

Enriching our understanding of language change with vowel formant trajectories

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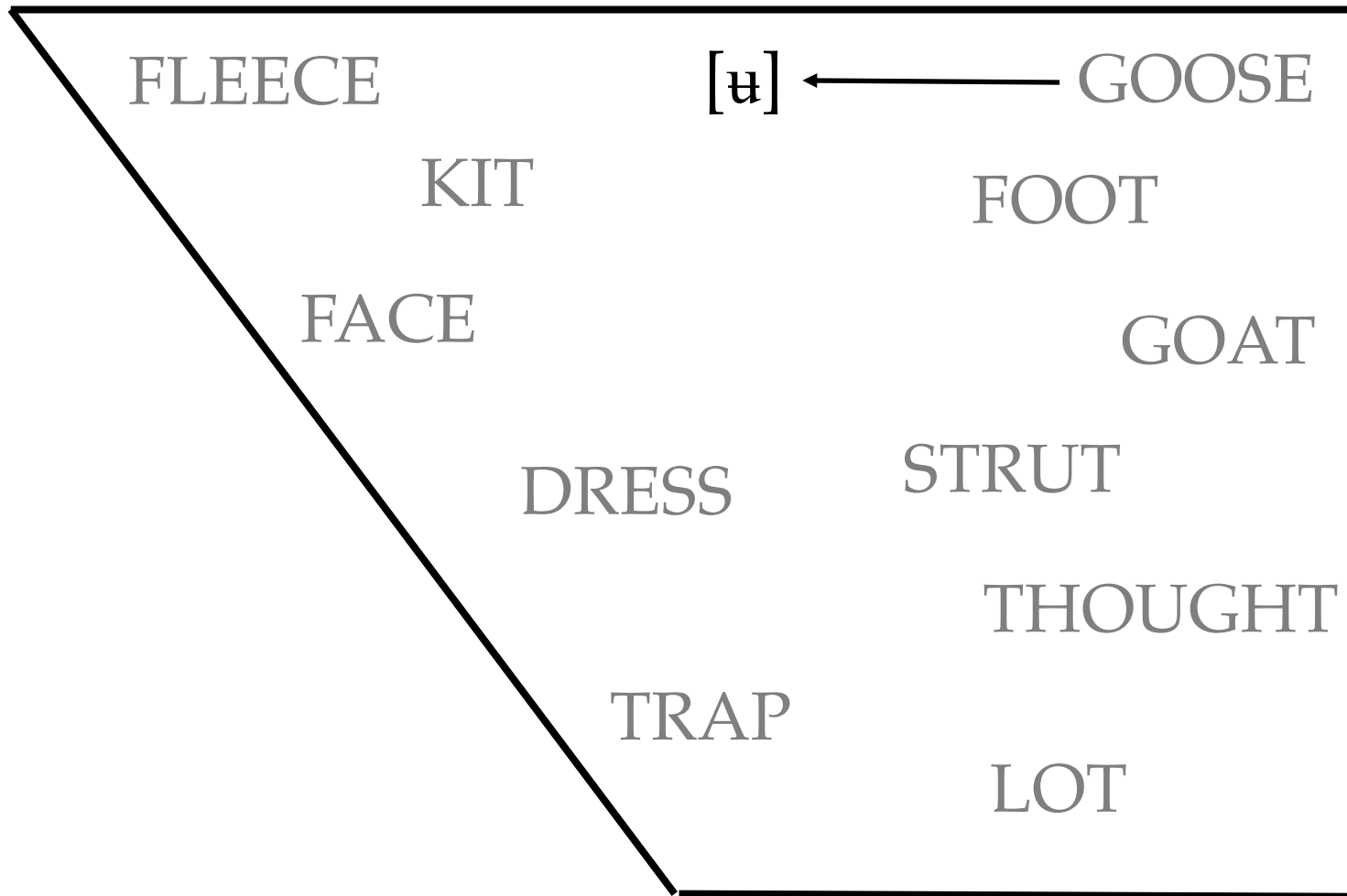
Colloquium Series

August 31, 2023

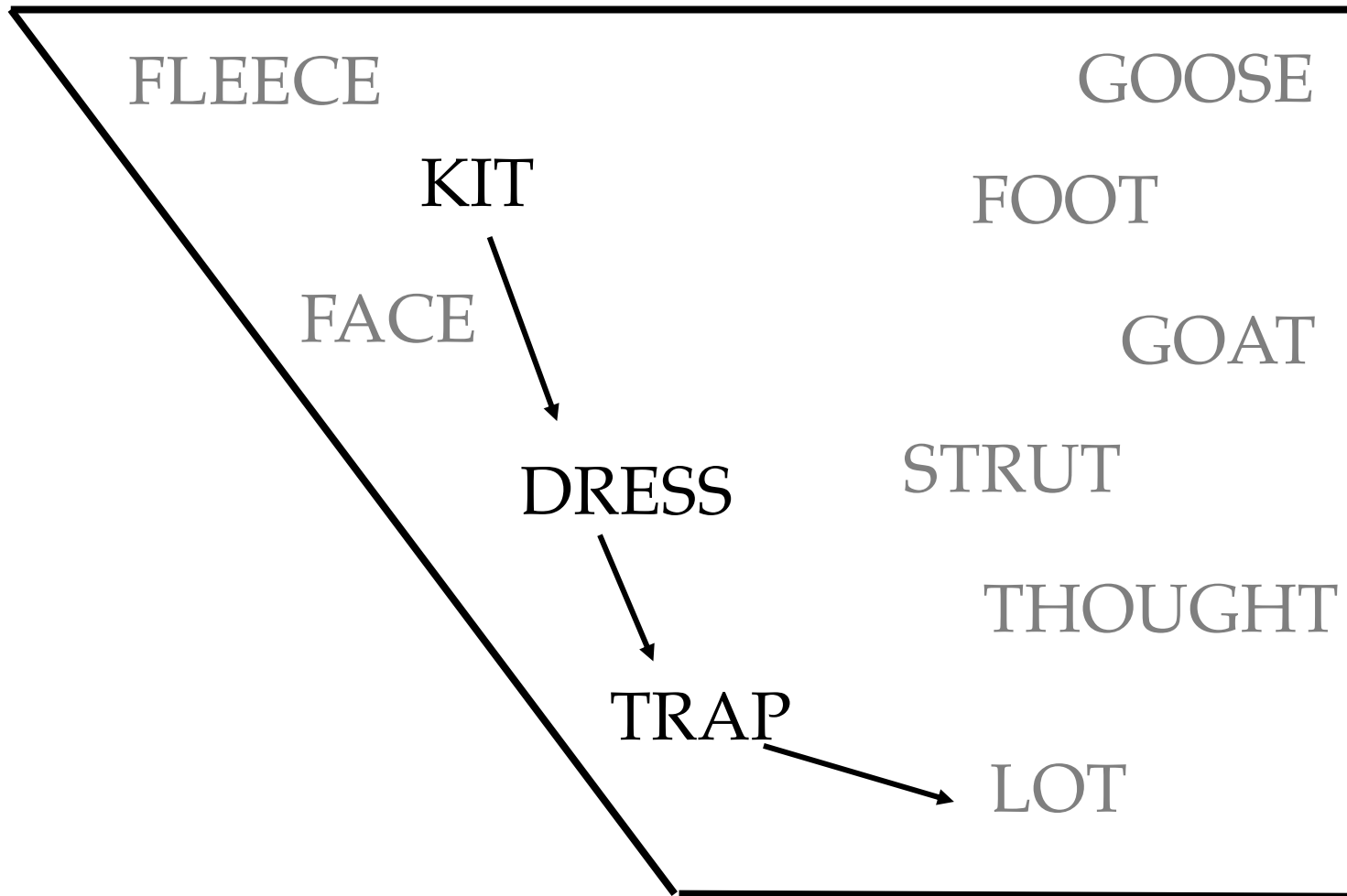
Vowels, Vowels, Vowels

- American English vowels are variable in pronunciation.
 - *ban* vs. *bat*, *too* vs. *boo*
 - *feel* vs. *fill*, [bæ̩t] vs. [bæ̩̆t]
- We can categorize these differences:
 - Shifts
 - I pronounce /u/ fronter than my grandparents do.
 - My students pronounce /æ/ as lower and more centralized than I do
 - Mergers
 - For me, *cot* and *caught* are distinct; for 95% of my students, they're homophones
 - In Utah, *feel* and *fill* are often pronounced the same
- Language change happens as some variants spread to more and more people.

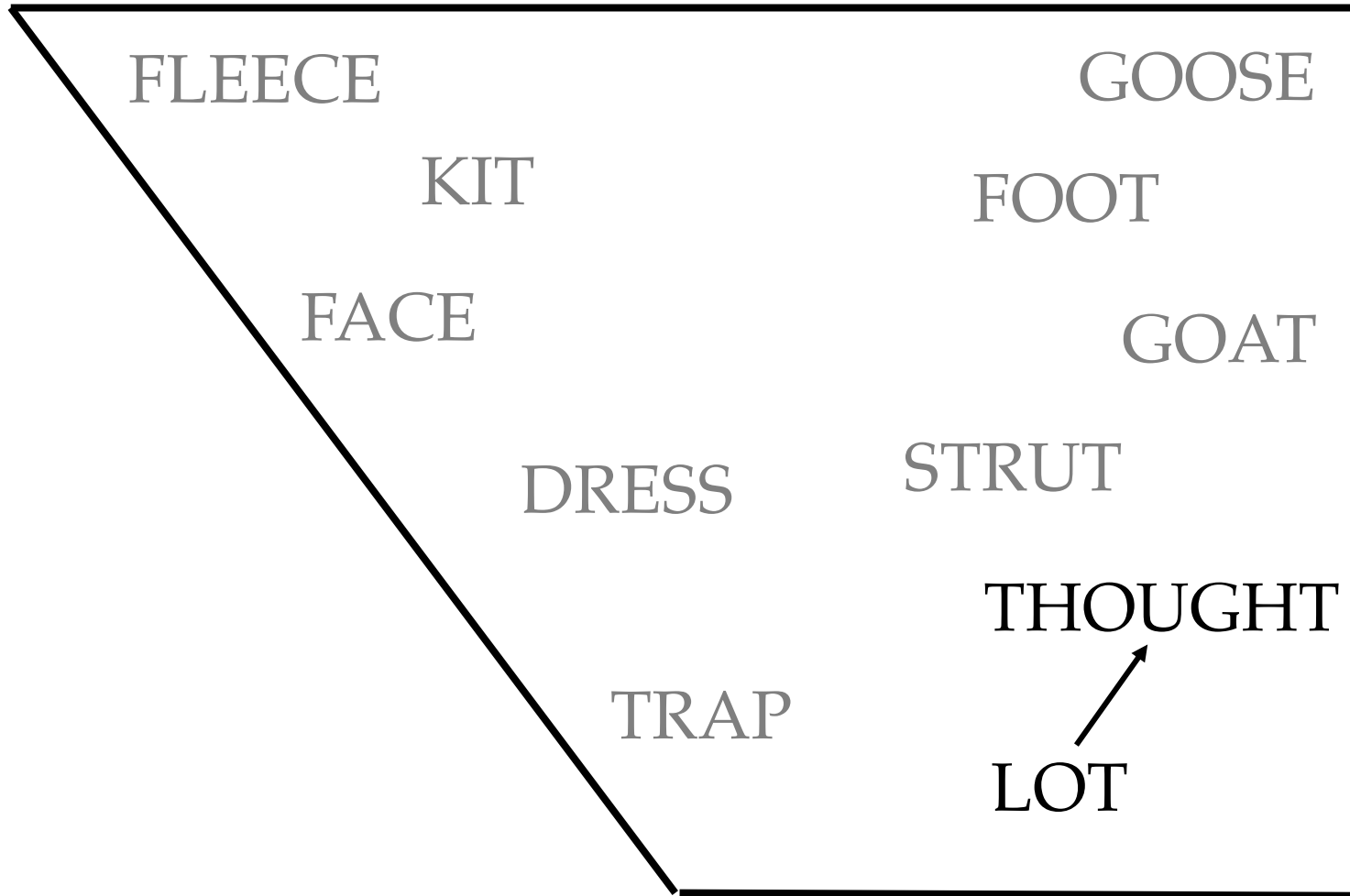
Vowel Shifts

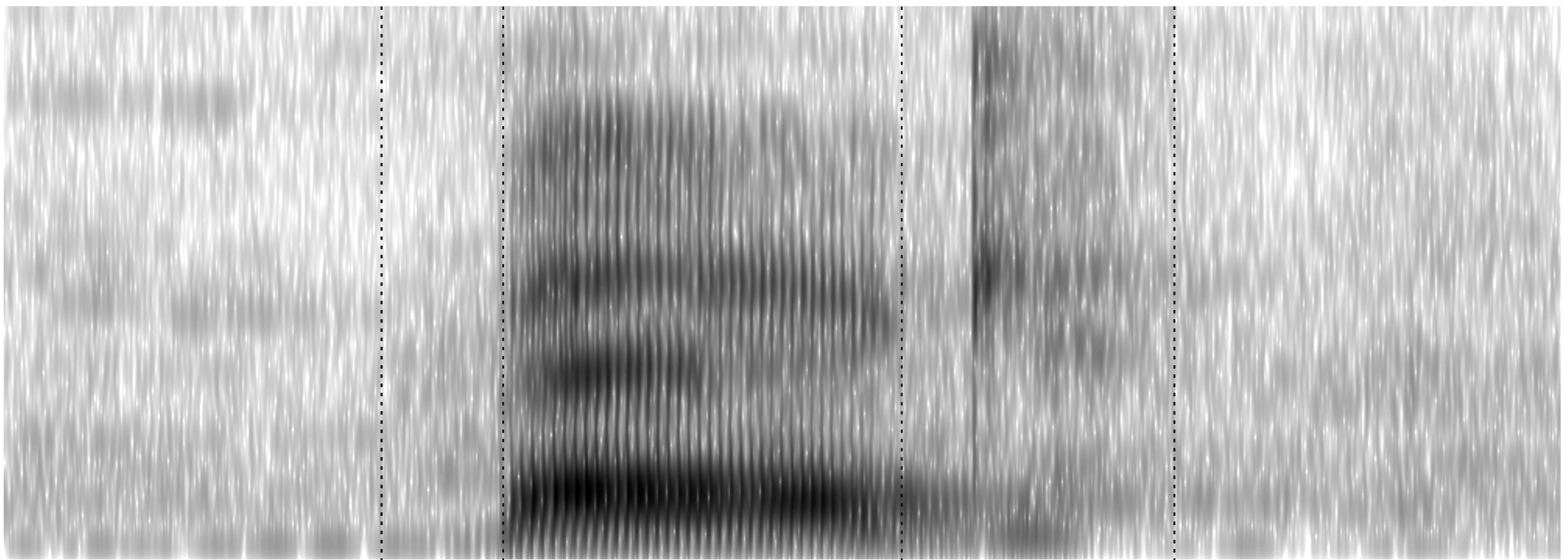


Chain Shifts

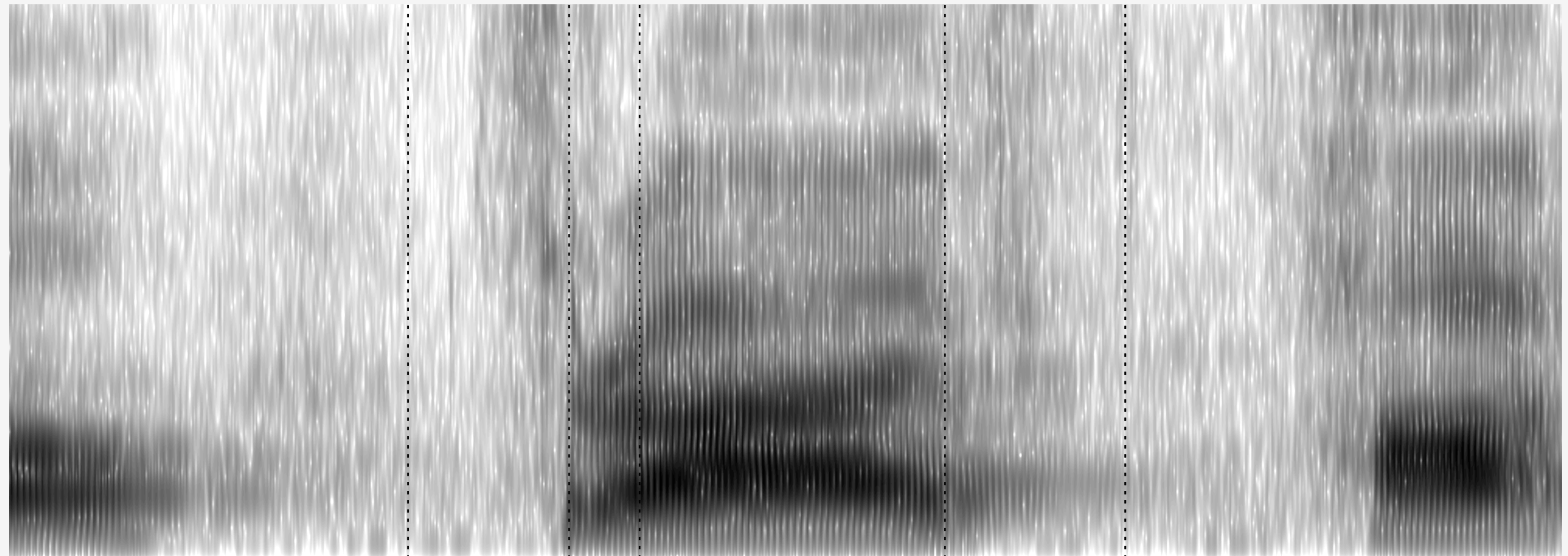


Mergers



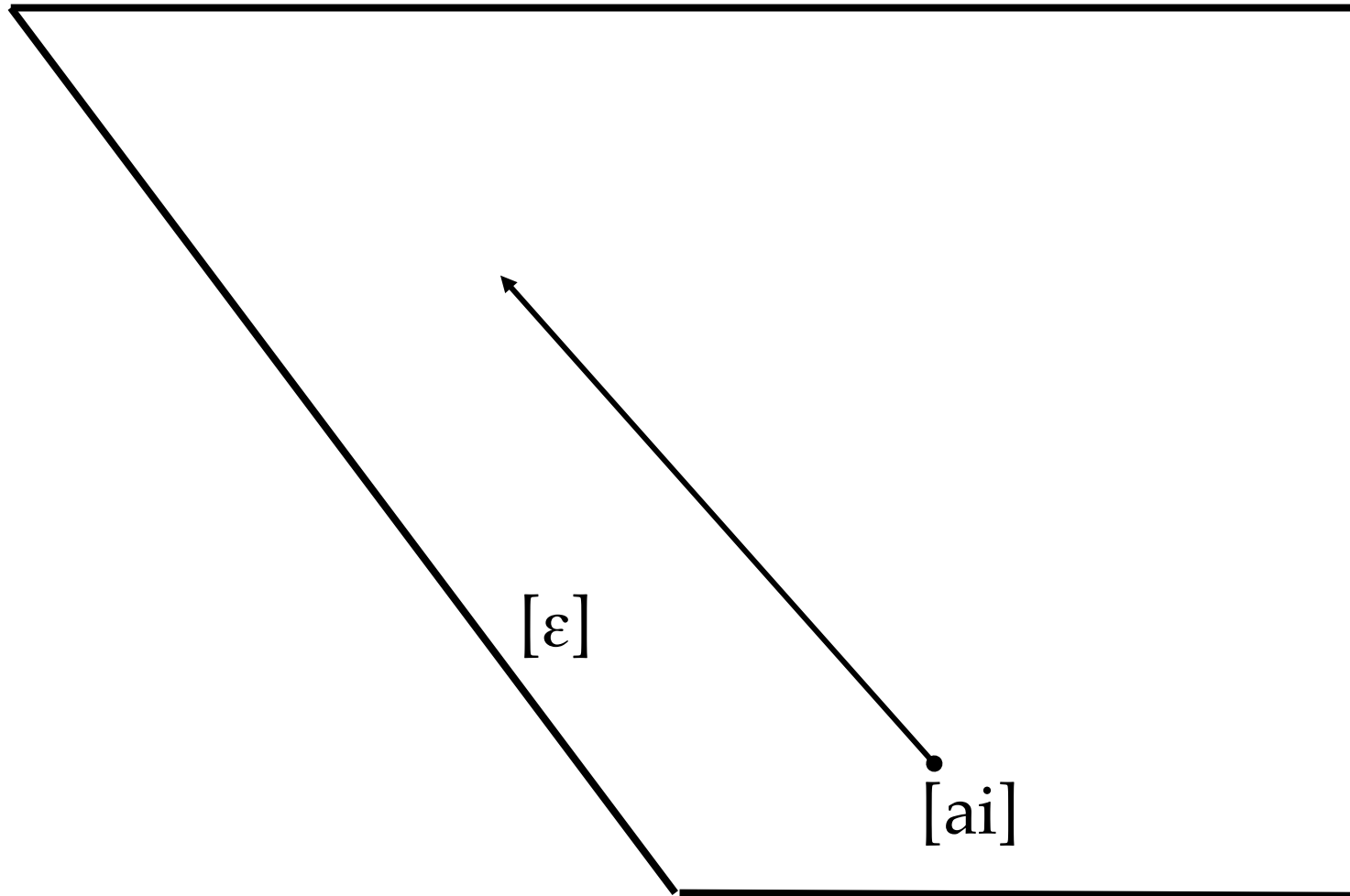


	b	ε	σ	
	beg			

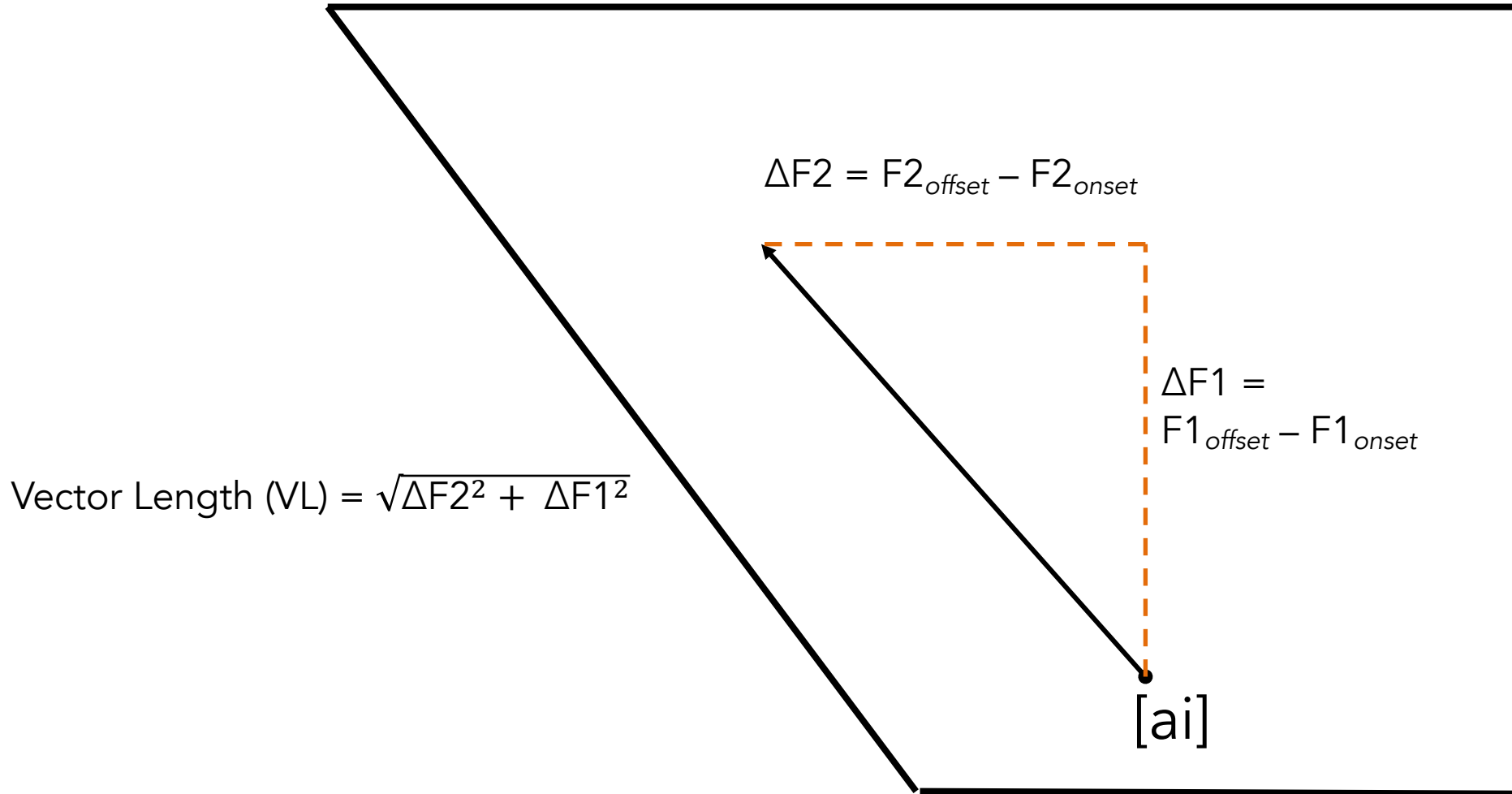


	θ	j	ai	v	
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Monophthongs vs. Diphthongs



Studying Diphthongs

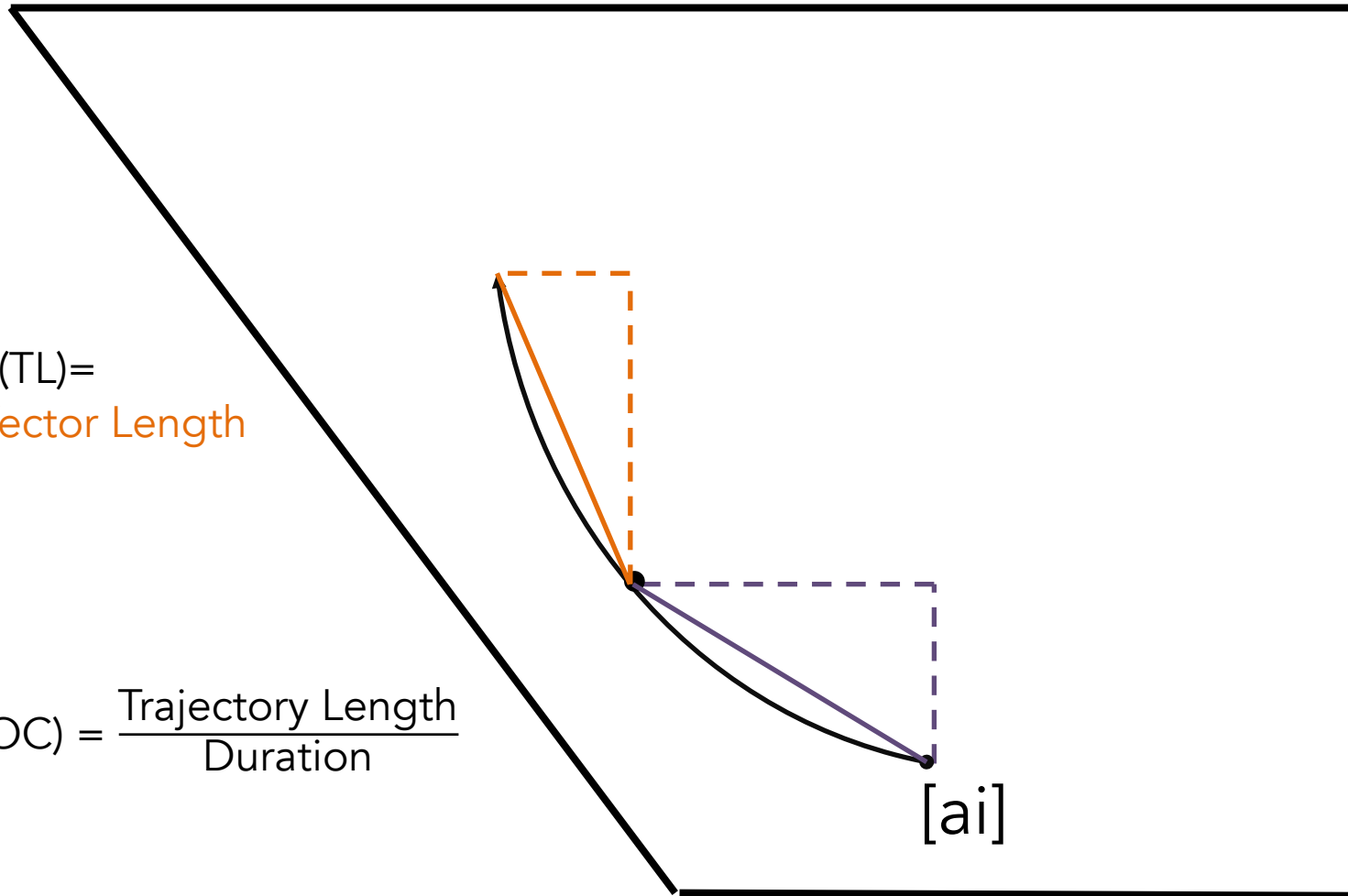


Farrington et al. (2018),
Fox & Jacewicz (2009)

Studying Diphthongs

Trajectory Length (TL)=
Vector Length + Vector Length

$$\text{Rate of Change (ROC)} = \frac{\text{Trajectory Length}}{\text{Duration}}$$



Farrington et al. (2018),
Fox & Jacewicz (2009)

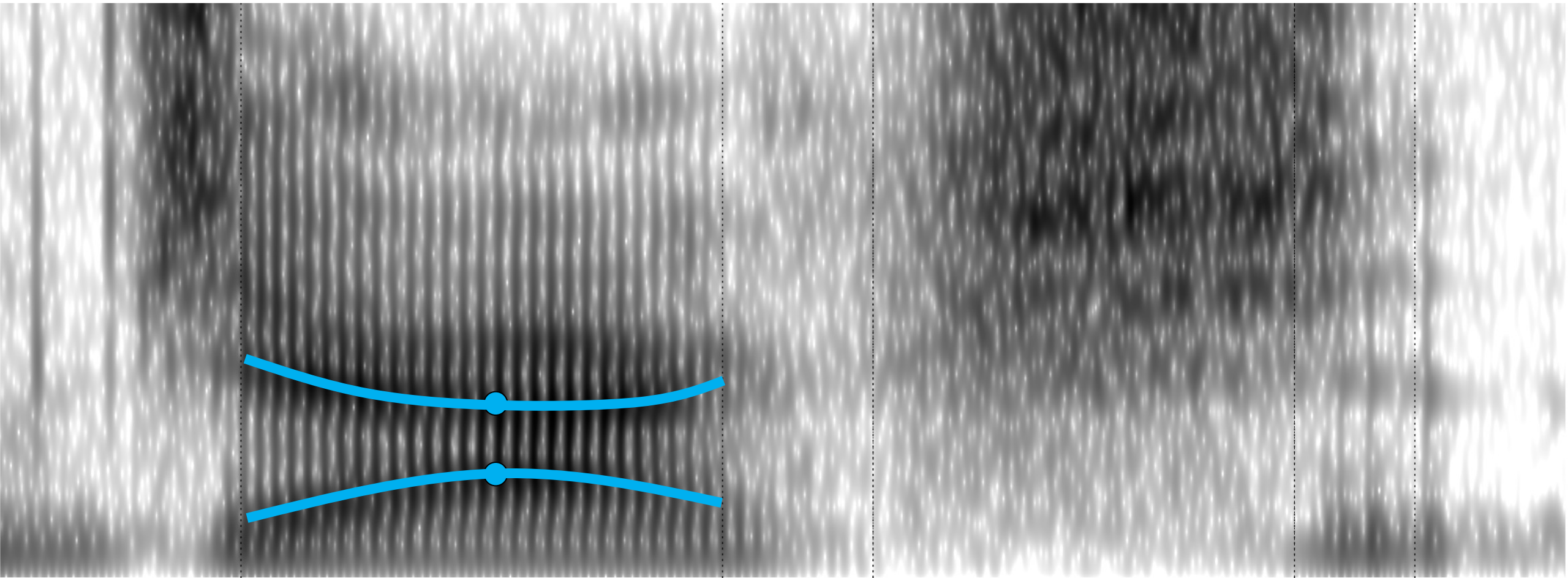
Issues

- A false dichotomy between monophthongs and diphthongs
 - Diphthongal methods only applied to canonical diphthongs
 - Are trajectories in monophthongs not important?

- Missing gradient in studying trajectory
 - VL, TL, ROC, etc. are only *properties* of trajectories
 - Are we missing nuance in the trajectory itself?







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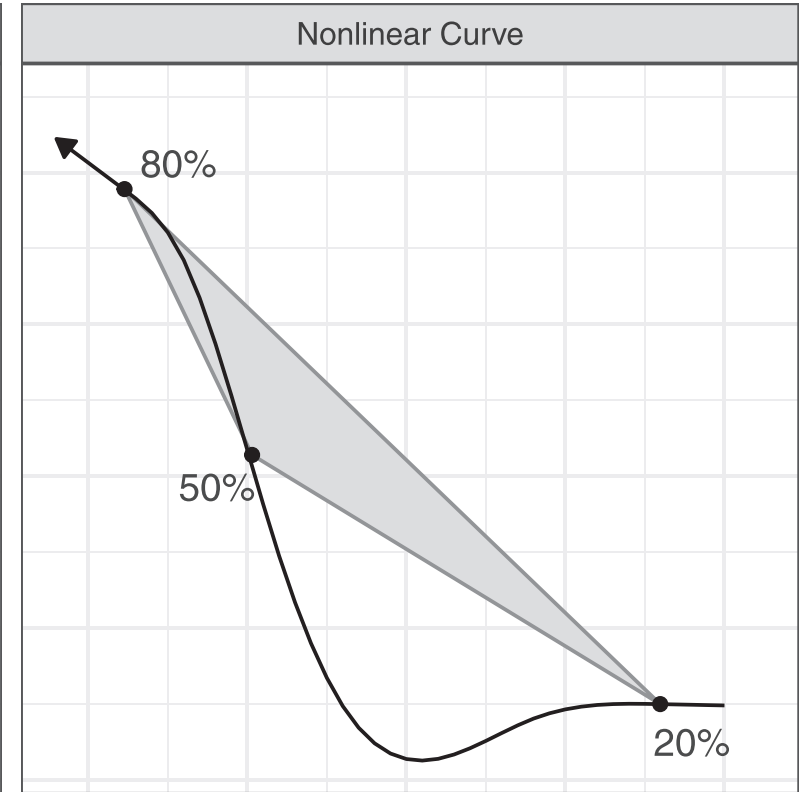
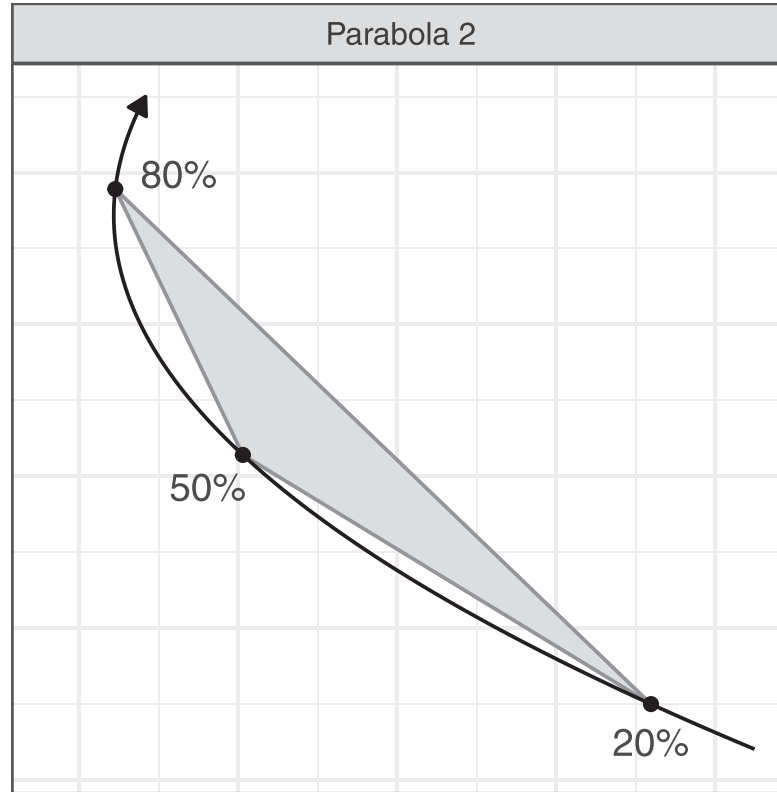
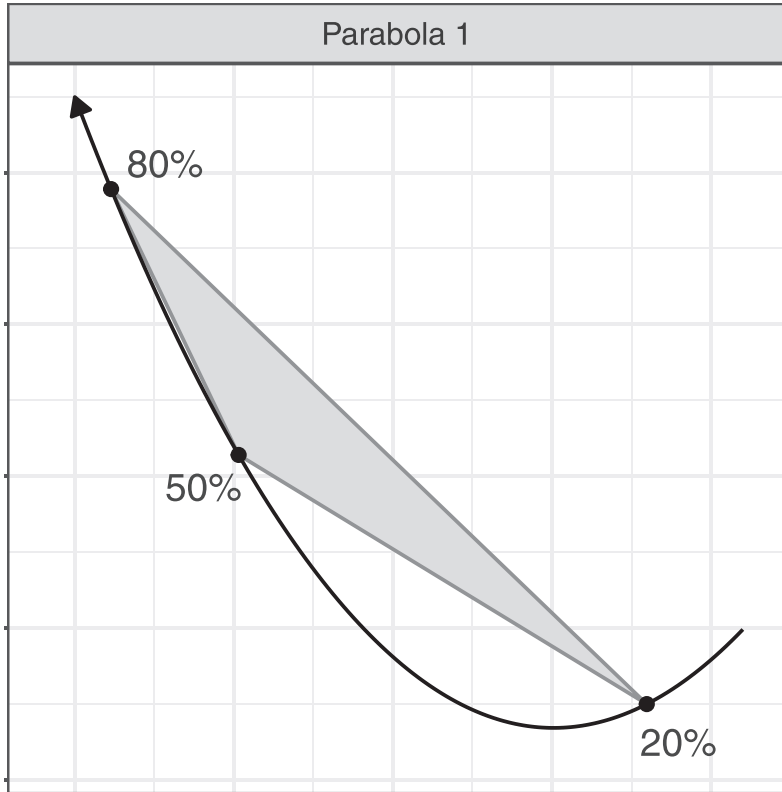
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jackson



From Renwick & Stanley (2020:582)

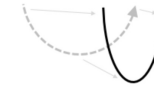
Recent Developments

- Easier to extract trajectory data
 - FAVE is good, but only returns 5 points, English-only
 - Fast Track has more gradience, cleaner, any language.
- Easier to analyze trajectory data
 - Generalized additive mixed effects models
 - “Difference smooths” can tell us where along the trajectory we see statistical significance between two curves.
- We can analyze the trajectories *themselves*, rather than *properties* about them.
- Pause

Overview

1. Vowel shifts may involve changes in trajectory
 - Data: sociolinguistic interviews in Cowlitz County
 - Phenomenon: The Low-Back-Merger Shift
2. Vowel shift might not involve changes in trajectory
 - Data: Legacy linguistic atlas interviews in the South
 - Phenomenon: Southern Vowel Shift
3. Enrich our understanding of merger
 - Data: Wordlists in Heber City, Utah
 - Phenomenon: The *feel-fill* merger

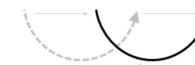
Trajectories Change as Vowels Shift



Joseph A. Stanley. 2020. *Vowel Dynamics of the Elsewhere Shift: A Sociophonetic Analysis of English in Cowlitz County, Washington*. Ph.D. Dissertation. University of Georgia: Athens, Georgia.

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Vowel Shifts without Trajectory Changes



Joey Stanley



Peggy Renwick



Rachel Olsen



Katie Kuiper

Joseph A. Stanley, Margaret E. L. Renwick, Katie Ireland Kuiper, & Rachel Miller Olsen (2021). "Back vowel dynamics and distinctions in Southern American English." *Journal of English Linguistics*. 49(4): 389-418.

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Trajectories' Role in Vowel Merger



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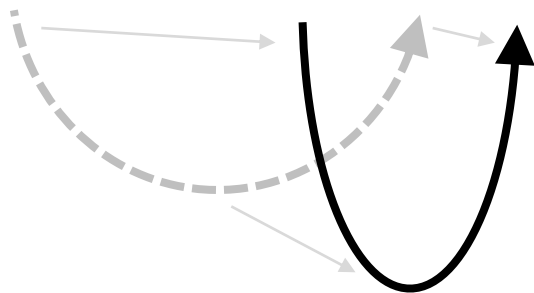


Lisa Johnson

Joseph A. Stanley & Lisa Morgan Johnson. Vowels can merge because of changes in trajectory: Prelaterals in rural Utah English. The 96th Annual Meeting of the Linguistic Society of America. Washington, D.C. January 6-9, 2022.

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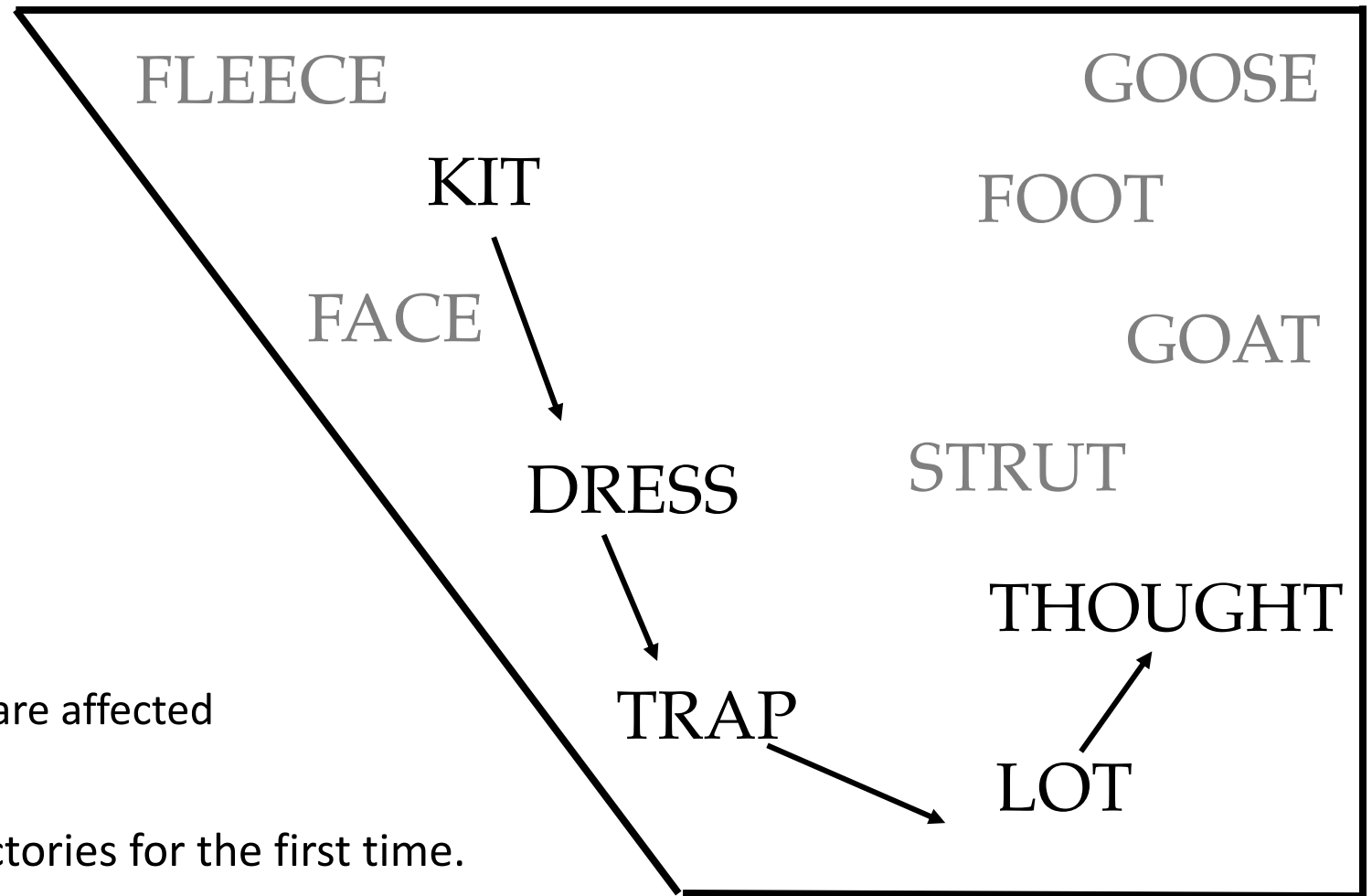
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The Low-Back-Merger Shift

- Geographically widespread.
 - California (Hinton et al. 1987)
 - Canada (Clarke et al. 1995)
 - Colorado (Holland & Brandenburg 2017)
 - Ohio (Durian 2012)
 - Massachusetts (Stanford et al. 2019)
 - Michigan (Mason 2018)
 - Georgia (Stanley & Renwick 2021)
- Applies to elsewhere allophones
 - Only preobstruent allophones are affected
- Stanley (2020) describes its trajectories for the first time.



Data Collection



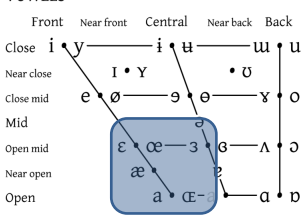
When	Summer 2016
Field site	Cowlitz County in southwestern Washington
Recruitment	face-to-face, business cards, snowball, family
Method	Traditional sociolinguistic interviews (Labov 1984)
Speakers	54
Audio	45h 16m
Corpus size	~350,000 words
Vowels analyzed	128,370

Data Processing

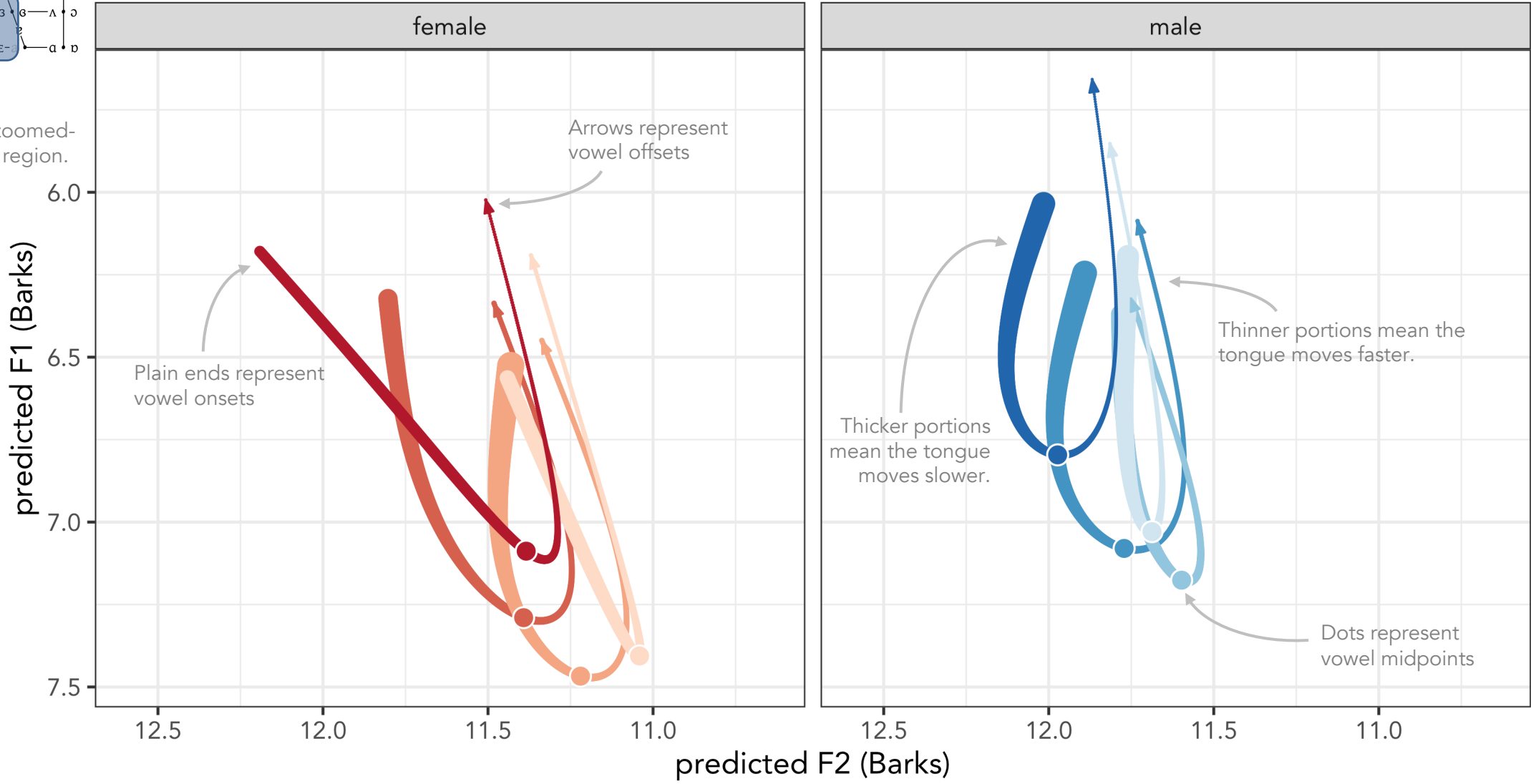
Transcription	Manual
Forced-Alignment	Montreal Forced Aligner (McAuliffe et al. 2017)
Formant Extraction	Praat (Boersma & Weenink 2018) at 11 points per vowel
Filtering	Mahalanobis distance (Mahalanobis 1936)
Normalization	ANAE method (Labov, Ash, Boberg 2006; cf. Nearey 1978)
Transformation	Barks (Zwicker 1961, Traunmüller 1990)
Statistical Modeling	Generalized additive mixed-effects models (Wood 2017)
Software	R (R Core Team 2018), tidyverse (Wickham 2018)
Visuals	ggplot2 (Wickham 2015)

Predicted vowel trajectories for /æ/ in Cowlitz County, WA, by gender and generation

What you should see: Trajectories change shape as the midpoints shift.

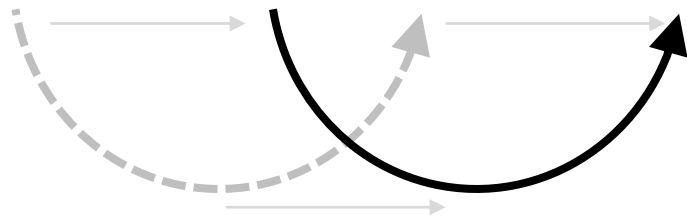


This plot is a zoomed-in view of this region.



- generation and gender
- silent F
 - genX F
 - silent M
 - genX M
 - boomer F
 - millennial F
 - boomer M
 - millennial M

Vowel Shifts without Trajectory Changes



Joey Stanley



Peggy Renwick



Rachel Olsen

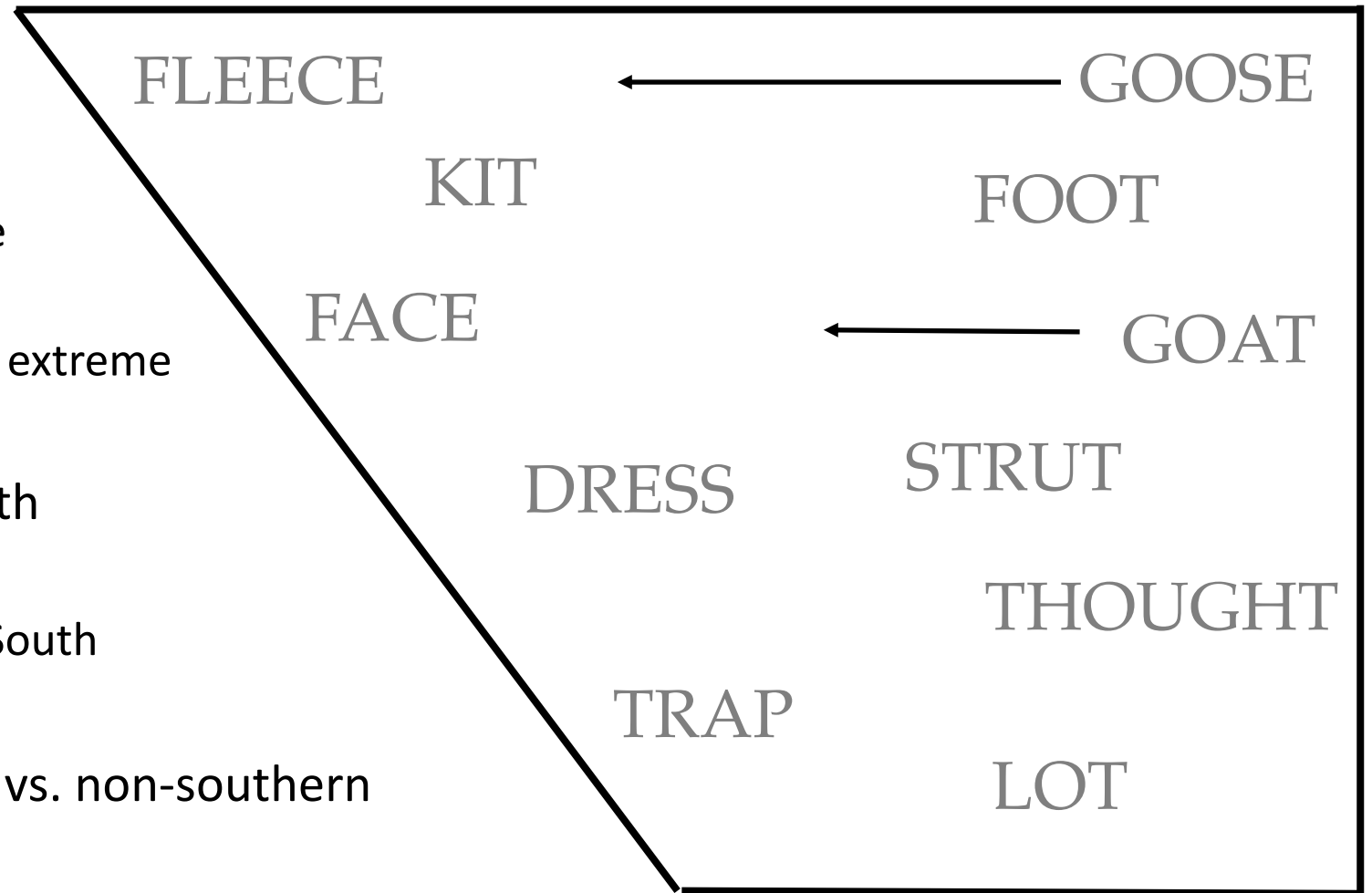


Katie Kuiper

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Back Vowel Fronting

- Canonical back vowels are becoming phonetically central or even front
 - /u/-fronting is older and more extreme
 - /o/-fronting is newer and less extreme
- Found in most varieties of North American English
 - Today's focus: The American South
- Koops (2010) describes southern vs. non-southern trajectory shapes



Data "Collection"

Dataset	Linguistic Atlas of the Gulf States (Pedersen et al. 1986)
Field site	Texas, Arkansas, Louisiana, Tennessee, Mississippi, Alabama, Georgia, Florida
When	1968–1983
Method	Linguistic Atlas interviews
Format	Reel-to-reel; digitized
Speakers	48
Audio	290 hours
Vowel tokens	89,367

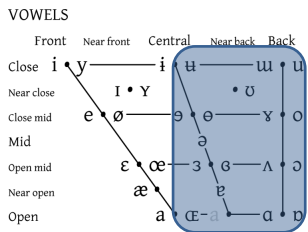
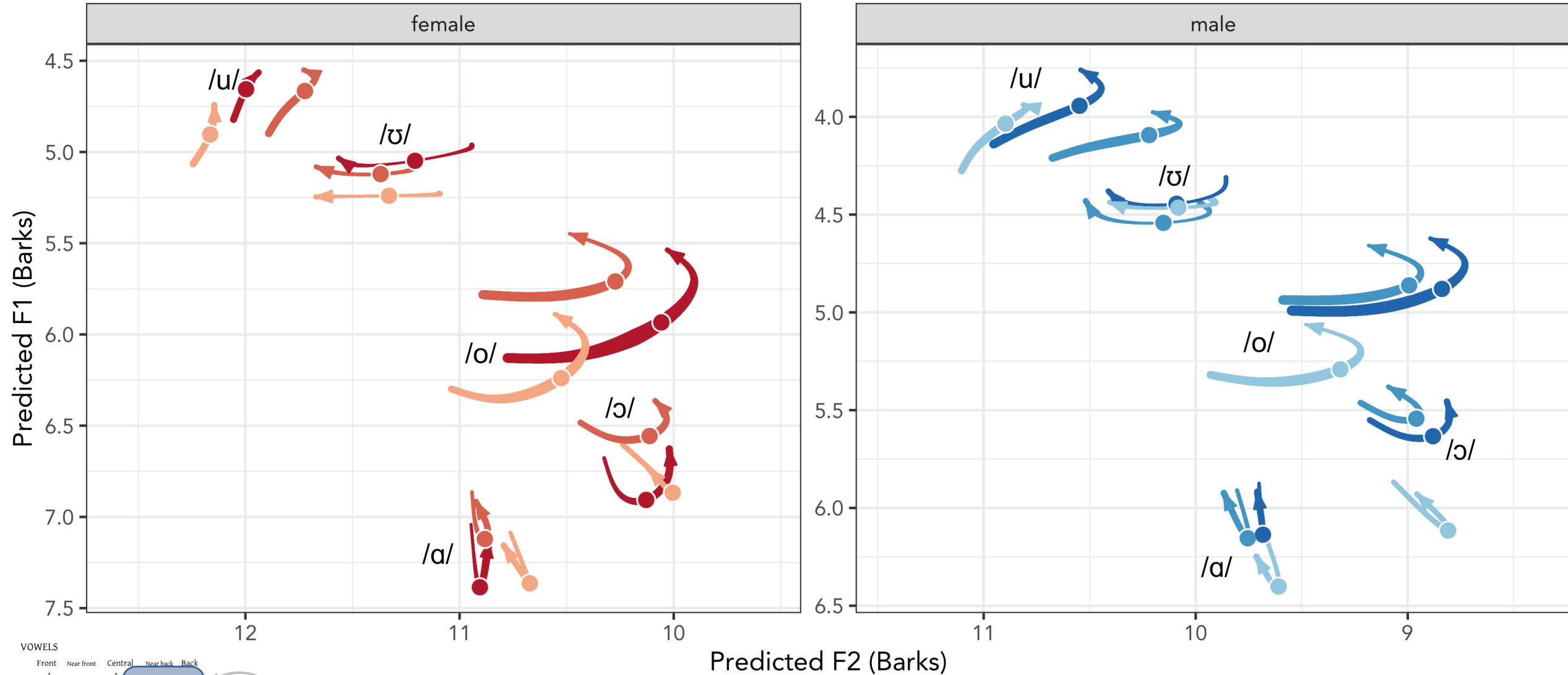


Data Analysis

Transcription	manual (Olsen et al. 2017)
Forced-Alignment	Montreal Forced-Aligner (McAuliffe et al. 2017)
Formant Extraction	FAVE (Rosenfelder et al. 2014) at 20%, 35%, 50%, 65%, 80% into vowels' durations
Exclusions	stopwords, pre-liquids, pre-nasals, non-primary lexical stress
Outlier detection	Mahalanobis Distance (Mahalanobis 1936); furthest 5% removed
Transformation	Barks (Zwicker 1961, Traunmüller 1990)
Statistics	generalized additive mixed-effects models (Wood 2017; cf. Sóskuthy 2017, Gahl & Baayen 2019, Renwick & Stanley 2020)
Modeling	Five separate models: /aɪ/, /eɪ/, /ɛ/, /u/, /oʊ/
Software	R (R Core Team 2018), tidyverse (Wickham 2018); mgcv (Wood 2011); itsadug (van Rij et al. 2020)
Visuals	ggplot2 (Wickham 2015)

Predicted vowel trajectories for /o/ in the South, by gender and generation

What you should see: Trajectories don't change even though midpoints shift

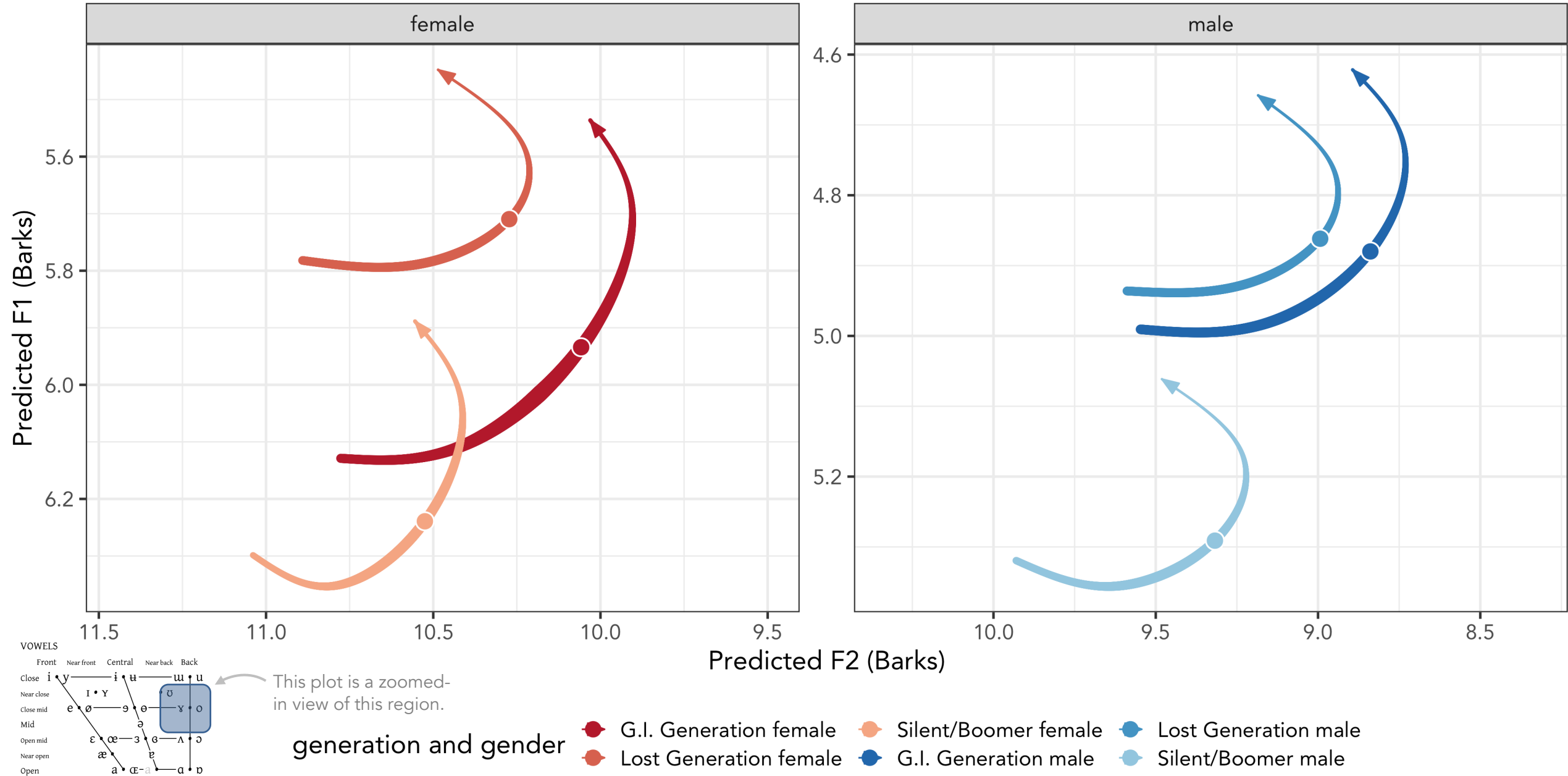


This plot is a zoomed-in view of this region.

- generation and gender
- G.I. Generation female
 - Silent/Boomer female
 - Lost Generation female
 - Lost Generation male
 - G.I. Generation male
 - Silent/Boomer male

Predicted vowel trajectories for /o/ in the South, by gender and generation

What you should see: Trajectories don't change (much) even though midpoints shift



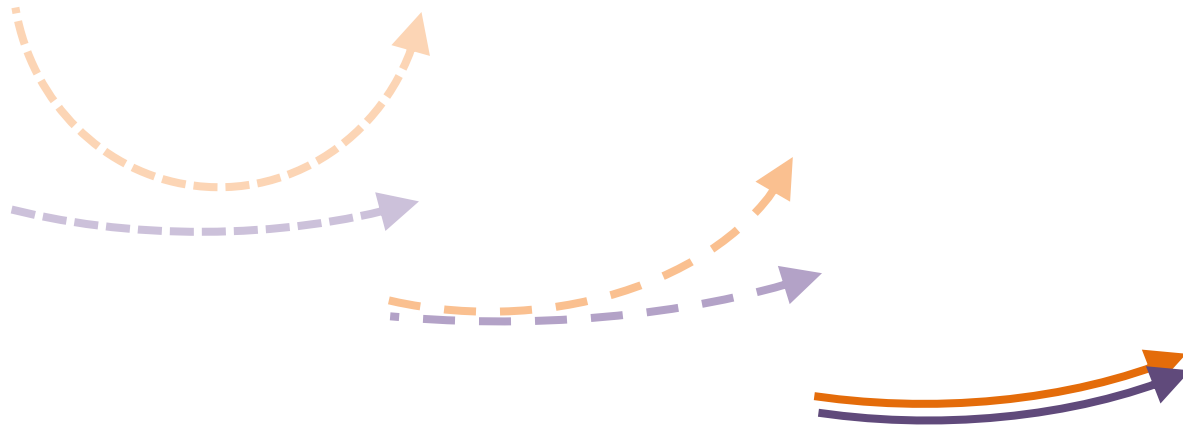
Trajectories' Role in Vowel Merger



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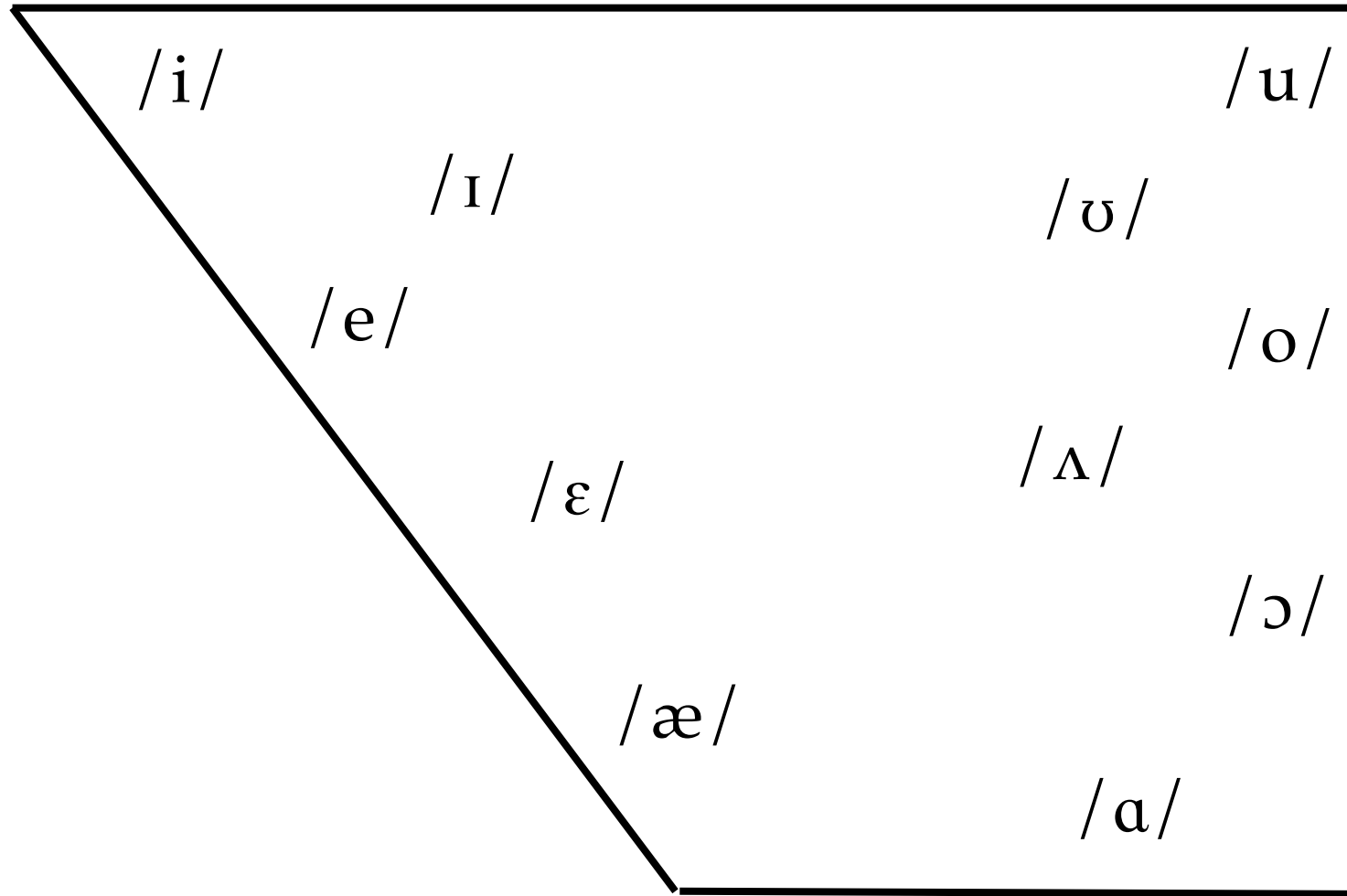


Lisa Johnson

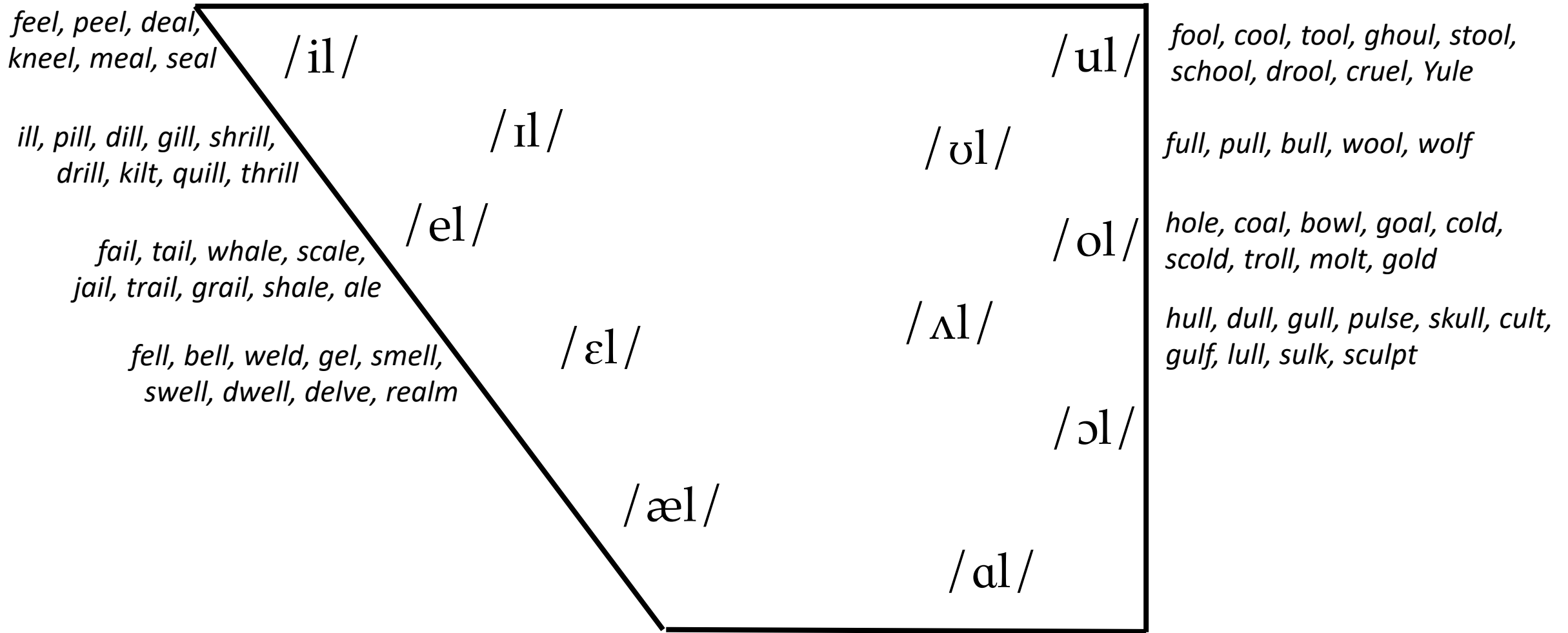


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Prelateral Mergers



Prelateral Mergers



Prelateral Mergers

*feel, peel, deal,
kneel, meal, seal*

ZEAL

SPOOL

*fool, cool, tool, ghoul, stool,
school, drool, cruel, Yule*

*ill, pill, dill, gill, shrill,
drill, kilt, quill, thrill*

GUILT

WOLF

full, pull, bull, wool, wolf

*fail, tail, whale, scale,
jail, trail, grail, shale, ale*

FLAIL

JOLT

*hole, coal, bowl, goal, cold,
scold, troll, molt, gold*

*fell, bell, weld, gel, smell,
swell, dwell, delve, realm*

SHELF

MULCH

*hull, dull, gull, pulse, skull, cult,
gulf, lull, sulk, sculpt*

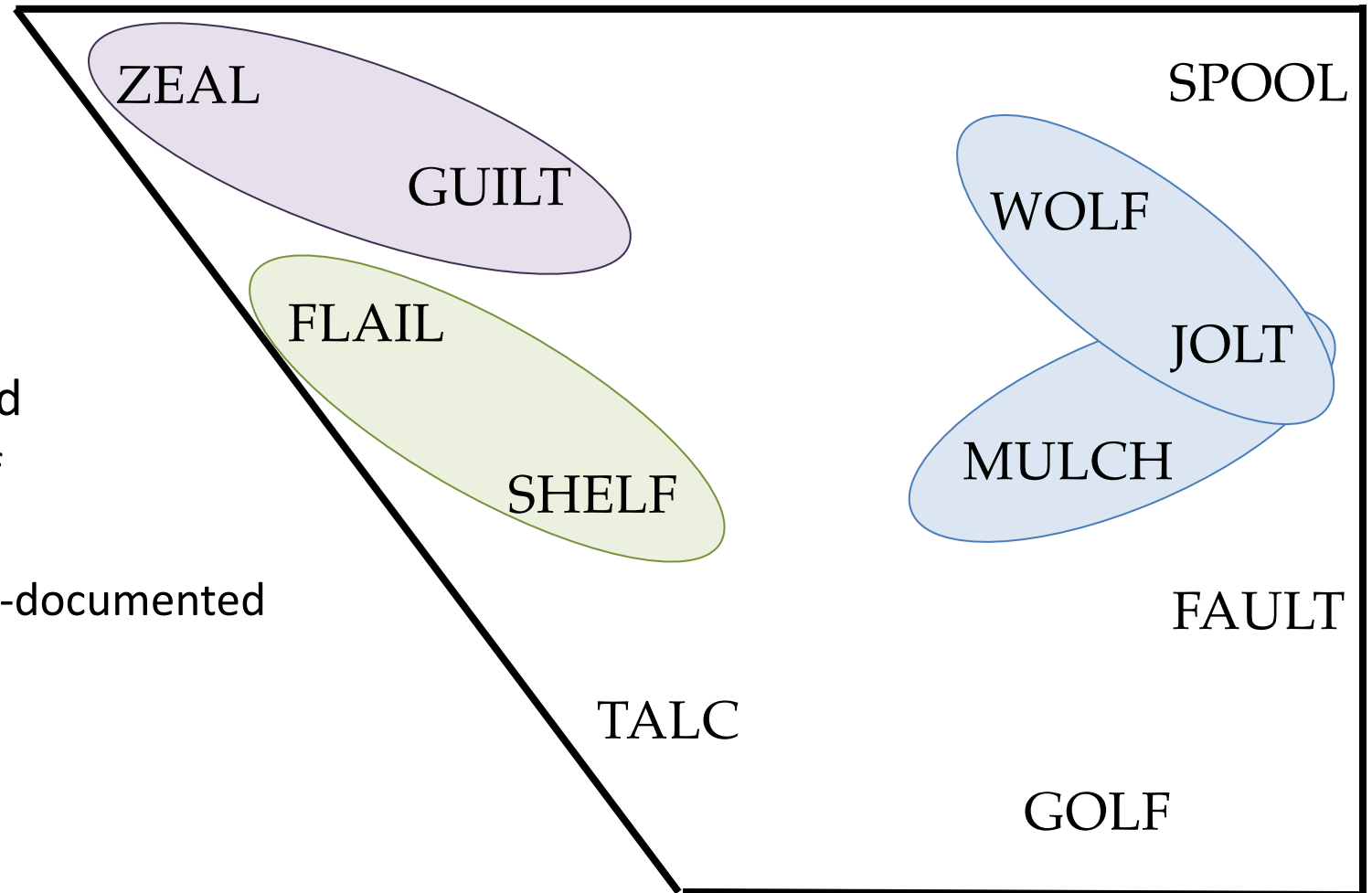
TALC

FAULT

GOLF

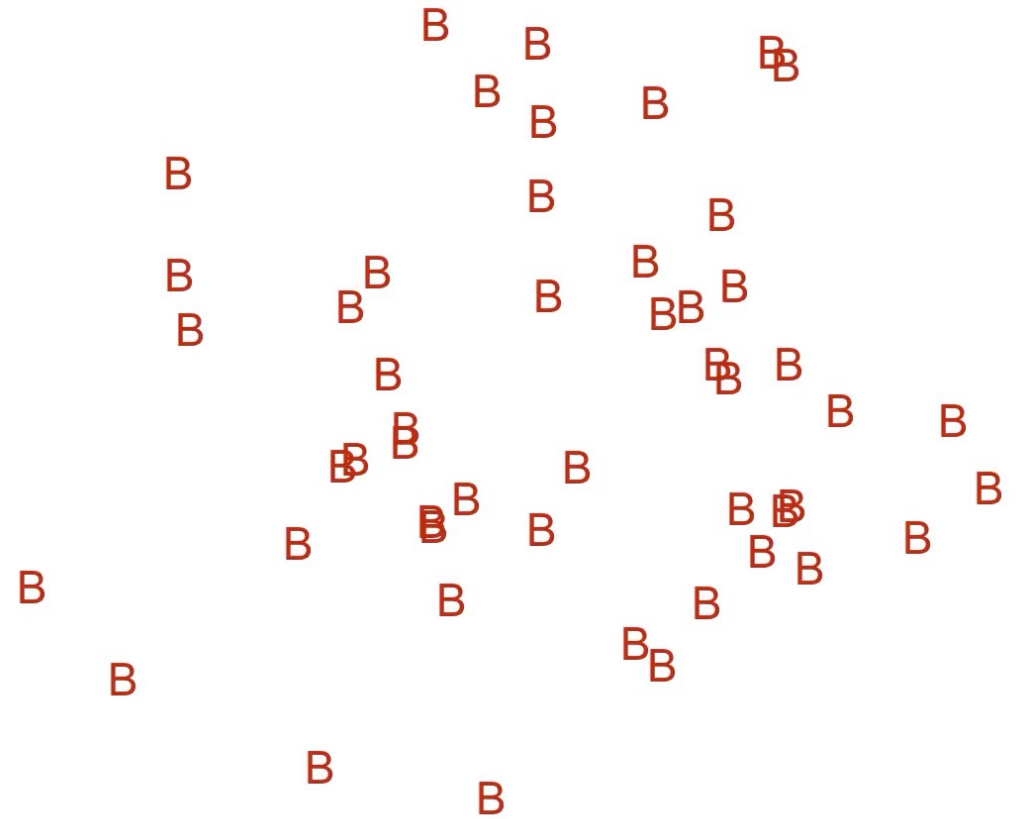
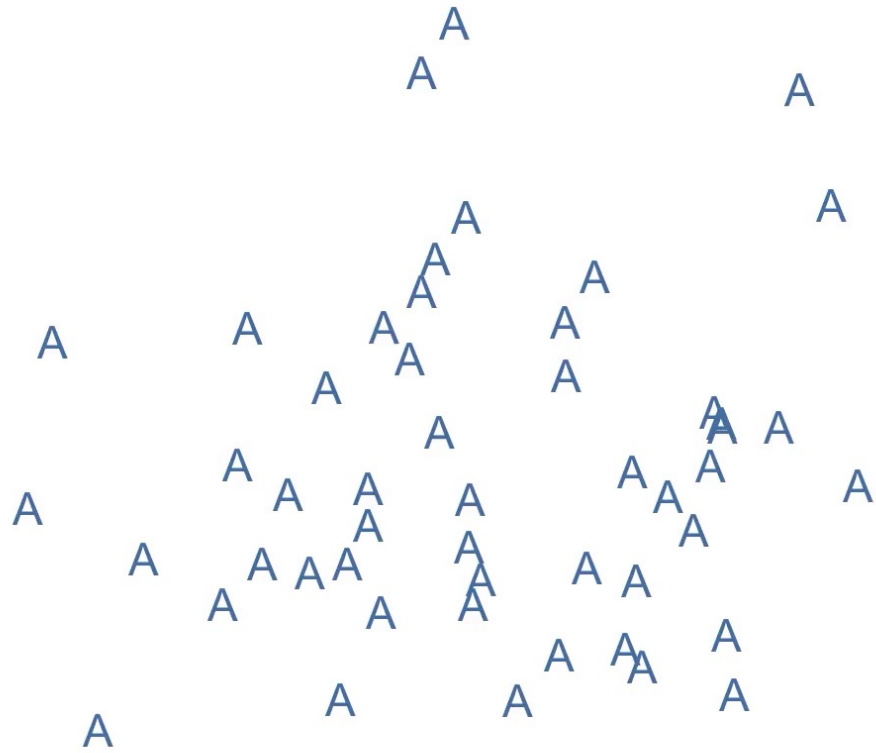
Prelateral Mergers

- In front vowels, tense-lax distinction is lost before /l/
 - Found in Utah, Texas, and scattered elsewhere
- In back vowels, it's complicated
 - Basically, any configuration of mergers has been attested.
 - Regional distribution not well-documented



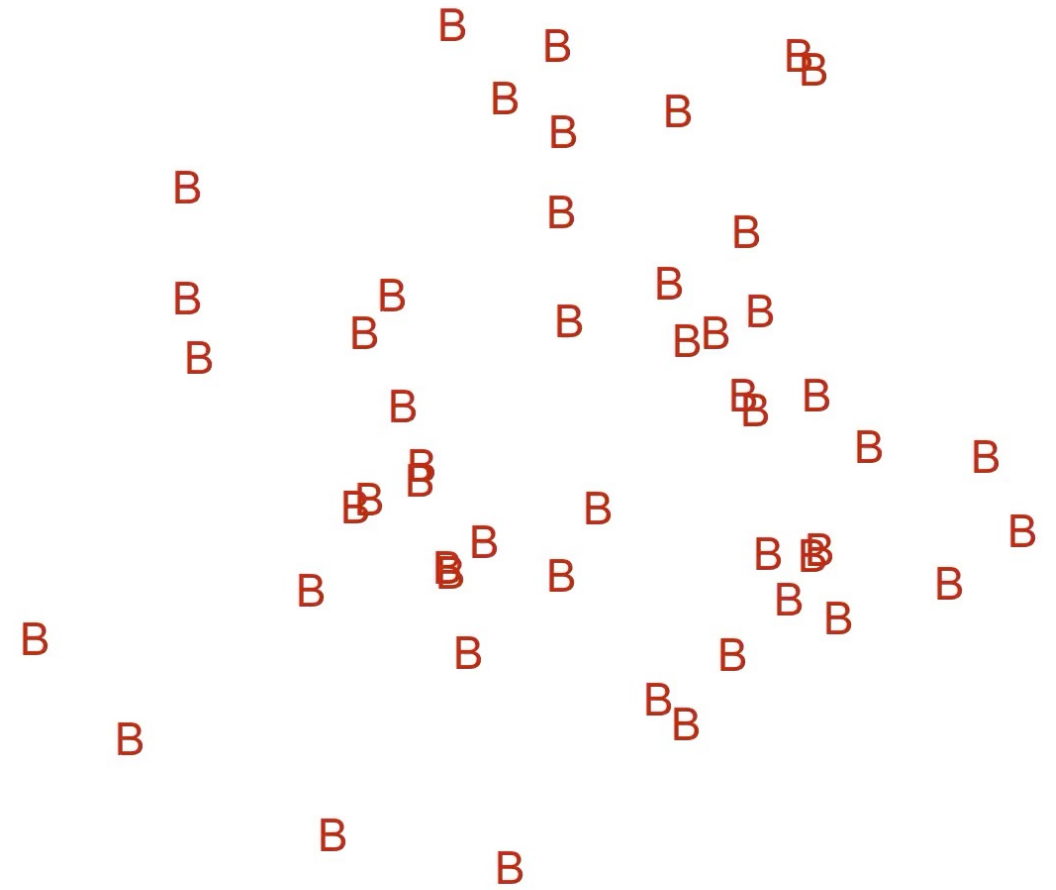
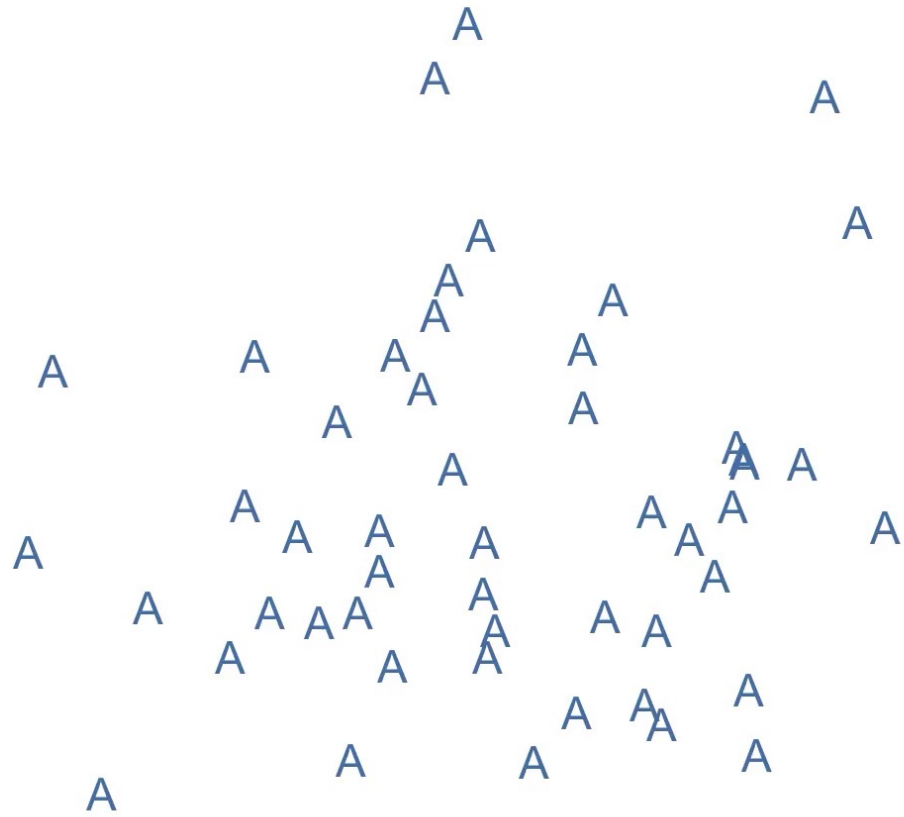
Merger by Approximation (Trudgill & Foxcroft 1978)

Based on 100 randomly generated data points



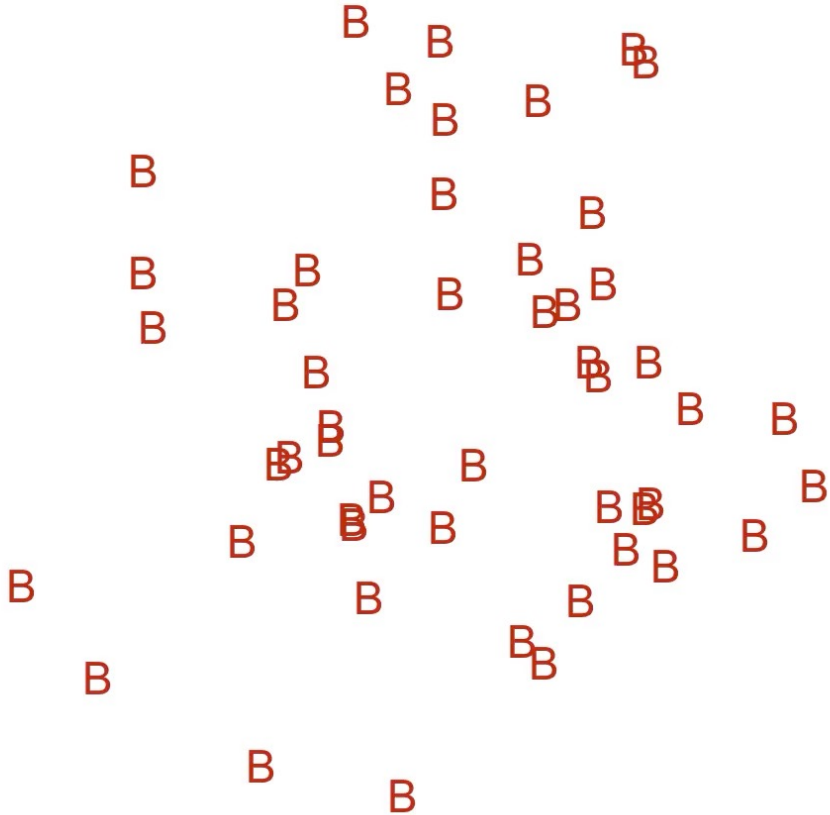
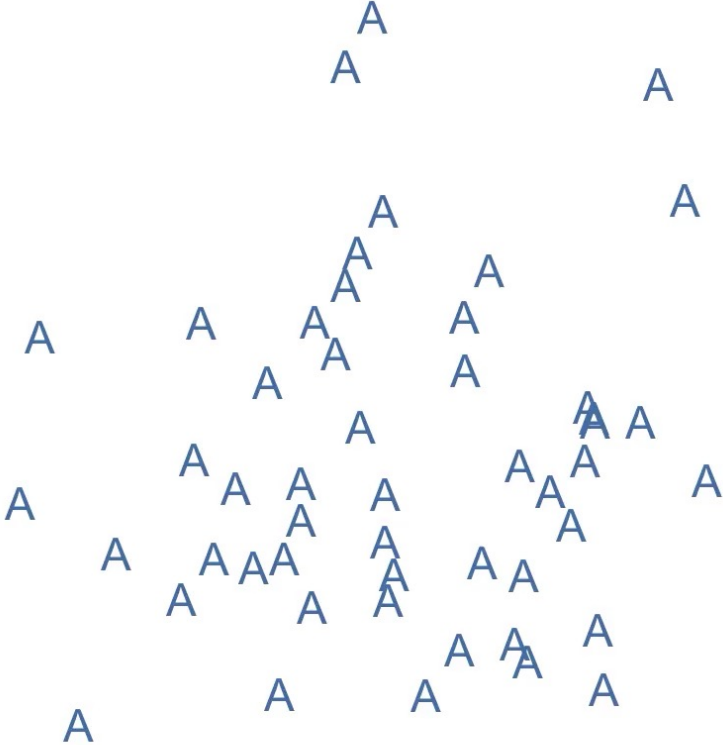
Merger by Transfer (Foxcroft & Trudgill 1978)

Based on 100 randomly generated data points



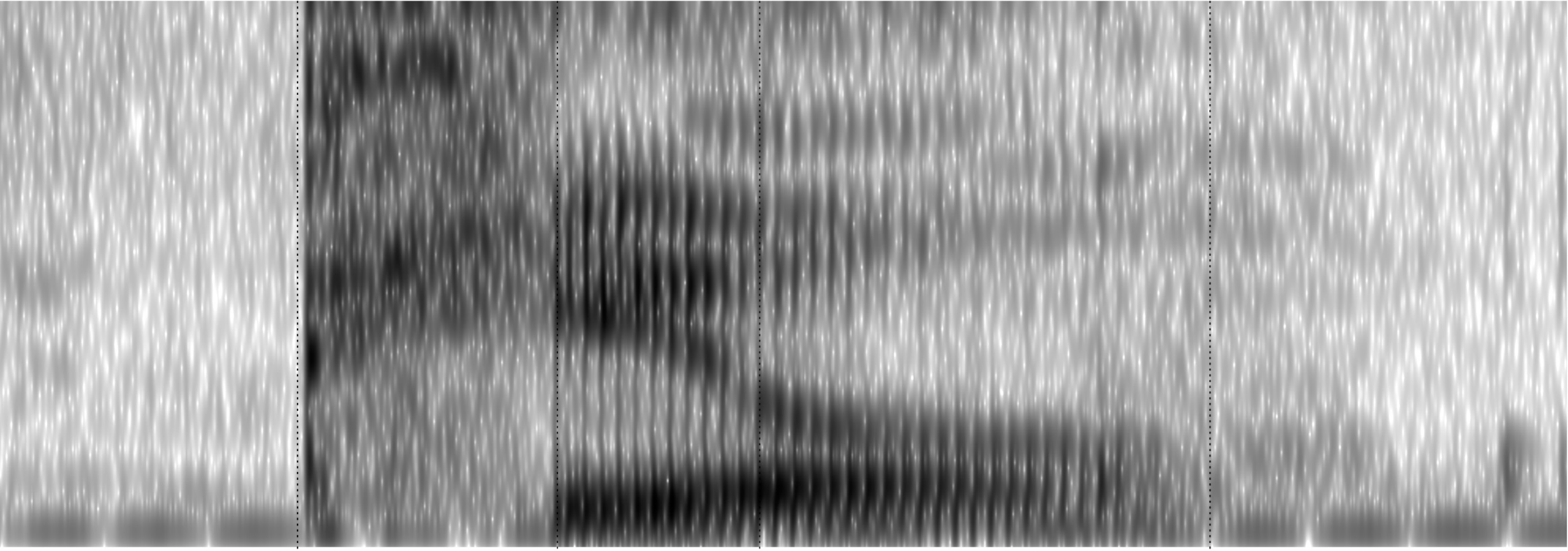
Merger by Expansion (Herold 1990)

Based on 100 randomly generated data points



Mechanisms of Merger

- Several have been proposed
 - Merger by approximation (Foxcroft & Trudgill 1978)
 - Merger by transfer (Foxcroft & Trudgill 1978)
 - Merger by expansion (Herold 1990)
 - Merger by phonological transfer (Dinkin 2016)
 - Merger by glide loss (Irons 2007)
- Trajectories and merger?
 - Other than merger by glide loss, trajectories have not been considered

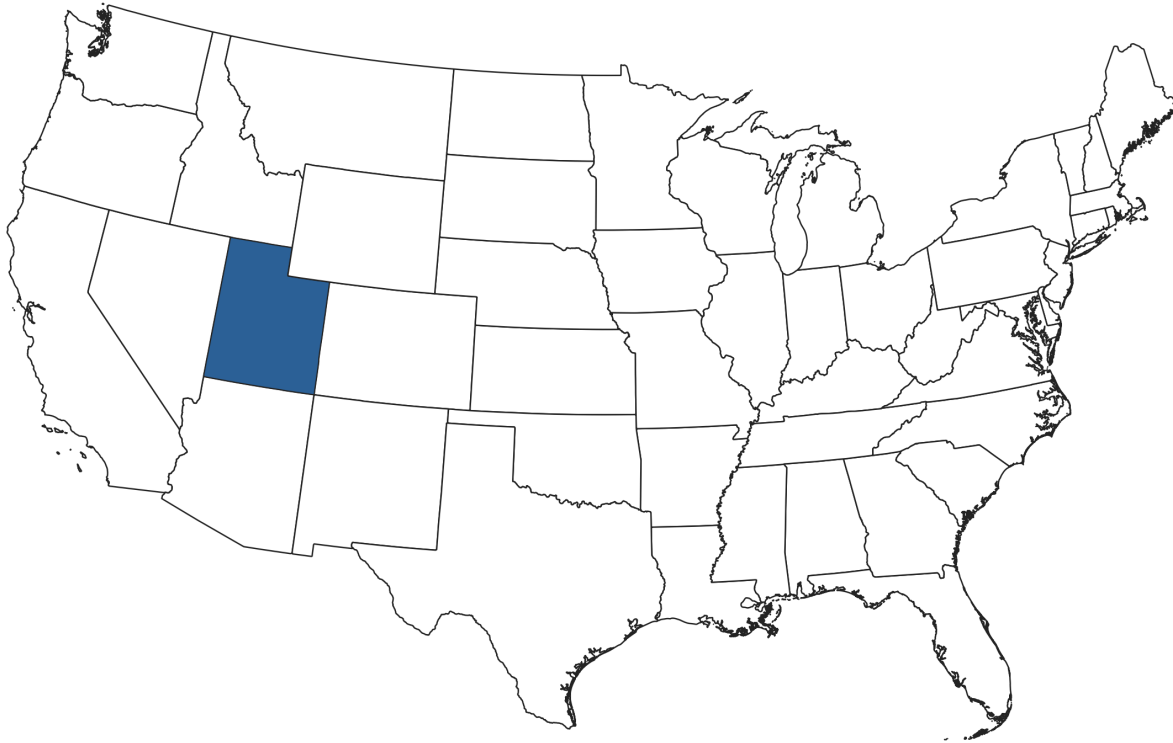


	p	i	l	
	peel			

Mechanisms of Merger

- Several have been proposed
 - Merger by approximation (Foxcroft & Trudgill 1978)
 - Merger by transfer (Foxcroft & Trudgill 1978)
 - Merger by expansion (Herold 1990)
 - Merger by phonological transfer (Dinkin 2016)
 - Merger by glide loss (Irons 2007)
- Trajectories and merger
 - Other than merger by glide loss, trajectories are not considered
 - What role to trajectories play in merger?

Data Collection



When January 2018

Field Site Wasatch County, Utah

Recruitment face-to-face, business cards, snowball, family

Method Wordlist

Speakers 28

Vowels analyzed 4,514 prelateral vowel tokens

Data Processing

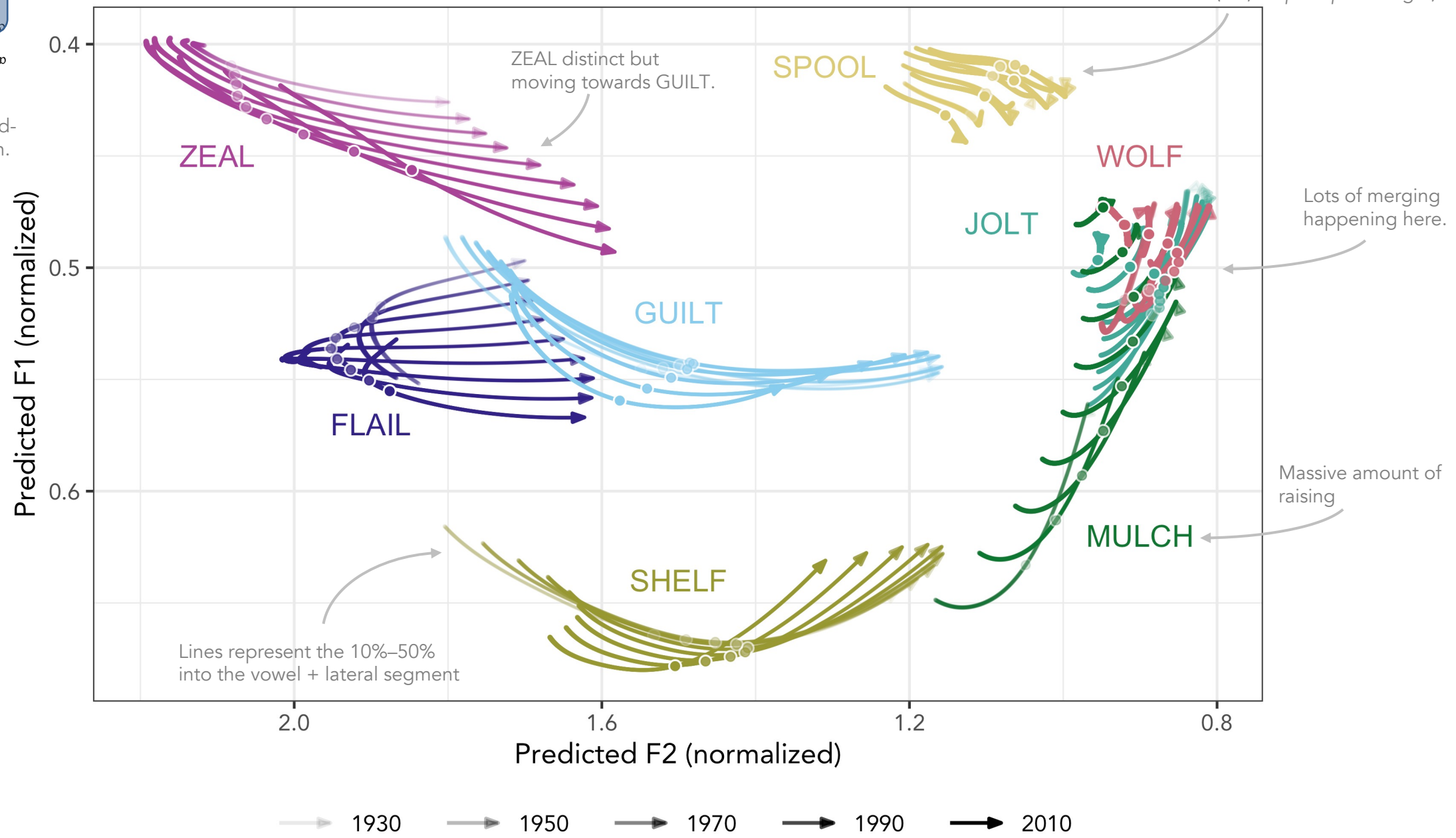
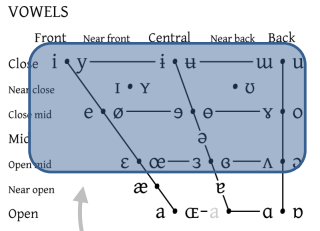
Transcription	Manual
Forced-Alignment	Manual
Formant Extraction	Fast Track (Barreda 2021), binned at 11 points per vowel
Filtering	Mahalanobis distance (Mahalanobis 1936)
Normalization	ΔF (Johnson 2020)
Statistical Modeling	Generalized additive mixed-effects models (Wood 2017)
Software	R (R Core Team 2018), tidyverse (Wickham 2018); mgcv (Wood 2011); itsadug (van Rij et al. 2020)
Visuals	ggplot2 (Wickham 2015)

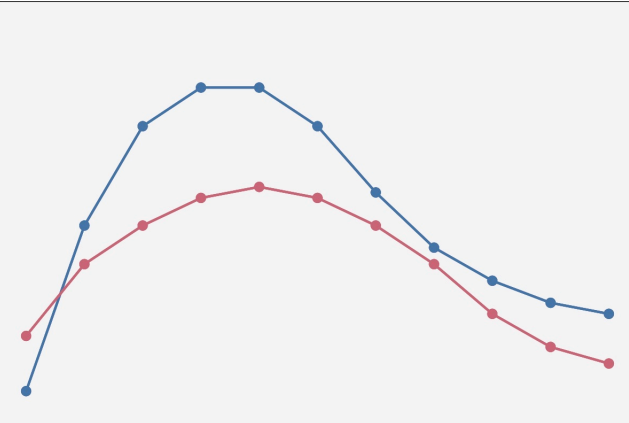
I can make some sweet plots.

Birth year modeled as a continuous, nonlinear variable.

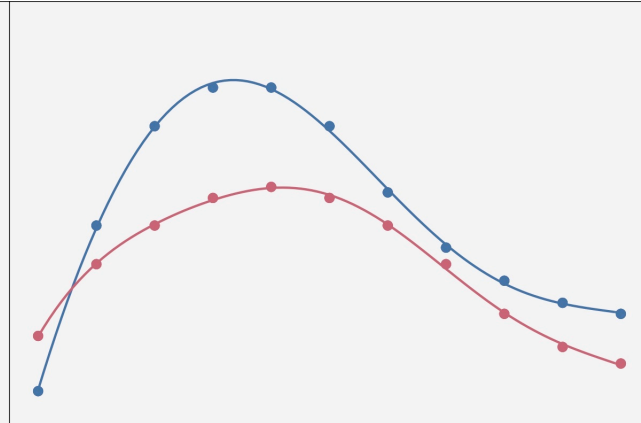
Predicted prelateral vowel trajectories in Heber City, UT

What you should see: Lots of change!

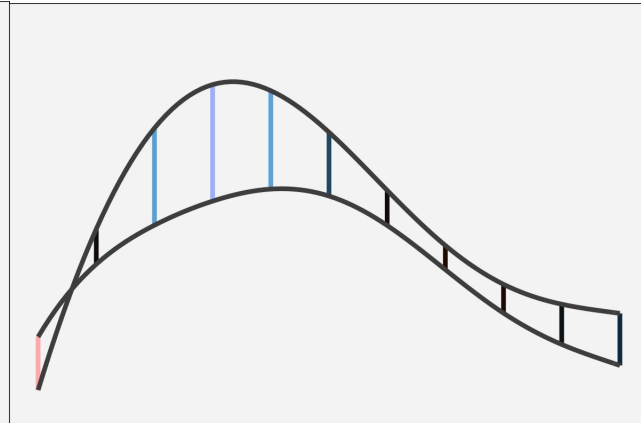




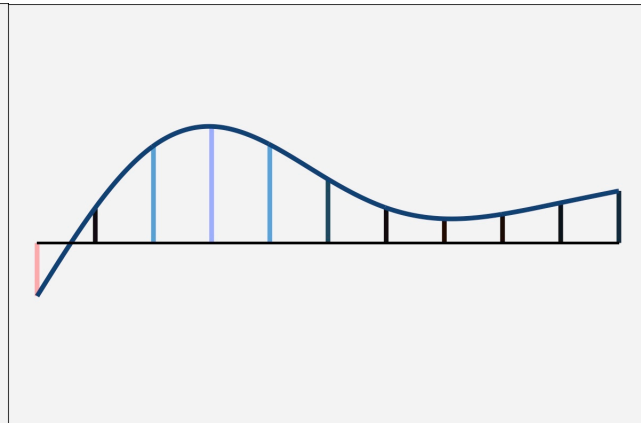
The raw data



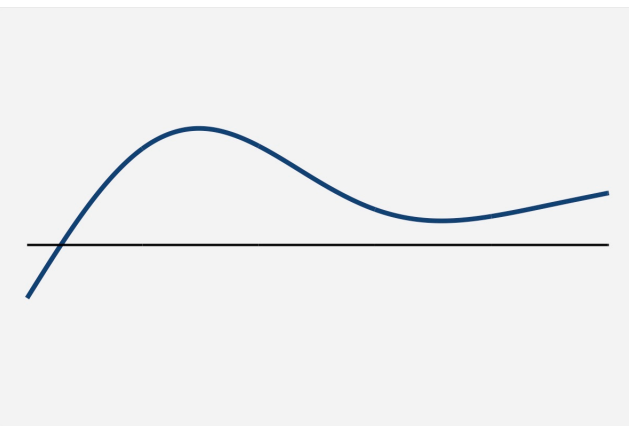
Raw data connected smoothly via GAMM.



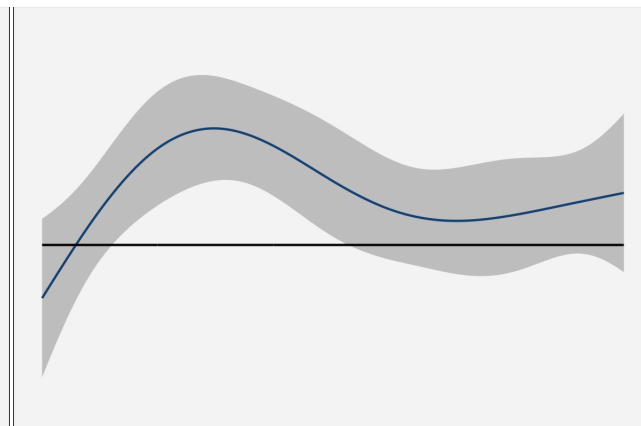
Difference between the smooths. Larger = bluer.



Flatten one of them; keep vertical lines consistent.

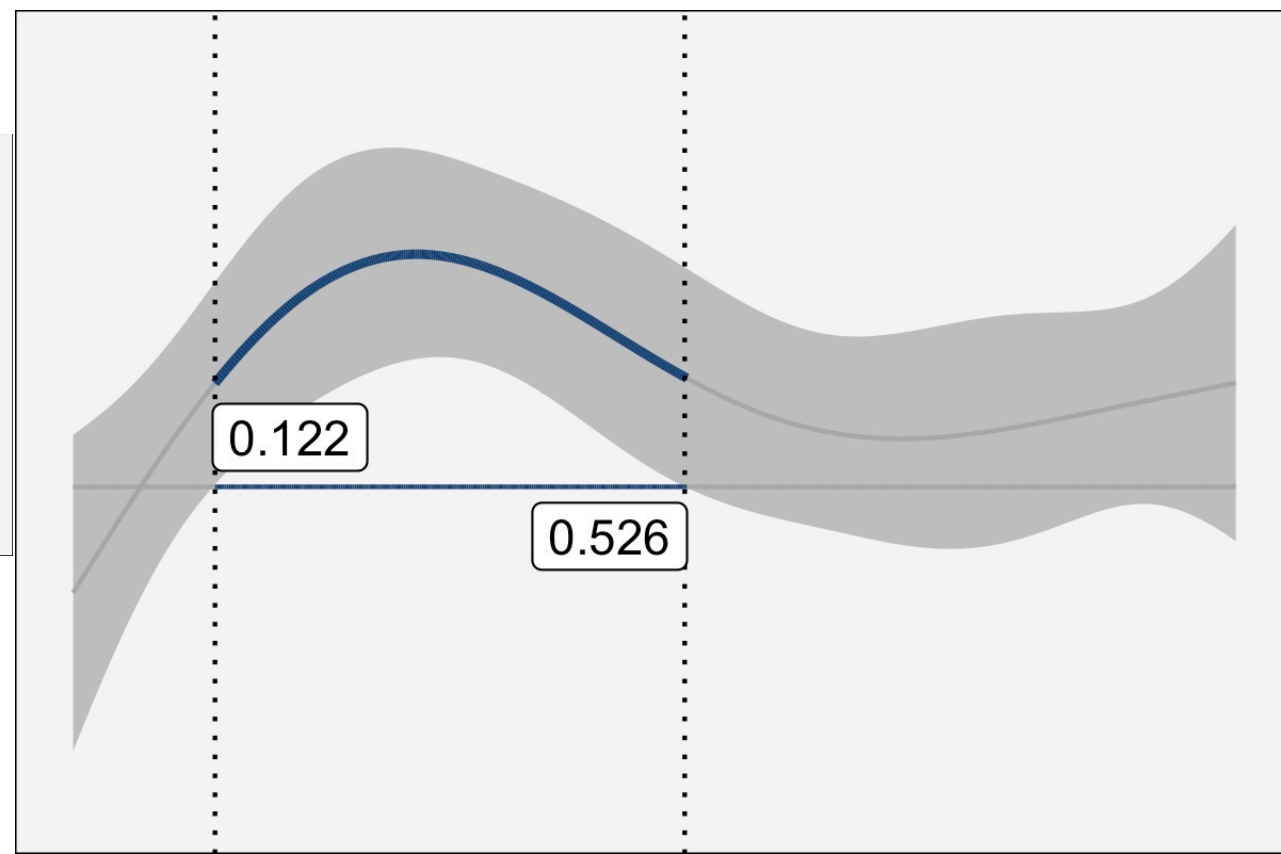


Extract just the top line. This is the **difference smooth**.



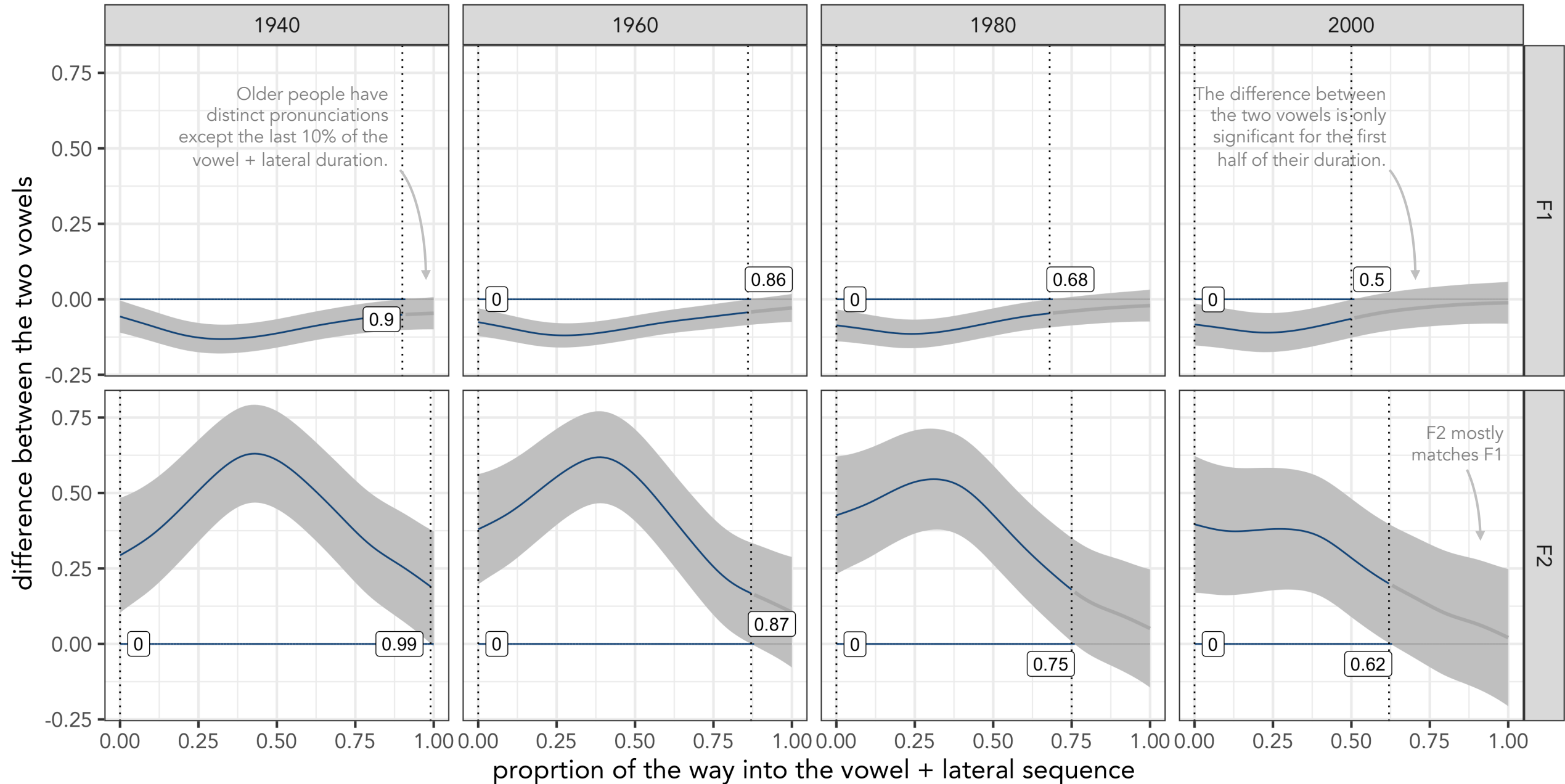
Add confidence intervals.

Indicate where confidence intervals do not include 0. ►



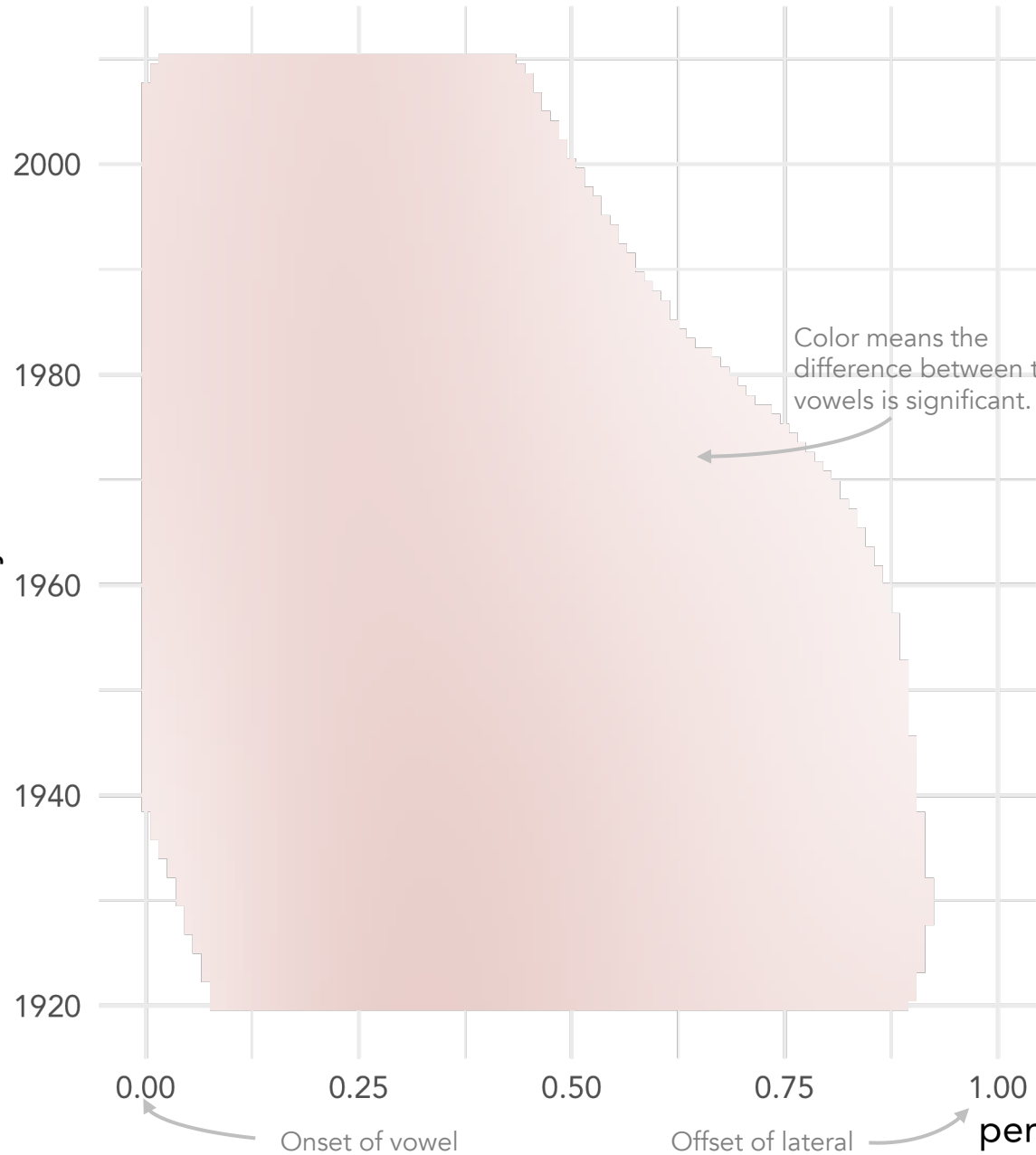
Difference smooths between ZEAL and GUILT over time in Heber City, UT

What you should see: Merge happens leftward from the lateral.



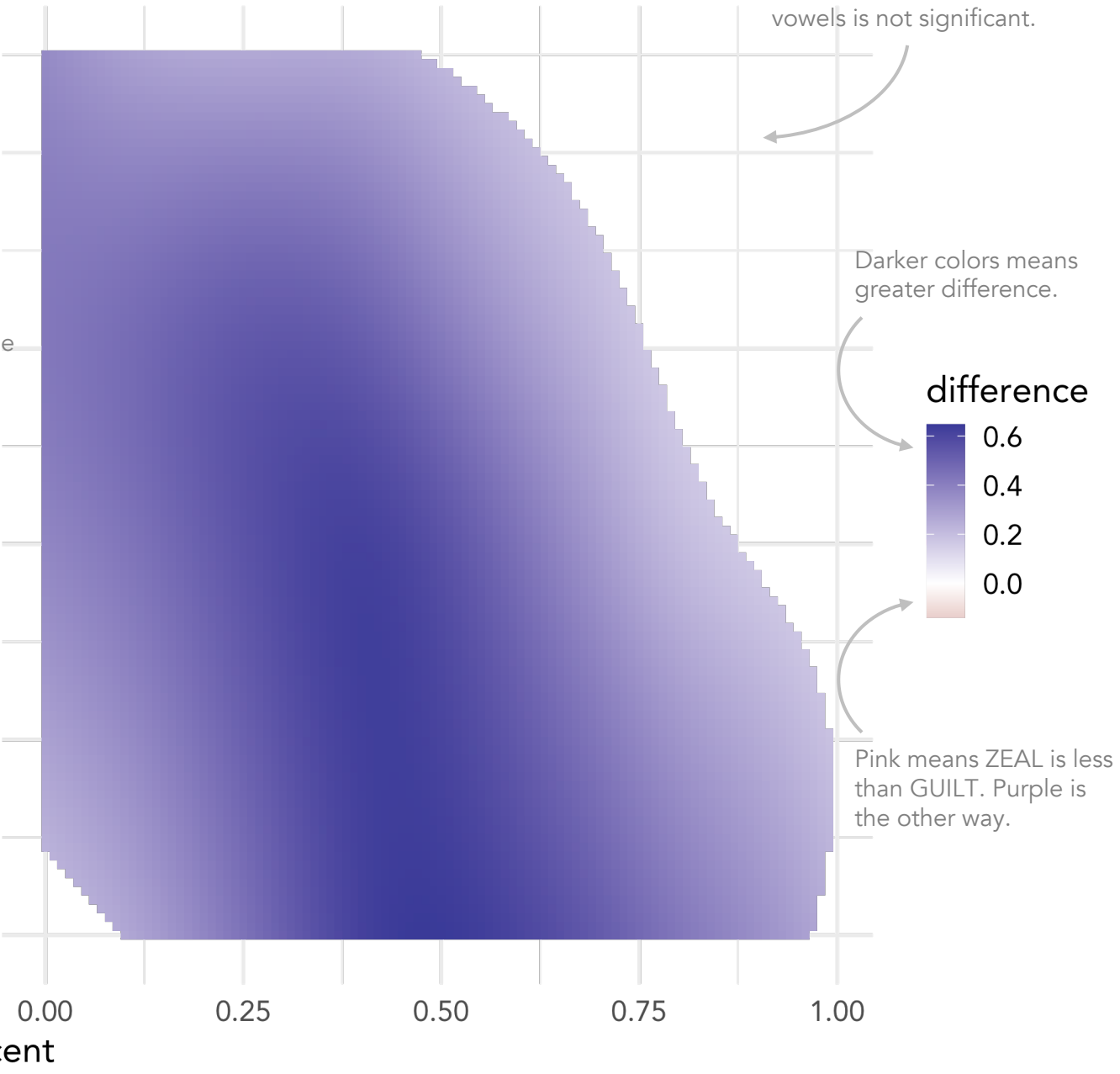
ZEAL-GUILT

F1



ZEAL-GUILT

F2



So what?

- The vowel plot suggests a merger by approximation
 - ZEAL and GUILT are gradually getting closer in apparent time.
 - ... at least based on the midpoints.
- Expanding to trajectories gives greater insight into this type of merger.
 - In this sample, offsets are ahead of the curve than midpoints.
 - Kinda like a zipper.



Conclusion

Summary

- Changes in trajectory may accompany vowel shifts
 - With BAT in Washington, trajectories changed as the vowel lowered.
 - With GOAT in the South, trajectories were more stable as the vowel fronted.
- Trajectories are involved in vowel mergers.
 - With ZEAL and GUILT in Utah, the lateral has more and more influence on the vowel.

Conclusion

- Trajectories illuminate greater detail in sociophonetic change.
- We now have the ability to analyze trajectories.
 - Let's ditch the (phonetic) monophthong vs. diphthong distinction (at least in methods).
 - Let's reanalyze existing theories about phonetic change.
 - Let's discover new ways that language changes.
- What kind of sociolinguistic meaning is encoded in trajectories?

References

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