Social factors in Southern US Speech: Acoustic analysis of a large-scale legacy corpus

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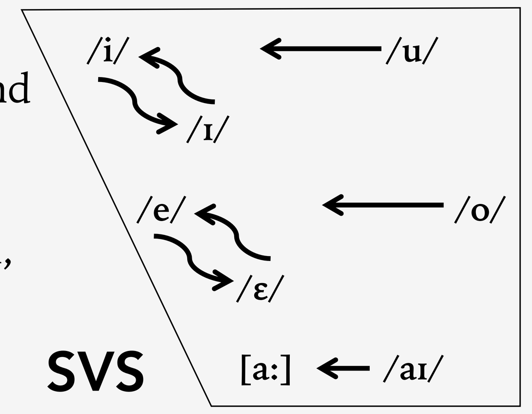
Vowel shifts in Southern US speech

- Vowels in the Southern US speech vary within the region and across racial and social groups.
- What are the effects and interactions of these factors, measured in a large acoustic corpus?

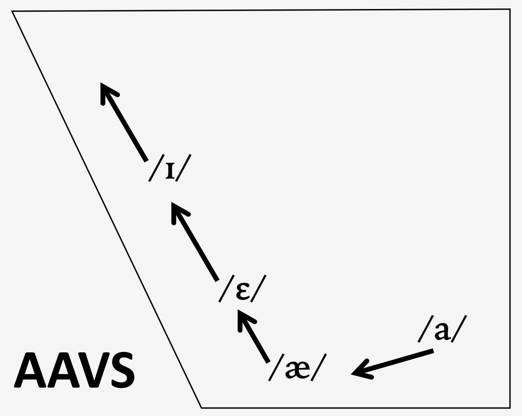
Southern Vowel Shift

- lowering and backing of tense /i eɪ/, and raising and fronting of lax /ɪ ɛ æ/
- /oʊ u/ fronting (Clopper, Pisoni, and De Jong 2005)
- dynamic changes like diphthongization, even triphthongization (Thomas 2005)



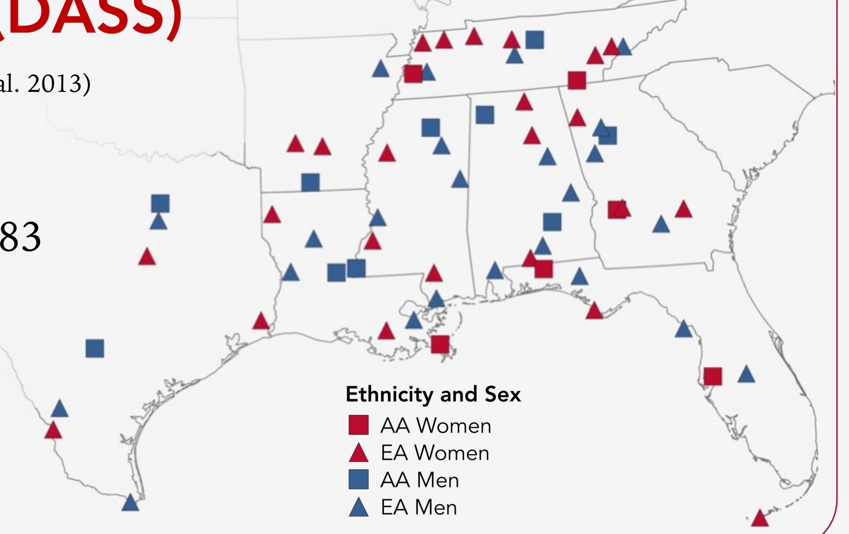
African American Vowel Shift

- /ɑ/-fronting, and raising and fronting of /æ ɛ ɪ/
- Less back-vowel fronting than the SVS, as well as less /eɪ ɛ/ "swapping" (Thomas 2007)



Digital Archive of Southern Speech (DASS)

- A 64-speaker subset of LAGS (Pederson et al. 1986; Kretzschmar et al. 2013)
  - 30 women, 34 men
  - 18 African Americans, 46 European Americans
  - Speakers born born 1886–1965; recorded 1970–1983
- Transcribed and processed at UGA (Olsen et al. 2017)
  - Forced alignment and vowel formant measurement by DARLA (Reddy & Stanford 2015)
  - This study includes 626,669 vowel tokens
  - See the *Gazetteer of Southern Vowels* (Stanley et al. 2018)



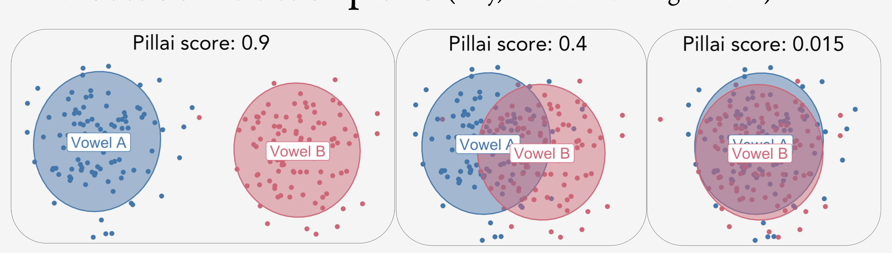
Methods

Data Processing

- Stressed vowels only
- Removed 5% of tokens based on Mahalanobis Distance from means
- Normalized with Lobanov transformation
- Birth year reset to "years since 1886"

Static Methods

- Pillai scores quantify the relative overlap between vowel pairs (Hay, Warren & Drager 2006)



- We calculate these using measurements from vowel midpoints

Statistical Analysis

- Linear mixed-effects model using lme4 (Bates et al. 2015)
- Separate models for each measure and for each vowel or pair of vowels
- In all models, speaker was included as a random intercept

Dynamic Methods (Fox & Jacewicz 2009; Farrington et al. 2018)

Vector length (VL)

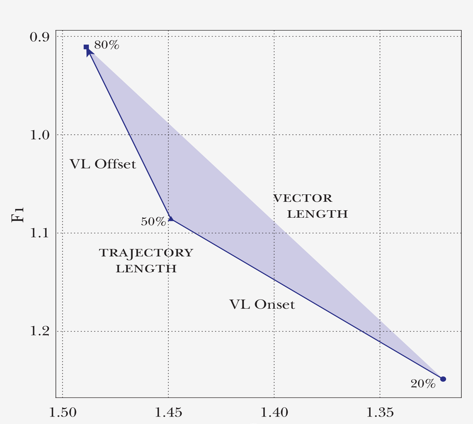
$$VL = \sqrt{(F1_{20} - F1_{80})^2 + (F2_{20} - F2_{80})^2}$$

- Longer VL = more diphthongal vowel

Trajectory length (TL)

$$TL = \sqrt{(F1_{20} - F1_{50})^2 + (F2_{20} - F2_{50})^2} + \sqrt{(F1_{50} - F1_{80})^2 + (F2_{50} - F2_{80})^2}$$

- Longer TL = more dynamic vowel



From Farrington, Kendall, & Fridland (2018:196)

Spectral Rate of Change (ROC)

$$ROC = \frac{TL}{0.6 \times duration}$$

- Higher ROC = more dynamic movement

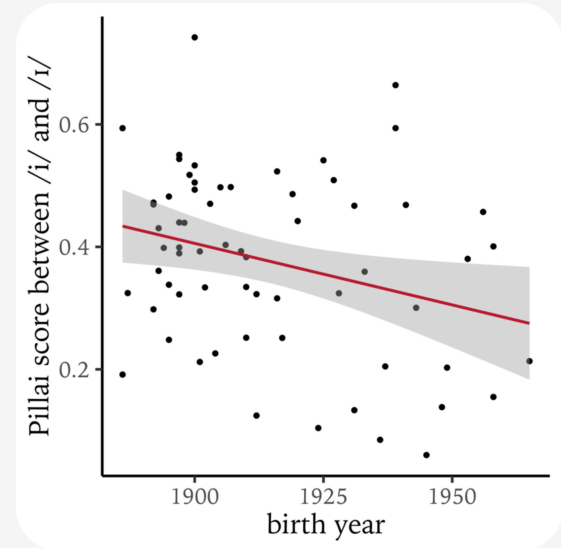
Results

High Front Vowels

Swapping of /i ɪ/ increases with birth year

Model: pillai(i,ɪ) ~ yob_z + sex * eth + dur

yob_z: $\beta = -0.002$, $SE = 0.0007$, $t = -2.533$, $p < 0.05$ *



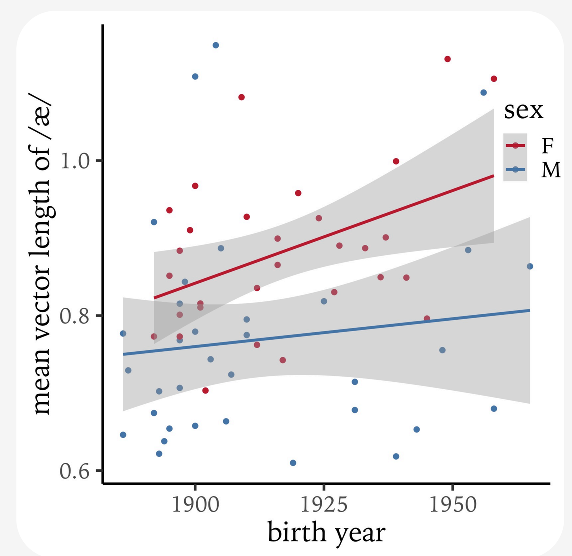
Low Vowels

Vector length of /æ/ increases with birth year and in women

Model: VL(æ) ~ yob_z + sex * eth + dur

yob_z: $\beta = -0.0017$, $SE = 0.0008$, $t = -2.271$, $p < 0.05$ *

sex: $\beta = -0.17$, $SE = 0.0064$, $t = -2.754$, $p < 0.01$ **



Mid Front Vowels

Women diphthongize /ɛ/ more than men

Model: VL(ɛ) ~ yob_z + sex * eth + dur

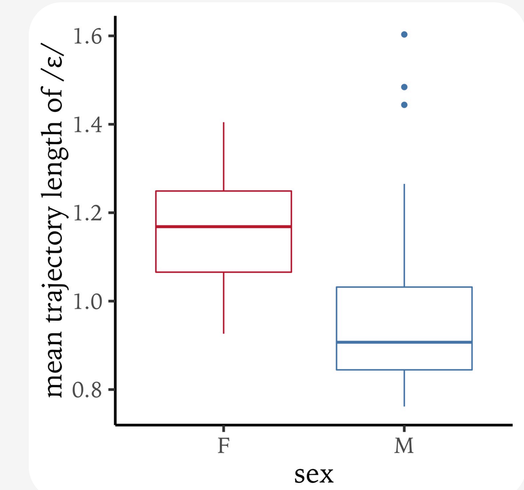
sex: $\beta = -0.2001$, $SE = 0.0661$, $t = -3.027$, $p < 0.01$ **

Model: TL(ɛ) ~ yob_z + sex * eth + dur

sex: $\beta = -0.2536$, $SE = 0.1002$, $t = -2.531$, $p < 0.05$ *

Model: ROC(ɛ) ~ yob_z + sex * eth + dur

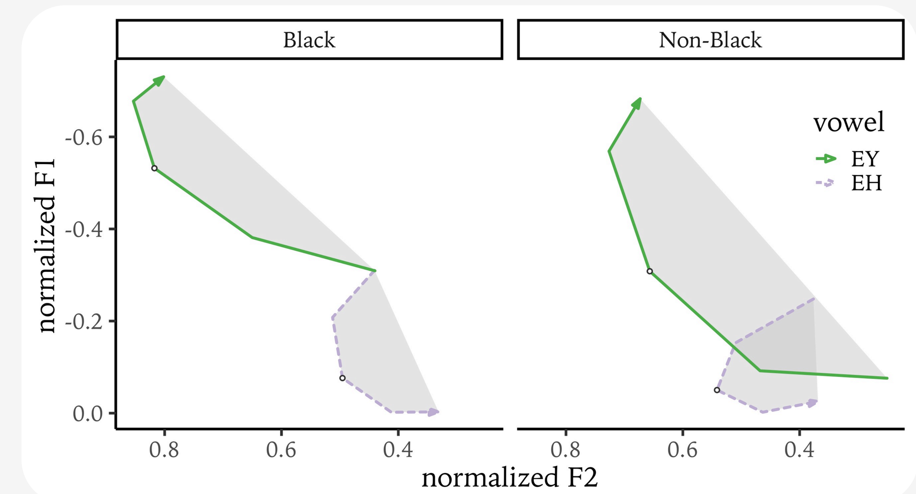
sex: $\beta = -3.587$, $SE = 1.595$, $t = -2.249$, $p < 0.05$ *



EA speakers swap /eɪ ɛ/ more than AA speakers.

Model: pillai(eɪ,ɛ) ~ yob_z + sex * eth + dur

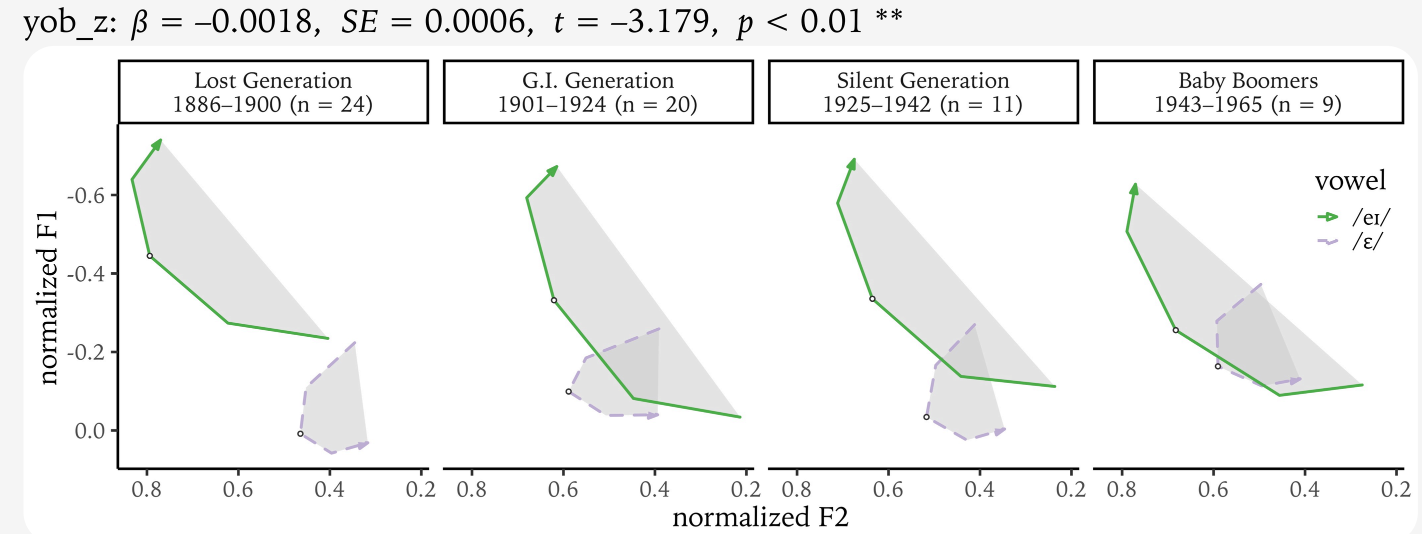
yob_z: $\beta = -0.174$, $SE = 0.043$, $t = -4.081$, $p < 0.001$ ***



Swapping of /eɪ ɛ/ increases with birth year

Model: pillai(eɪ,ɛ) ~ yob_z + sex * eth + dur

yob_z: $\beta = -0.0018$, $SE = 0.0006$, $t = -3.179$, $p < 0.01$ **

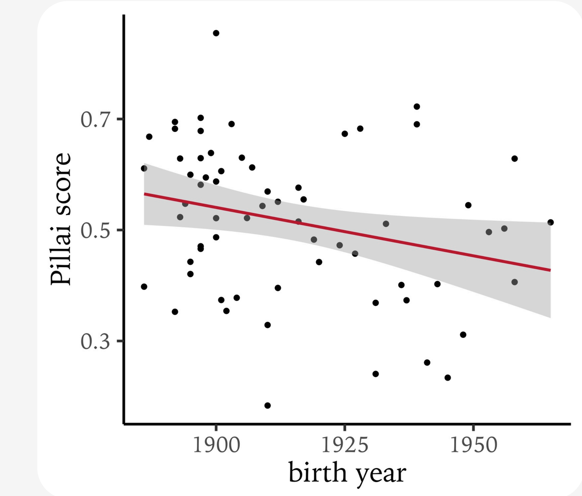


Back Vowels

Younger speakers have more /u/-fronting

Model: pillai(u,i) ~ yob_z + sex * eth + dur

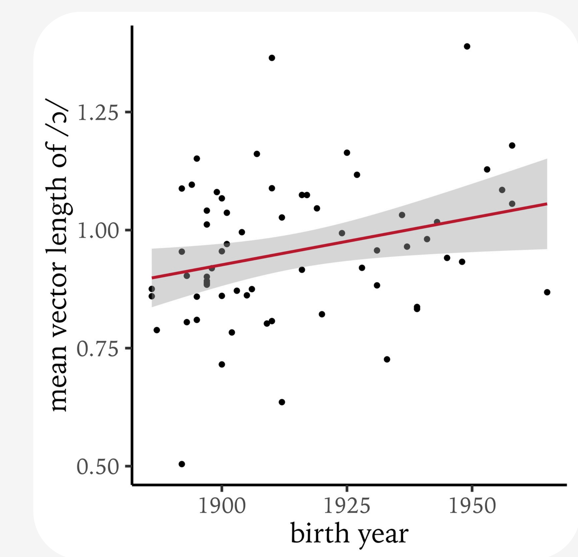
yob_z: $\beta = -0.0016$, $SE = 0.0008$, $t = -2.093$, $p < 0.05$ *



/ɔ/ is more diphthongal in younger speakers

Model: VL(ɔ) ~ yob_z + sex * eth + dur

yob_z: $\beta = -0.0021$, $SE = 0.0010$, $t = 2.0242$, $p < 0.05$ *



Conclusions

Vowels' acoustics vary by race, sex and age

- European American speakers have greater /eɪ ɛ/ swapping than African Americans, supporting Thomas' (2007) characterization of the African American Vowel Shift
- Women have a more diphthongal realization of front /ɛ æ/ than men

Active divergence of Southern speech from other varieties

- In this historical dataset, younger speakers lead Southern shifting: they have more "swapping" of /i ɪ/and /eɪ ɛ/, more back-vowel fronting, and more dynamic /æ/ and /ɔ/ vowels
- Older speakers are more conservative both in vowels' relative positioning, and their dynamics

/eɪ ɛ/ are the nexus of shifting in DASS

- These vowels vary across sexes, races and age groups, in their relative positions and dynamics
- Younger, European American women have the "most Southern" treatment of /eɪ ɛ/

Methodological *variety* reveals Southern vowel shifting

- Neither static nor dynamic measures alone capture all these sources of significant variation

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