Comparison of vowel acoustics in children from the Northern, Midland, and Southern regions of the United States

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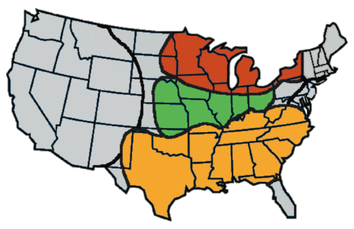
Background

- Features of regional dialects of American English (Labov et al., 2006):
  - /æ/ raising in the North (Northern Cities Vowel Shift)
  - /u/ fronting in the Midland and South
  - /aɪ/ monophthongization (in certain phonetic contexts) in the South
- Stages of dialect acquisition (Labov, 1964):
  - Basic grammar: child learns general grammatical rules and begins to form vocabulary of spoken words; ages 0-5 years
  - Vernacular: characteristics of local dialect emerge and eventually become parts of everyday speech; ages 5-12 years

Research Questions

The empirical evidence in support of Labov's stages is limited, so the goal of this study was to look at features of regional dialects for children in the vernacular stage.

1. Do the acoustic properties of children's speech show features of their respective regional dialects?
2. Do these features become stronger with age?



Methods

Talkers

- Recorded in the Language Sciences Lab at the Center of Science and Industry (COSI) in Columbus, Ohio
- 61 monolingual American English speakers ages 4-11 years

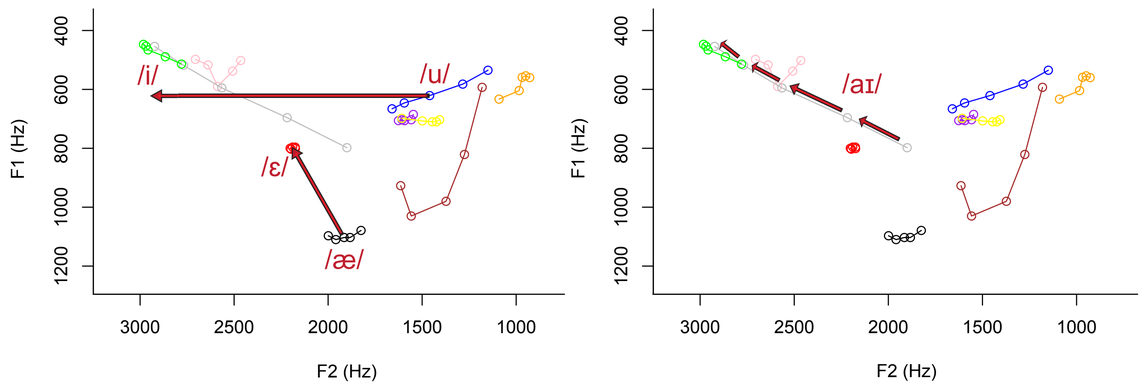
Region	North				Midland				South			
Age	4-5	6-7	8-9	10-11	4-5	6-7	8-9	10-11	4-5	6-7	8-9	10-11
N	4	3	4	9	8	5	6	10	4	2	2	4

Procedure

- Participants saw blocks of color on a computer monitor and said the names of the colors into a microphone
- Stimulus colors: red, orange, yellow, green, blue, purple, pink, black, white, brown
- Color blocks were presented in random order for each participant

Acoustic Analysis

- F1, F2: first and second formants
  - Peaks in frequency spectrum of speech signal that determine vowel quality
  - Five points were estimated over duration of each vowel using Praat
- Euclidean distance: distance between two points in terms of both F1 and F2
- Trajectory: sum of Euclidean distances between each point in vowel



- Euclidean distance between midpoints of /æ/ and /ɛ/
  - Shorter distance = vowels are more acoustically similar
- F2 at midpoint of /u/ subtracted from F2 at midpoint of /i/
  - Smaller difference = /u/ is more fronted
- Total distance between all five points for /aɪ/
  - Shorter length = vowel is more monophthongized

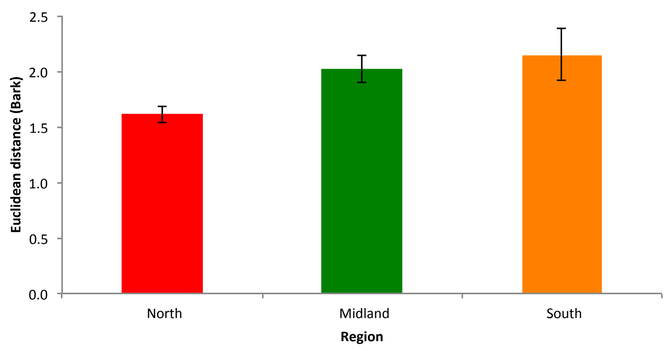
Color word	*Target vowel*	*Relevant region(s)*
black	/æ/	North
red	/ɛ/	North
green	/i/	Midland, South
blue	/u/	Midland, South
white	/aɪ/	South

Predictions

- Euclidean distance between /æ/ and /ɛ/ should be the shortest for Northerners
- F2 distance between /i/ and /u/ should be the shortest for Southerners, followed by Midlanders
- Length of /aɪ/ trajectory should be the shortest for Southerners
- Dialect features should be the most prominent in 10-11 year olds and the least prominent in 4-5 year olds

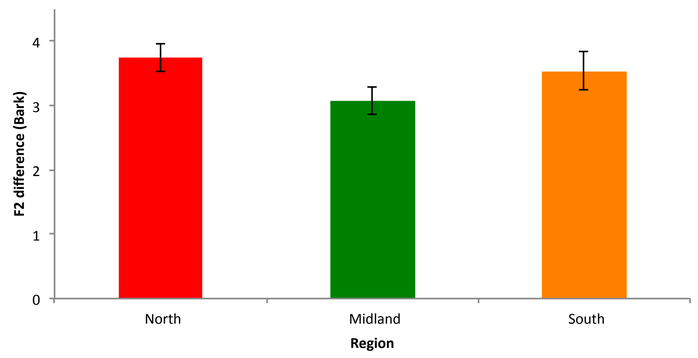
Results

Mean /æ/-/ɛ/ distance by region



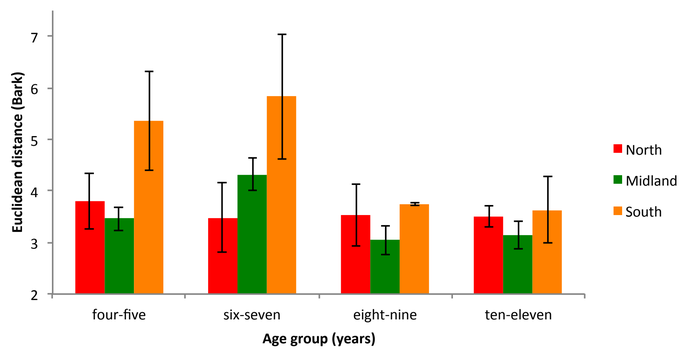
- North has shortest distances [$F(2, 38) = 4.09$, $p = 0.025$]
- Neither age nor age X region interaction were significant

Mean /i/-/u/ F2 distance by region



- No significant effect of region, age, or age X region interaction

Mean /aɪ/ trajectory by age and region



- South [$F(2, 40) = 6.31$, $p = 0.004$] and 4-5, 6-7 year olds [$F(3, 40) = 3.19$, $p = 0.034$] have longest trajectory lengths
- Although region and age were not orthogonal, there was no age X region interaction [$F(6, 40) = 1.07$, n.s.]

Summary

1. /æ/ raising: Northerners have the shortest /æ/-/ɛ/ distance, as predicted
2. /u/ fronting: No differences across regions
3. /aɪ/ monophthongization: 4-7 year old Southerners generally have the longest /aɪ/ trajectory lengths

Discussion

- Northern children show early stage of Northern Cities Vowel Shift
  - /æ/ and /ɛ/ are pronounced the most similarly to each other in the Northern region
  - No effect of age, suggesting acquisition of this feature of the Northern Cities Vowel Shift by age 4-5 years
- No effect of region on /u/ fronting
  - Children from all three regions produced both fronted /u/s and backed /u/s, across age groups
  - Further research with older children needed to determine when the adult-like pattern is acquired
- Opposite of our prediction, /aɪ/ trajectory was the longest for 4-7 year old Southerners
  - Young Southern children might emphasize contrast between "white" and "wide"
  - Need to study additional phonetic contexts where /aɪ/ monophthongization can occur

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