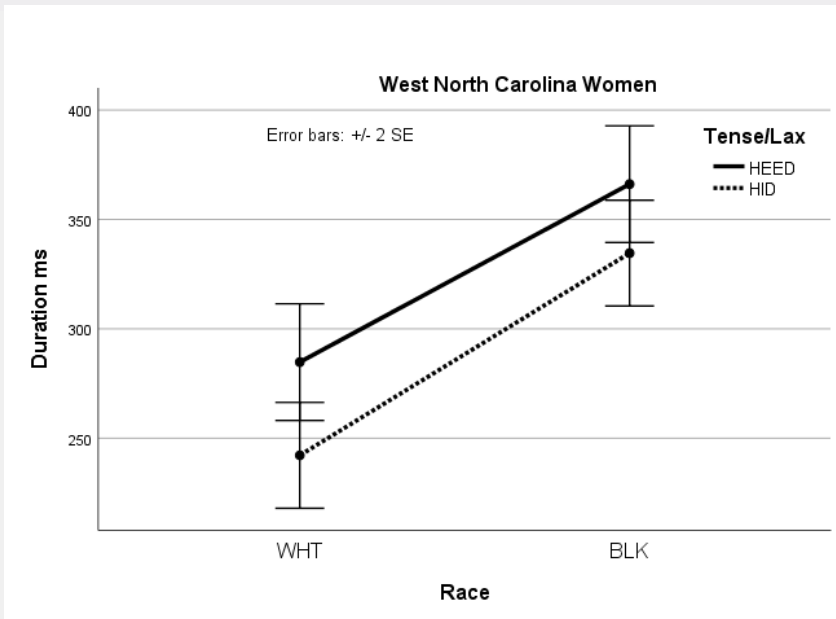
AAE vowel duration ($M = 375$), 95%CI [354.1, 396.0] was greater than WAE vowel duration ($M = 300$), 95%CI [278.5, 320.4] in both east and west North Carolina
Race $F(1, 48) = 26.3$, $p < .001$, $\eta_p^2 = 0.354$

1. Is the tense/lax distinction diminished for the vowel pairs [*heed/hid; heyd/head; whod/hood*] for AAE women in both west and east NC?

- Tense/Lax Pairs [*heed/hid; heyd/head; whod/hood*]
- Analysis of variance was evaluated separately for each pair using the within subject factor Tense/Lax and the between subject factors Socio-ethnic dialect (AAE, WAE) and Community (West, East)
- For all 3 pairs there was a significant difference in duration of tense/lax as expected.
- There was also a significant difference in duration by Socio-ethnic dialect but not by Community

Tense/Lax pairs HEED/HID

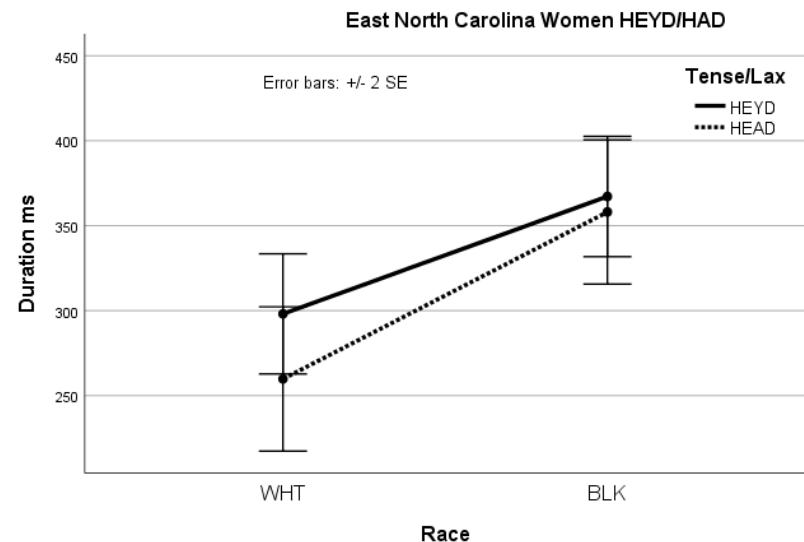
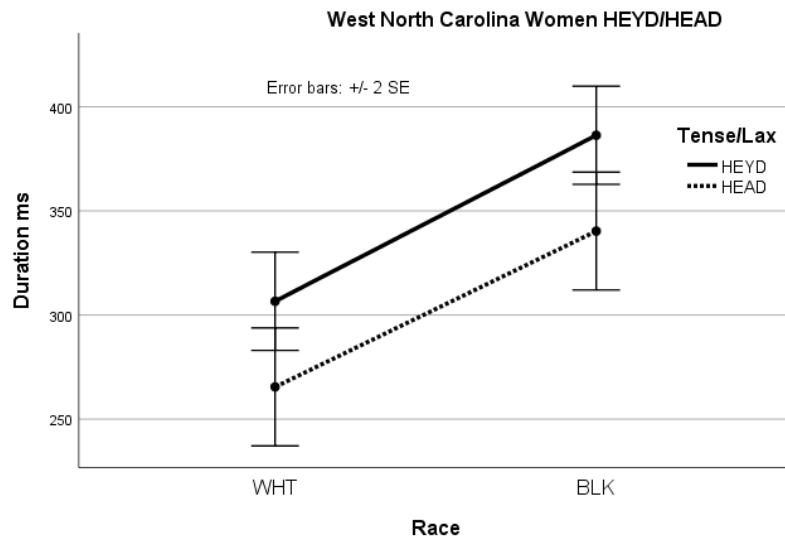
Hypothesized: AAE diminished tense/lax difference compared to WAE



West				East			
	HEED	HID	Difference		HEED	HID	Difference
BLK (AAE)	366.1 (ms)	334.6 (ms)	31.5 ms	BLK (AAE)	356.6 (ms)	335.0 (ms)	21.6 ms
WHT (WAE)	284.8 (ms)	242.1 (ms)	42.7 ms	WHT (WAE)	287.1 (ms)	252.3 (ms)	34.8 ms

Tense/Lax pairs HEYD/HEAD

Hypothesized: AAE diminished tense/lax difference compared to WAE



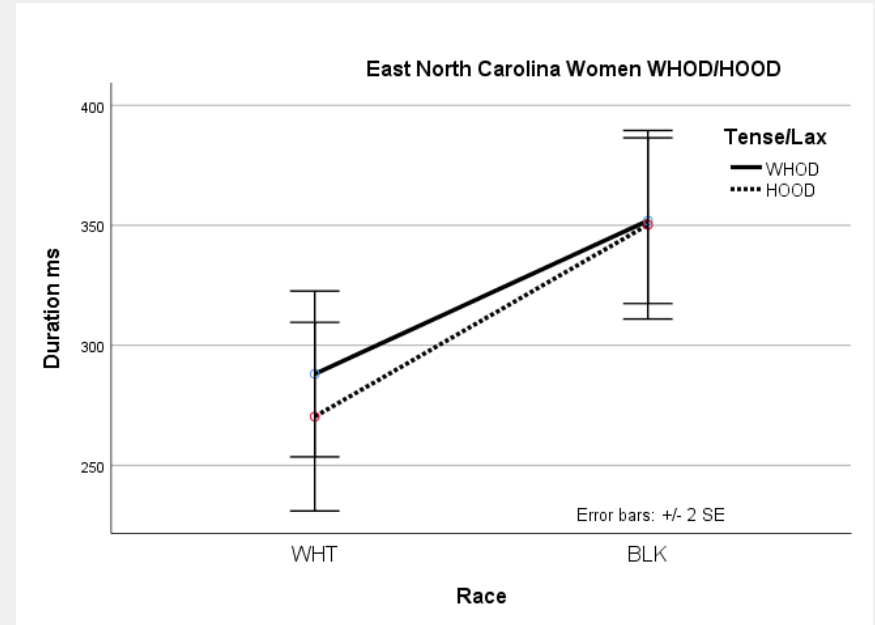
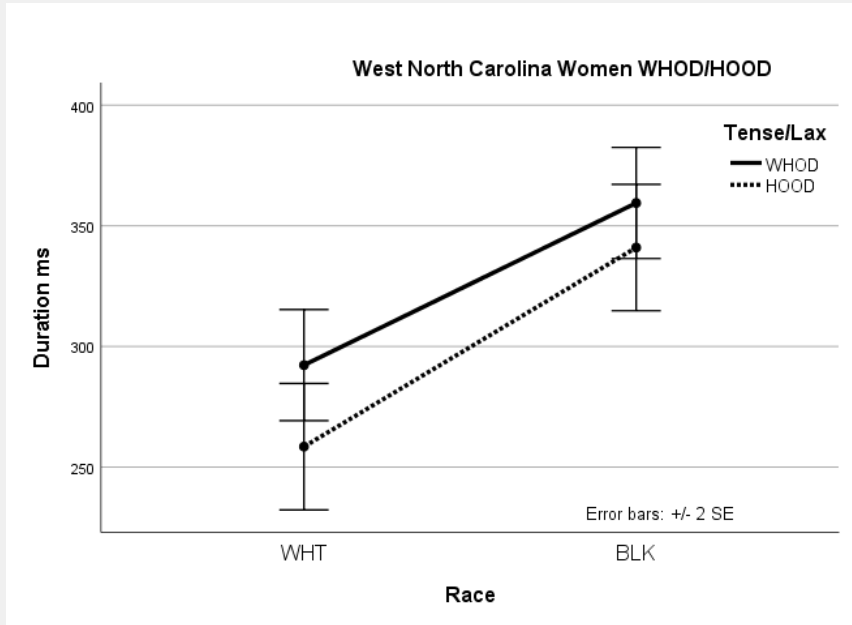
West

East

	HEYD	HEAD	Difference		HEYD	HEAD	Difference
BLK (AAE)	386.3 (ms)	340.3 (ms)	46.0 ms	BLK (AAE)	367.2 (ms)	358.1 (ms)	9.1 ms
WHT (WAE)	306.6 (ms)	265.5 (ms)	41.1 ms	WHT (WAE)	298.1 (ms)	259.8 (ms)	38.3 ms

Tense/Lax pairs WHOD/HOOD

Hypothesized: AAE diminished tense/lax difference compared to WAE



	West			East			
	WHOD	HOOD	Difference		WHOD	HOOD	Difference
BLK (AAE)	359.4(ms)	341.0(ms)	18.4 ms	BLK (AAE)	352.0 (ms)	350.2(ms)	1.8 ms
WHT (WAE)	292.3(ms)	258.5(ms)	33.8 ms	WHT (WAE)	288.0 (ms)	270.3(ms)	17.7ms

2. Is there similarity in Trajectory Length(TL) for AAE women in west and east NC or between AAE and WAE speaking women within the geographic region?

Trajectory Length

Trajectory length (TL) is a measure of the cumulative value of formant change without respect to speed (rate) or time.

Each vowel was extracted from the *hvd* frame and measured from the onset to the offset of periodicity. Measures of F1 and F2 were completed at five equidistant points (20, 35, 50, 65, 80 percent) over vowel duration. These values were used to derive both of measures Trajectory Length (TL) and Spectral Rate of Change (SROC).

$$TL = \sum_{n=1}^4 VSL_n \text{ where } VSL \text{ is}$$

$$VSL_n = \sqrt{(F_{1n} - F_{1n+1})^2 + (F_{2n} - F_{2n+1})^2}$$

Main Findings

- Trajectory length (TL) is a measure of the cumulative value of formant change without respect to speed (rate) or time.

TRAJECTORY LENGTH

As expected, the TL for the six vowels *heed*, *hid*, *heyed*, *head*, *whod*, *hood* was significantly different. $F(5, 240) 16.3, p < .001, \eta_p^2 = .254$

- No main effect of community
- No main effect of race

Interaction effects for :

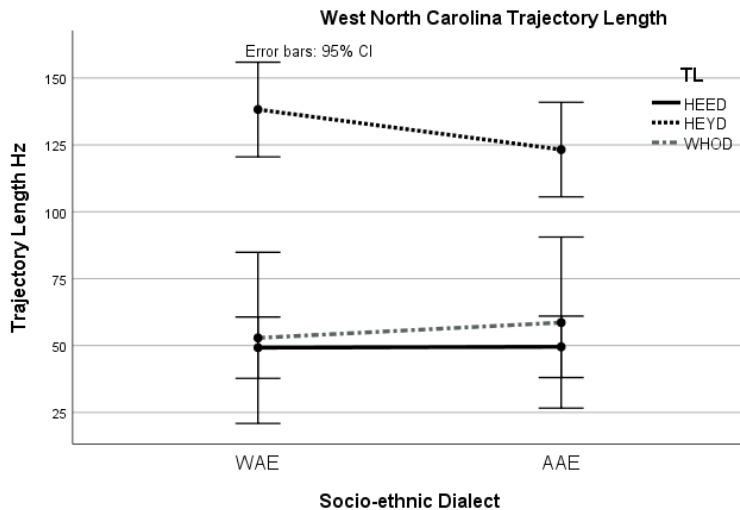
- Trajectory Length x Race $F(2.9, 143) 2.8, p = .041, \eta_p^2 = .056$
and
- Trajectory Length x Community $F(2.9, 143) 5.0, p = .003, \eta_p^2 = .094$

Women

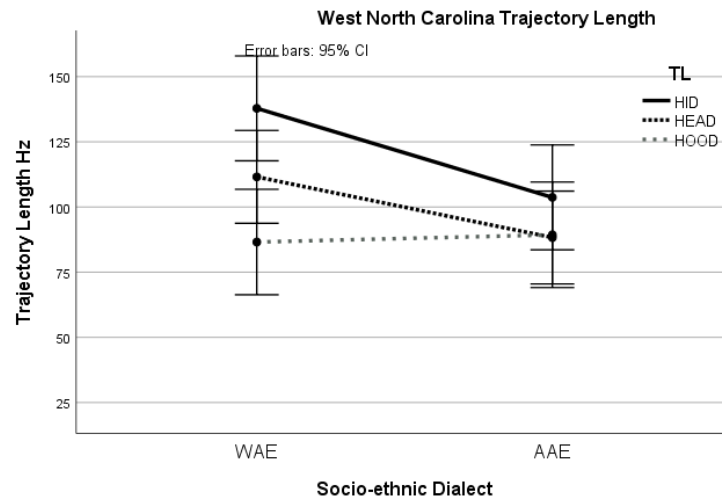
East and West
North
Carolina

West North Carolina Women Trajectory Length

Tense



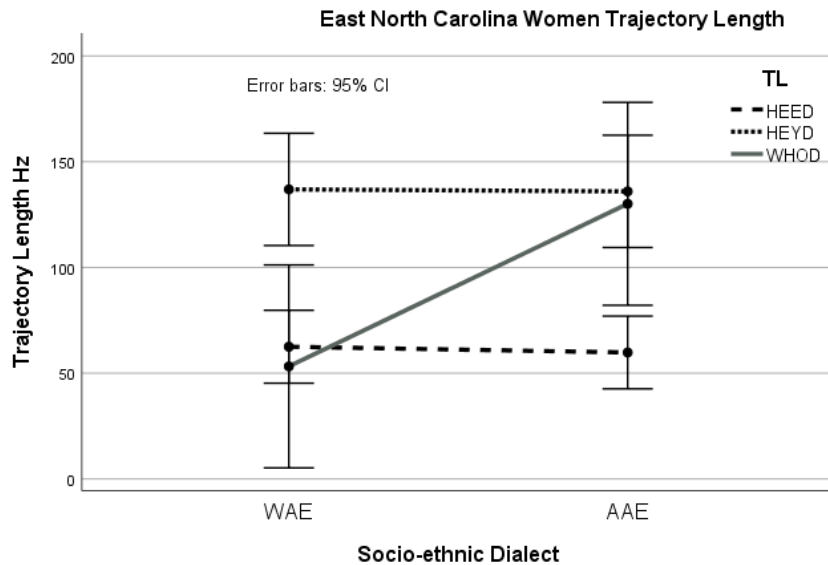
Lax



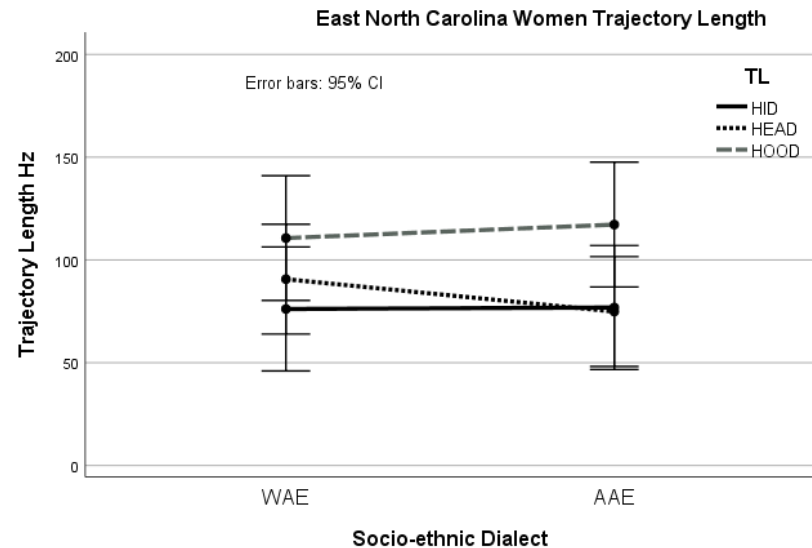
In the west, there appears to be similar amounts of change for tense vowels with relatively less change in frequency (smaller difference) for AAE women than WAE for lax vowels

East North Carolina Women Trajectory Length

Tense



Lax



For women in the east there appears to be relatively more change in frequency for AAE women, in both tense and lax vowels WAE peers.

3. Is there similarity in Spectral Rate of Change (SROC) for AAE women in west and east NC or between AAE and WAE women within the geographic region?

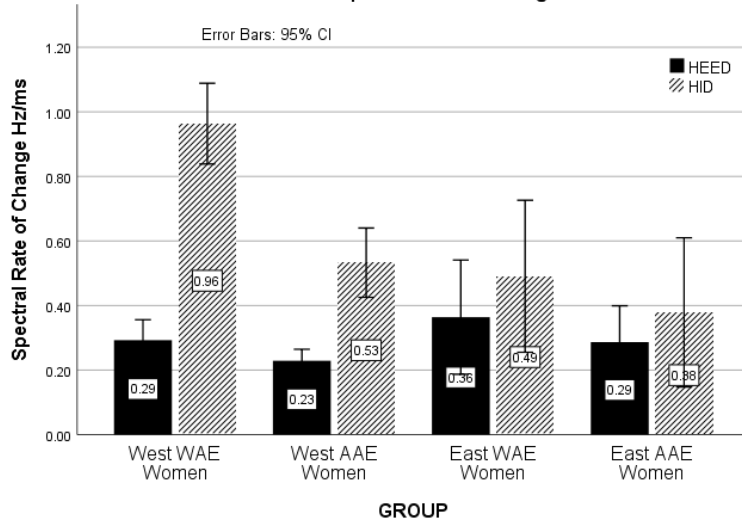
Spectral Rate of Change (SROC)

$$SROC = TL / (0.60 * \text{vowel duration})$$

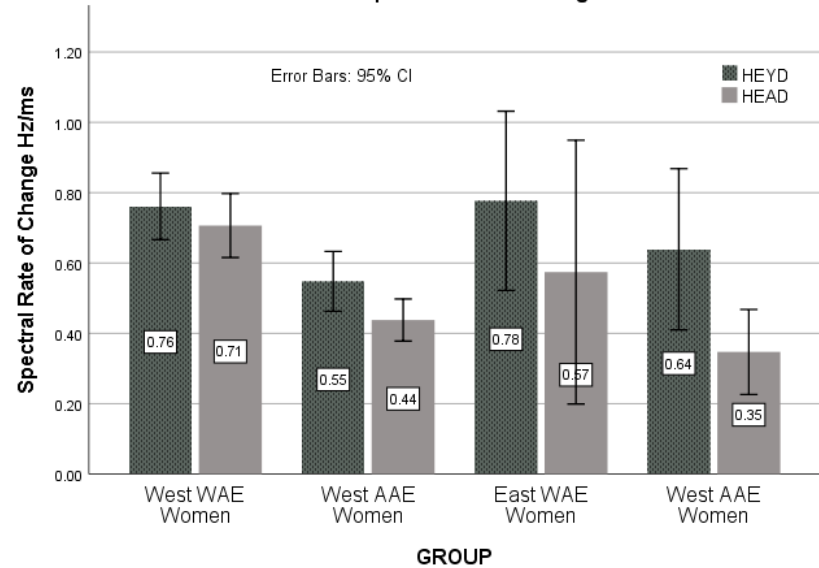
- Spectral Rate of Change (SROC) is a measure of the magnitude of formant frequency change over time. It measures how quickly or slowly formant frequency change occurs over the duration of the vowel (Fox & Jacewicz, 2009).
- SROC is calculated by dividing the TL (a measure of the amount of frequency change) by 60 percent of vowel duration.

North Carolina Spectral Rate of Change

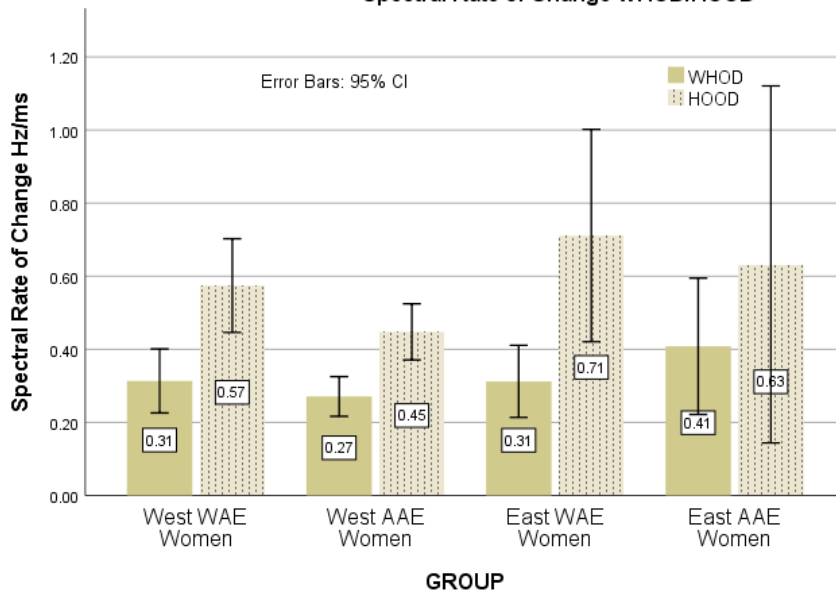
Spectral Rate of Change HEED/HID



Spectral Rate of Change HEYD/HEAD



Spectral Rate of Change WHOD/HOOD



Significant findings:

Word $F(5,44) 33.6 p < .001, \eta_p^2 = .793$

Race $F(1, 48) 9.5 p = .003, \eta_p^2 = .165$

Word x Community
 $F(5, 240) 6.4, p < .001, \eta_p^2 = .118$

Word x Socio-ethnic dialect
 $F(5, 240) 4.2, p = .005, \eta_p^2 = .081$

Discussion and Future Directions

- Black women in both communities produced longer vowels than White peers.
- AAE vowel duration ($M = 375$), 95%CI [354.1, 396.0] was greater than WAE vowel duration ($M = 300$), 95%CI [278.5, 320.4] in both east and west North Carolina Race $F(1, 48) = 26.3$, $p < .001$, $\eta_p^2 = 0.354$
- Tense/lax expect tense vowels longer than lax
 - **Trajectory Length:** HEED/HID $F(1, 48) = 51.9$, $p < .001$, partial eta squared .519. **Race:** $F(1, 48) = 27.4$, $p < .001$, partial eta squared .363.
 - **Trajectory Length:** HEYD/HEAD $F(1, 48) = 40.8$, $p < .001$, partial eta squared .460. **Race:** $F(1, 48) = 26.1$, $p < .001$, partial eta squared .352.
 - **Trajectory Length:** WHOD/HOOD $F(1, 48) = 10.9$, $p = .002$, partial eta squared .185. **Race:** $F(1, 48) = 24.7$, $p < .001$, partial eta squared .340.

Discussion and Future Directions

- Trajectory Length a measure of the cumulative value of formant change without respect to speed (rate) or time.
 - In the west, there appears to be relatively less change in frequency (shorter TL) for BLK (AAE) women than WHT (WAE) for lax vowels but similar amounts of change for tense, excluding *heyd*
 - For women in the east there appears to be relatively more change in frequency (longer TL) for BLK (AAE) women, in both tense and lax vowels compared to WHT (WAE) peers.
- Spectral Rate of Change a measure of the magnitude of formant frequency change over time. It measures how quickly or slowly formant frequency change occurs over the duration of the vowel
 - East > West M=2.8; M=.617;
 - WAE White women (M=1.9) had more change in frequency over time than Black women (M=1.5);
 - Word the lax vowels HID and HOOD had greater frequency change than their tense counterparts HEED and WHOD; However the tense vowel HEYD had a greater magnitude of change over time than HEAD. This variation may be related to vowel changes in progress

Discussion and Future Directions

- Next Steps

- Currently analyzing data from speech perception experiments to evaluate listener ability at race and word id
- Preliminary results show listeners can accurately distinguish most AAE from WAE talkers; however a few AAE talkers from the west were frequently misidentified as WAE.
- Ongoing analysis of Frequency variation and vowel space area for these data
- Interested in using these data in speech recognition training algorithms

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Thank you for your time and
attention

Questions

[Holt Lab at ECU](#)

