

Dialect evolution in the Pacific Northwest:
Reanalysis and conventionalization of a
universal phonetic pattern

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Introduction

Sociophonetics: Two conceptualizations

#1: “Accounting for how ... variation in the sound system is learned, stored cognitively, subjectively evaluated and processed in speaking and listening” (Foulkes, Scobbie and Watt 2010: 704)

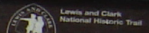
#2: “Investigating sociolinguistic research questions, using more sophisticated instrumental methodologies than has been traditional in variationist sociolinguistics.” (diPaolo & Yaeger-Dror 2011:8)

The Astoria-Megler Bridge





The Lewis and Clark Expedition



In 1804-06, Captains Meriwether Lewis and William Clark led about 40 soldiers and boatmen on an epic journey. President Thomas Jefferson commissioned this "Corps of Discovery" to find a route to the Pacific Ocean through the newly acquired Louisiana land, record its resources, and contact its native inhabitants.

The landscape has changed since Lewis and Clark explored it: rivers have been dammed, forests cut over, prairies plowed under, and roads built to the horizon. Although remnants of wilderness still exist, imagine this land as Lewis and Clark first saw it two centuries ago.



The United States purchased the Louisiana territory in 1803 from France. In 1803, President Jefferson named Meriwether Lewis (far left) to lead the expedition.

With Jefferson's permission, Lewis asked his friend and William Clark (far right) to be his co-leader. Although separate in responsibility, they worked harmoniously throughout the two-year journey.



Route of the Expedition



Roadmap

PNWE Study

- (æɨ) in PNWE: from imperceptible universal to dialect marker

Foundations from Sociolinguistics

- Variation in apparent time as indication of community change (conventionalization)

Foundations from Phonetics

- Coarticulation: automatic context-dependent adaptation
- Vowel-inherent spectral change (VISC): characterizing vowel trajectory and primary acoustic cues to vowel identity

Conclusion

- What we learn from between-group and within-speaker variation (Public manifestation) of variable patterns
- How sound change “goes public” (Conventionalization)

English in the PNWE

- Reed (1952) noticed raising* of (æ) in HANG
- Reed (1961) reported infrequent raising of (ɛ) EGG, and (æ) BAG
- Gordon (2004) asserts that The West shows no raising for (ɛ)
- Labov, et al. (2006) “the West shows considerable mixing,” with /æɡ/ > /æd/ and /æn/ > /æɡ,æd/



*raising: lowering of F1



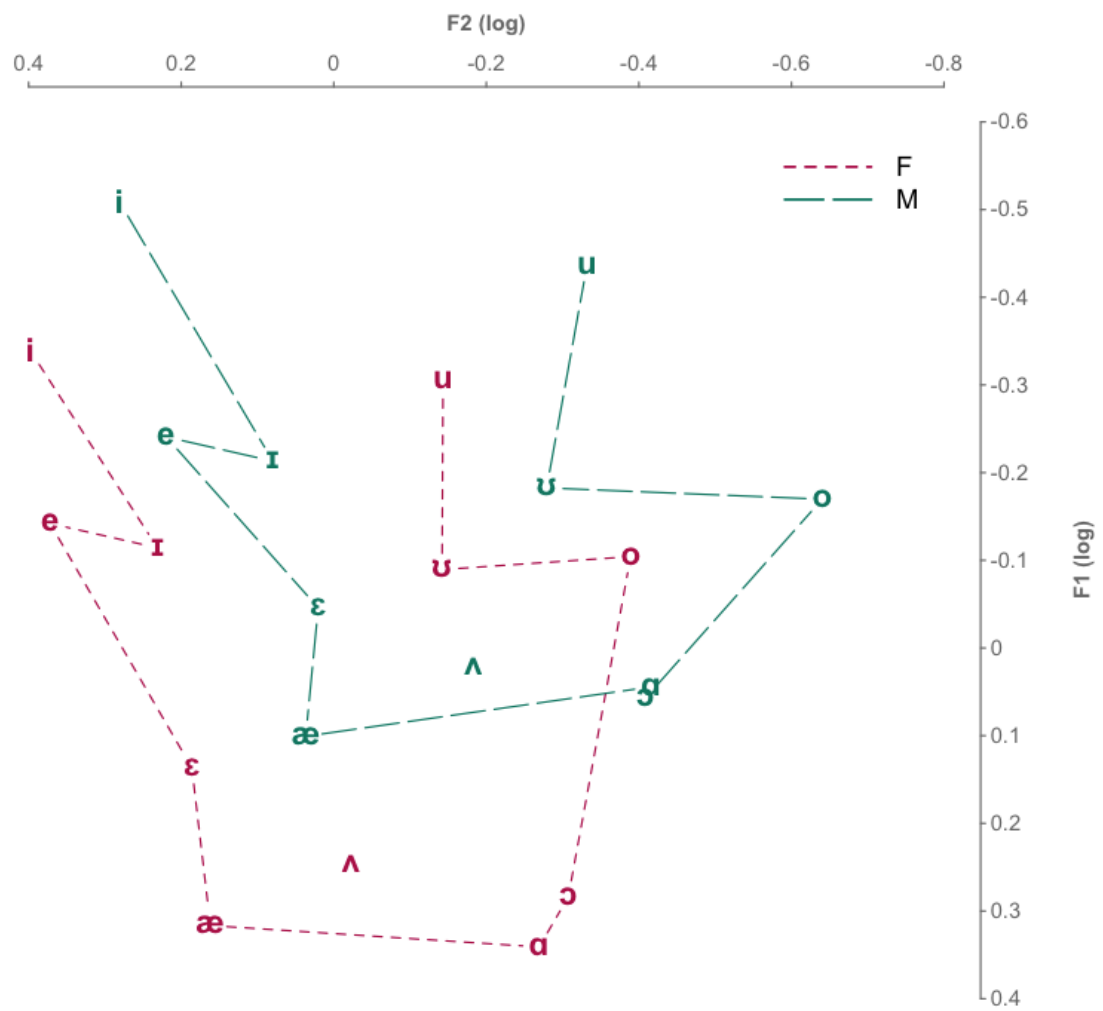
The Merger Problem

- Raising or merger? (Reed, 1961; Wassink et al., 2009; Wassink, 2014). Pre-velar raising is widespread, affects different WA communities (Riebold, 2014).
- Disruption of the symmetry of a vowel system (Martinet, 1952; Chen & Wang, 1975).
- Phonological implications of raising either (ɛ) or (æ) to (ey) may be minimal.
 - (eyg) may be susceptible to phonetic crowding: low functional load
“bagel”, “vague”, “plague”, “pagan”
 - no (æg~eyg) minimal pairs
 - but merging (æ) with (ɛ) has more significant implications
 - “bag/beg”, “lag/leg”, “rag/regular”

Method

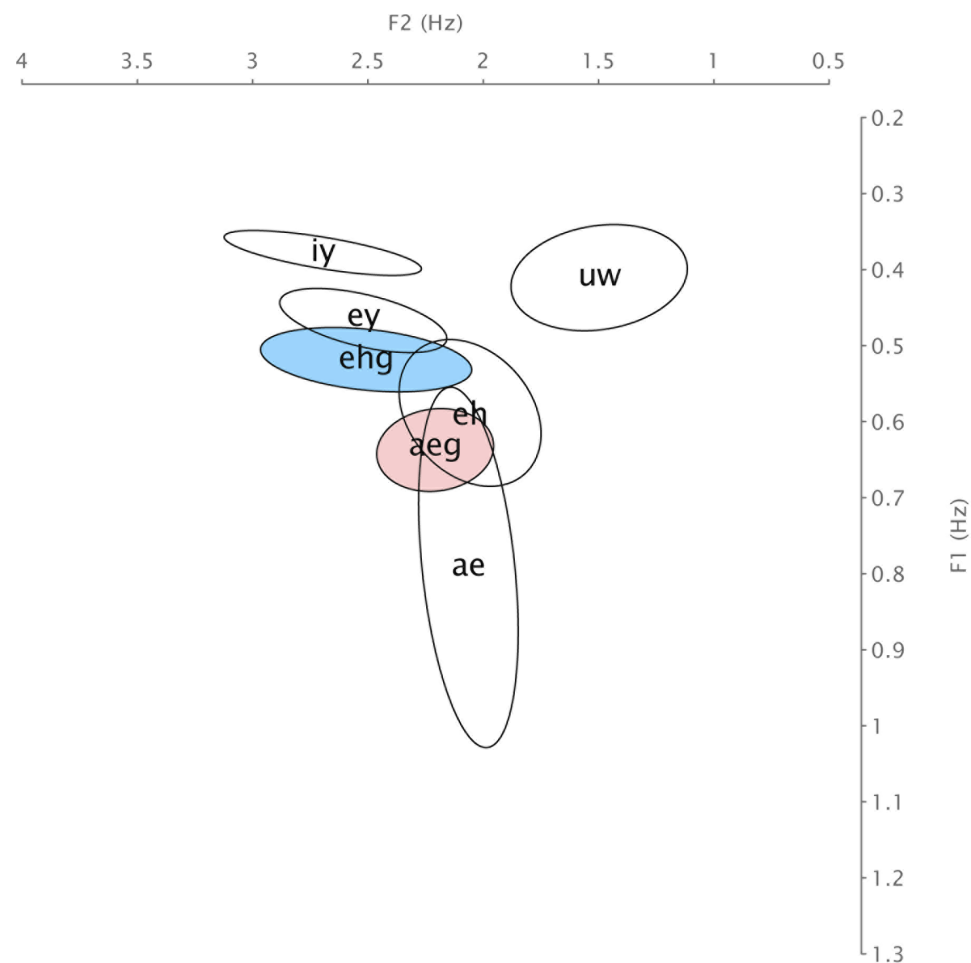
- Speakers: 25 Caucasian-Americans
- Apparent-time sample, 3 generational cohorts:
 - Generation 1: born 1900-1950 (eldest 100 y.o.a.)
 - Generation 2: born 1951-1976
 - Generation 3: born 1977-1992 (youngest 21 y.o.a.)
- Field recordings
- Words in carrier frame, “Write __ today”
- Reading Passage, adopted from Aesop’s Fables
- Token count: 14,519
- Normalization (Uniform Scaling; Nearey, 1977)

Vowels by Sex



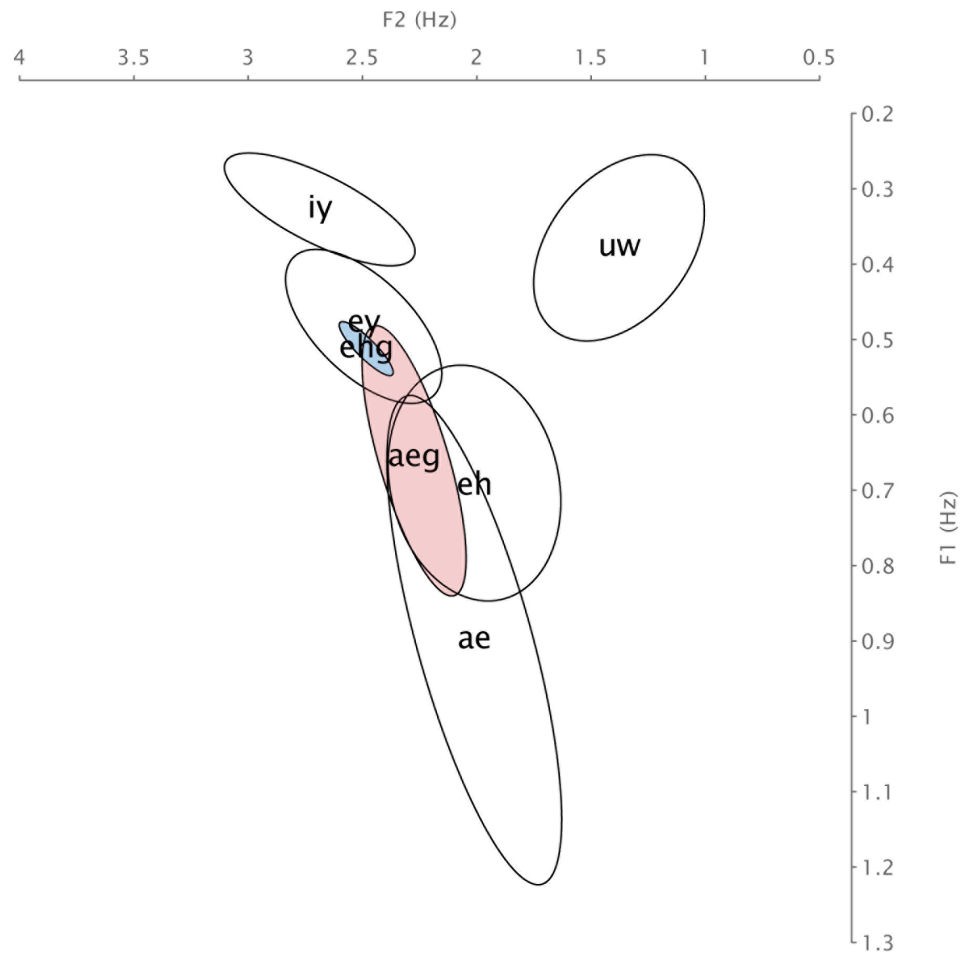
Speaker 8 (Oldest Generation Female)

- (æg) BAG tokens fall within the distribution of the larger (ε) BET class
- (εg) BEG class itself, (“ehg” in the figure) overlaps the (ey) category
- Wassink et al. (2009), Freeman (2013), Riebold (2014)



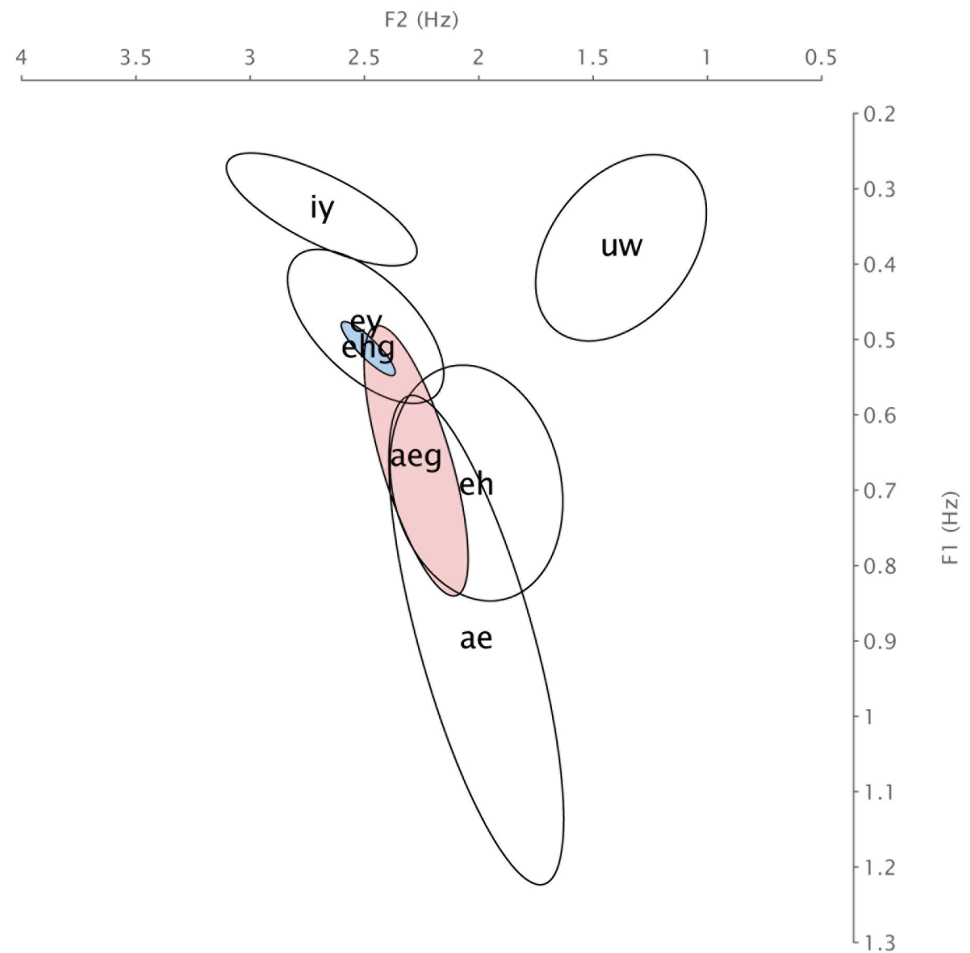
Source: Wassink, A. B. (in press) Sociolinguistic Patterns in Seattle English, *Language Variation and Change*

Speaker 1 (Middle Generation Female)



Speaker 1 (Middle Generation Female)

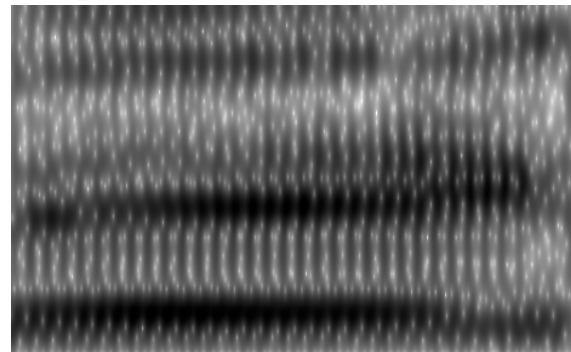
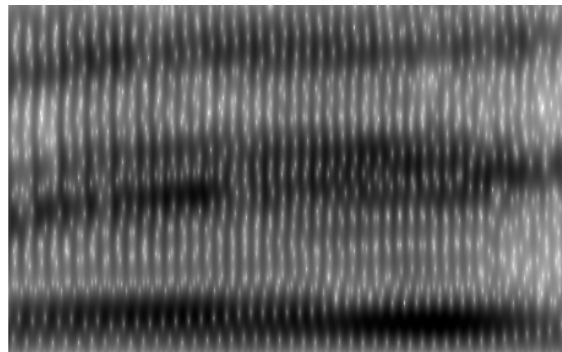
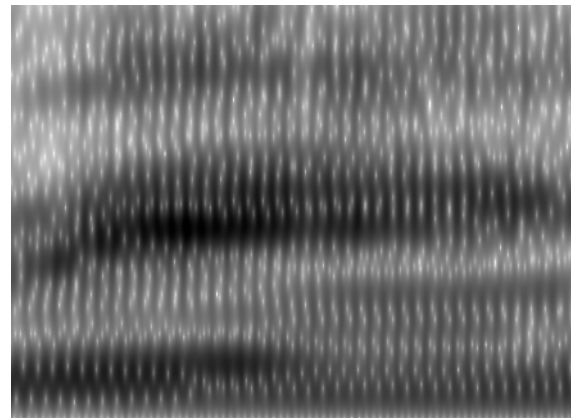
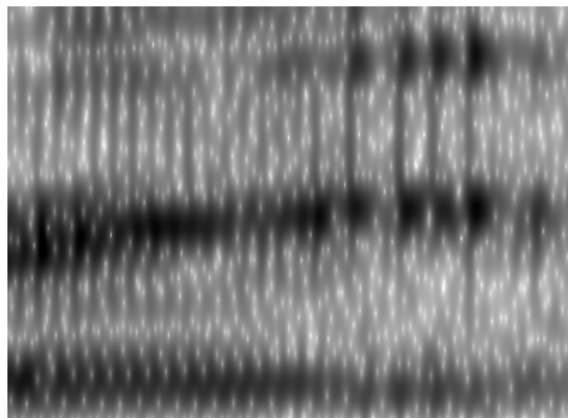
- (æg) forms show a great deal of variability, reflected in the large size of the associated ellipse



Speaker 24 (Oldest Generation Female)



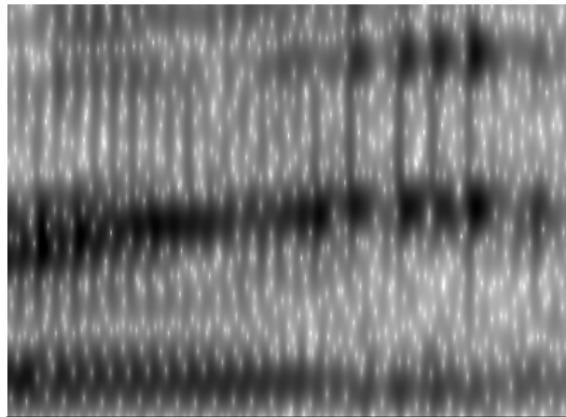
Speaker 24 (Oldest Generation Female)



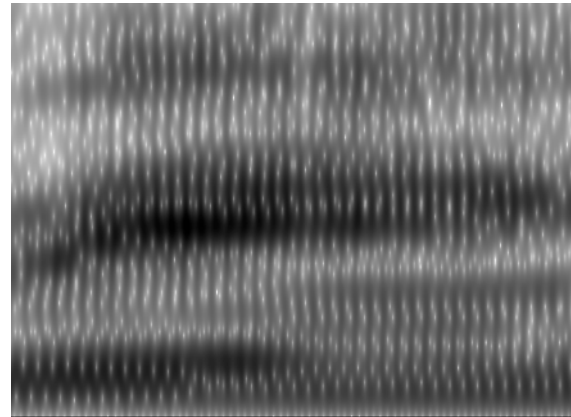
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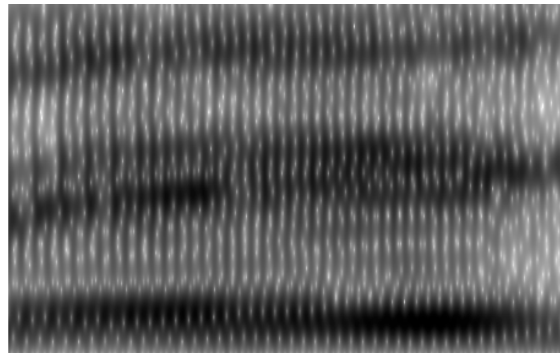
bait /eɪ/



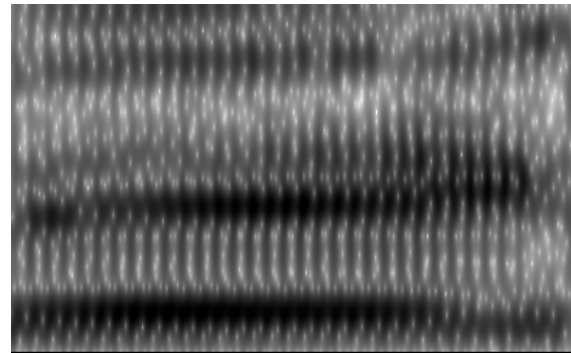
bang /æŋ/



bag /æg/



bɛg /ɛg/





How to care for your leg bag

Invariance in Phonetics

“The lack of invariance problem arises in response to the widespread recognition that there is no simple mapping between units of phonetic structure and units of acoustic structure. **A single phonetic segment is often realized by different acoustic signals and a single acoustic property may specify different consonants** in different phonetic contexts.”

Applebaum (1996:1541)

Invariance: why persist?

- Systematicity, if not invariance, is worth pursuing
- Patterns in variation exist
- These patterns are interpretable
- Great value in better understanding patterns of lawful variation
 - Synchronic questions
 - Diachronic questions

“In the discussion of a possibly invariant relation between phonetic and acoustic properties, we must bear in mind that the first question for the linguist is not one of evaluating the similarity relations among segments, but of deciding, with respect to the speech events observed in a language community, **which of them, taken pairwise, are perceived by community members to be repetitions of each other, and which are not..**”

Lisker (1985: 1199)

Roadmap

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Foundations from Sociolinguistics

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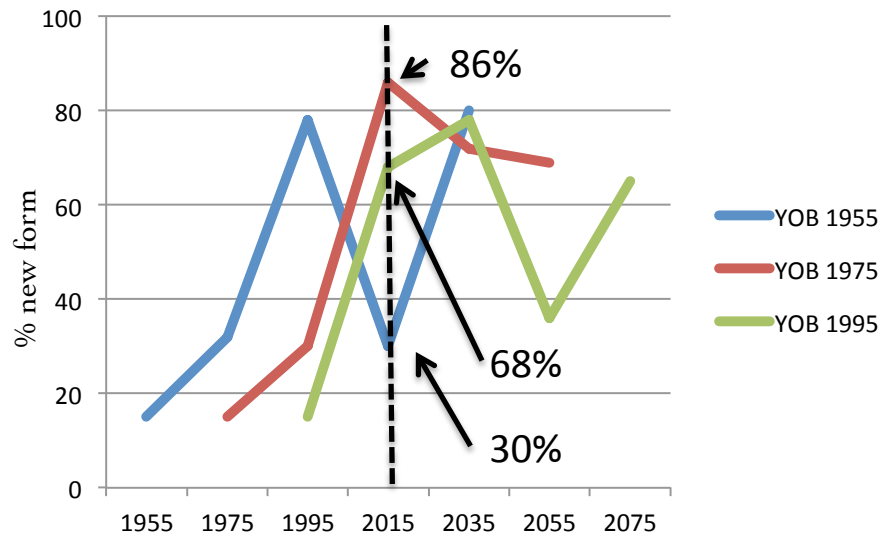
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- Coarticulation: automatic context-dependent adaptation
- Vowel-inherent spectral change (VISC): characterizing vowel trajectory and primary acoustic cues to vowel identity

Conclusion

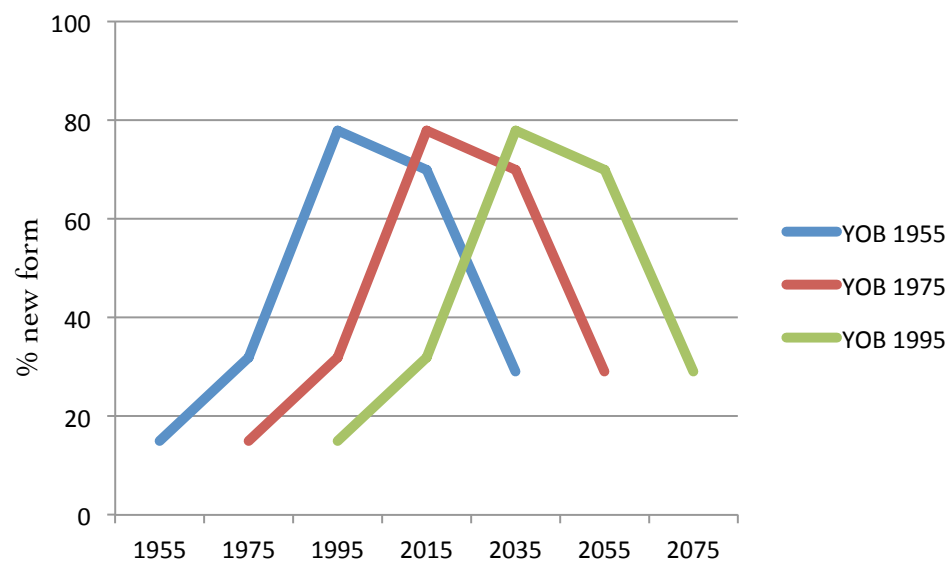
- What we learn from between-group and within-speaker variation (Public manifestation) of variable patterns
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Age-related Stratification



Random variation: no constancy in use of innovative form across cohorts. No speech community-wide language change is observed.

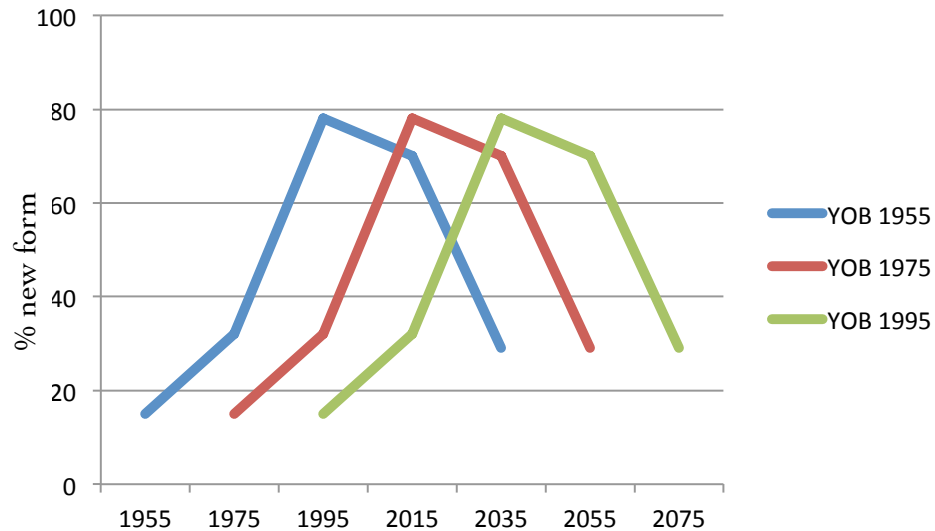
Apparent Time



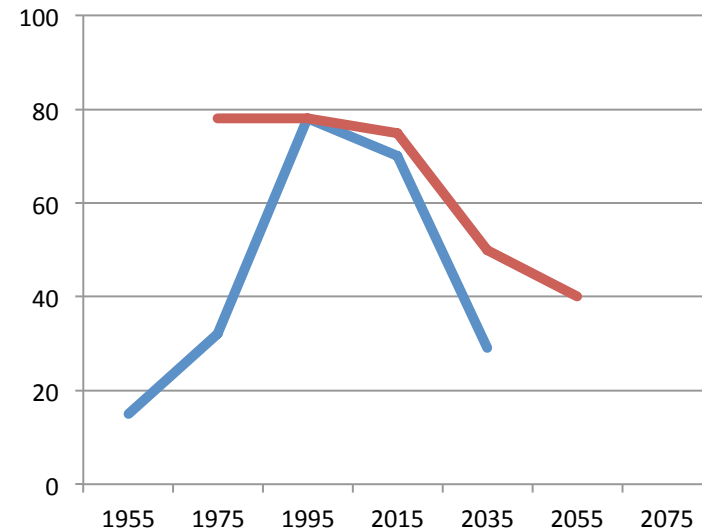
Age-grading: certain linguistic forms are more frequently used by younger speakers; speakers change their linguistic practices as they grow older, so pattern repeats in each generation.

Fluctuation across lifespan
(Sankoff & Blondeau, 2007)

Apparent Time

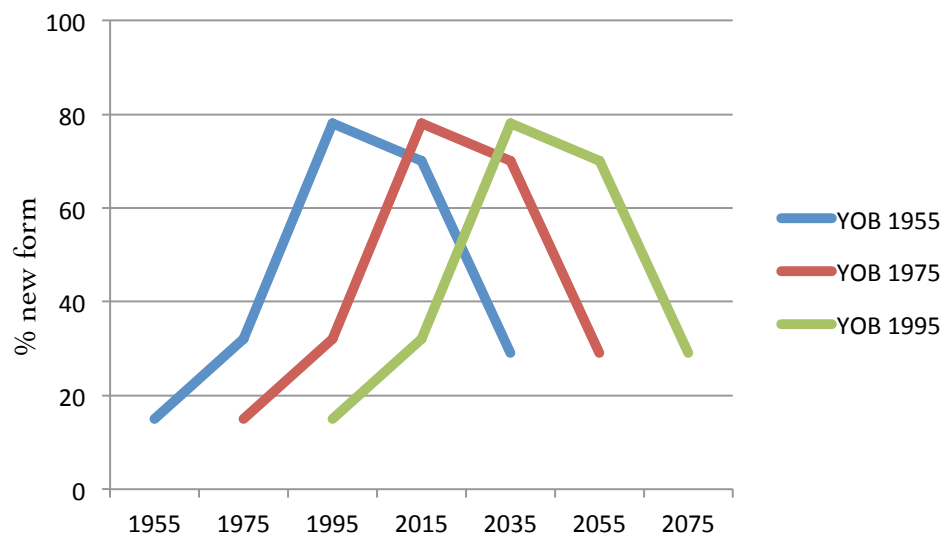


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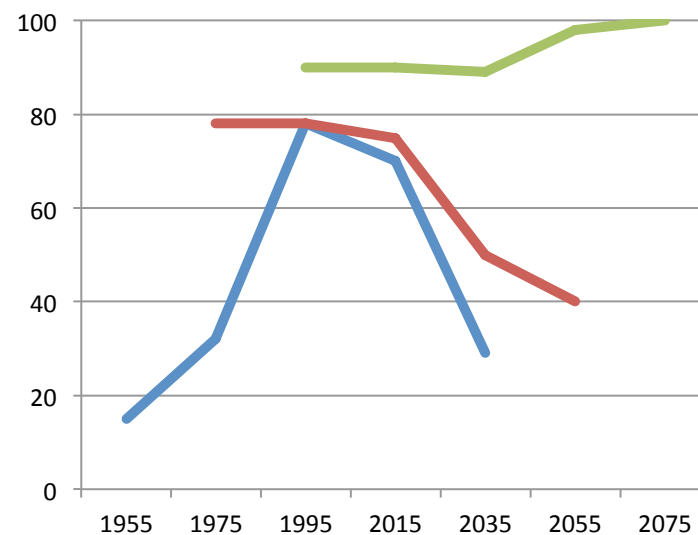


Generational Change: Change in some part of the linguistic system of a speech community over time (actual language change). Incoming variant occurs with higher frequency in younger than older, speakers.

Apparent Time



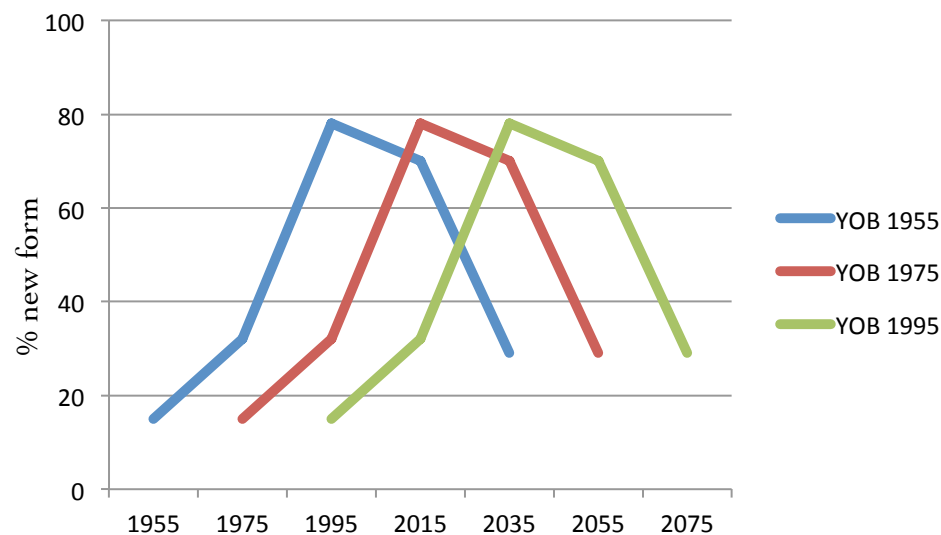
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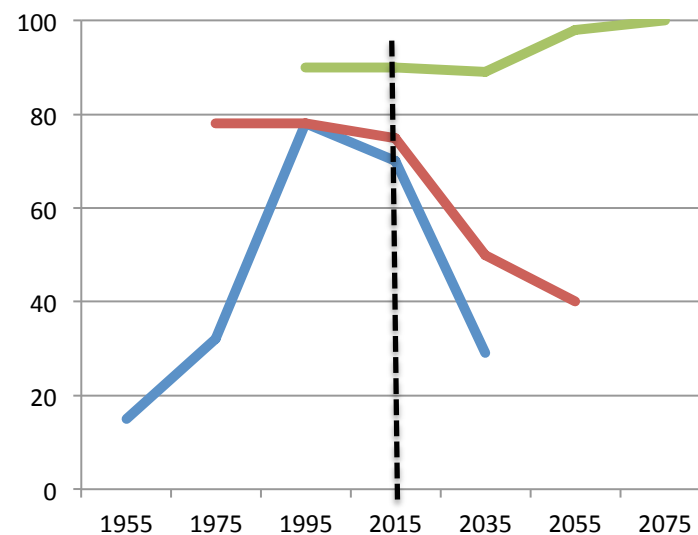
Generational Change: Change in some part of the linguistic system of a speech community over time (actual language change). Incoming variant occurs with higher frequency in younger than older speakers.

Real-time data: Same study respondents and successive points in time (Trudgill, 1988). Data collection can be prohibitive (time, cost, physiological aging, \$\$)

Apparent Time



Age-grading: certain linguistic forms are more frequently used by younger speakers; speakers change their linguistic practices as they grow older, so pattern repeats in each generation.



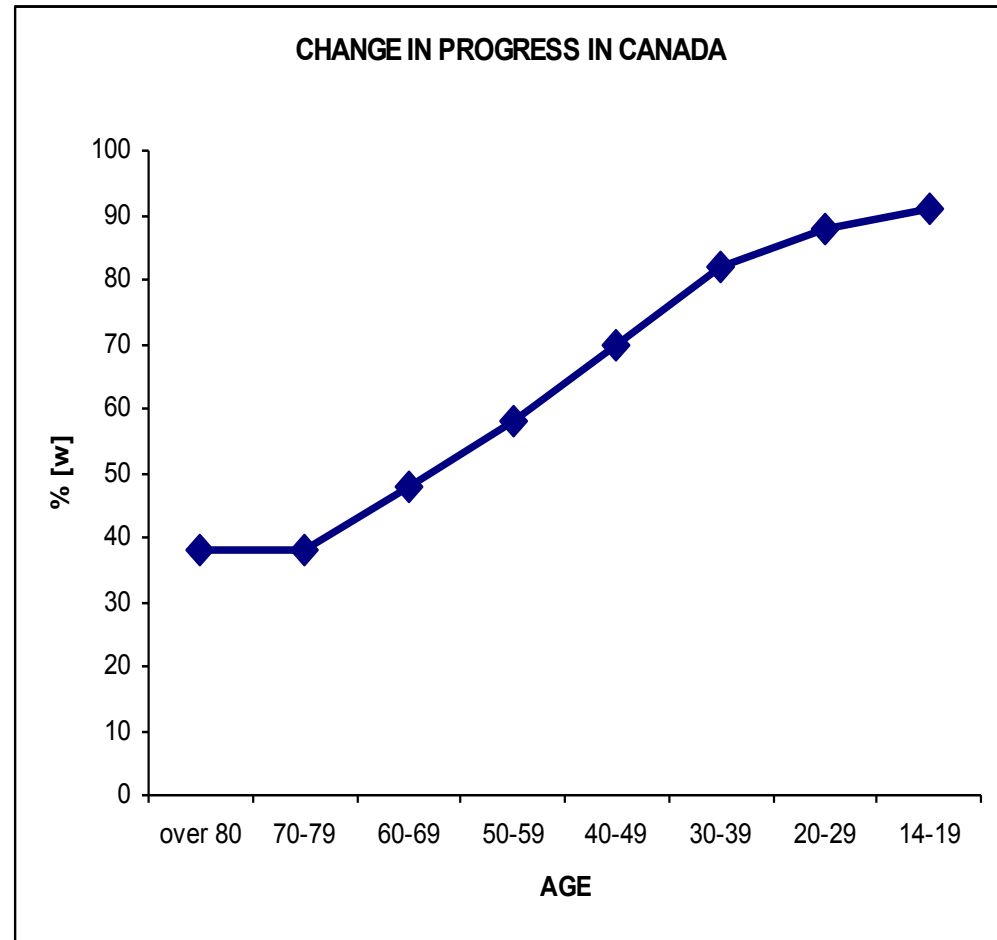
Generational Change: Change in some part of the linguistic system of a speech community over time.

Incoming variant occurs with greater frequency in younger than older, speakers

Apparent-time data: cross section of population--change is inferred rather than observed

Conventionalization

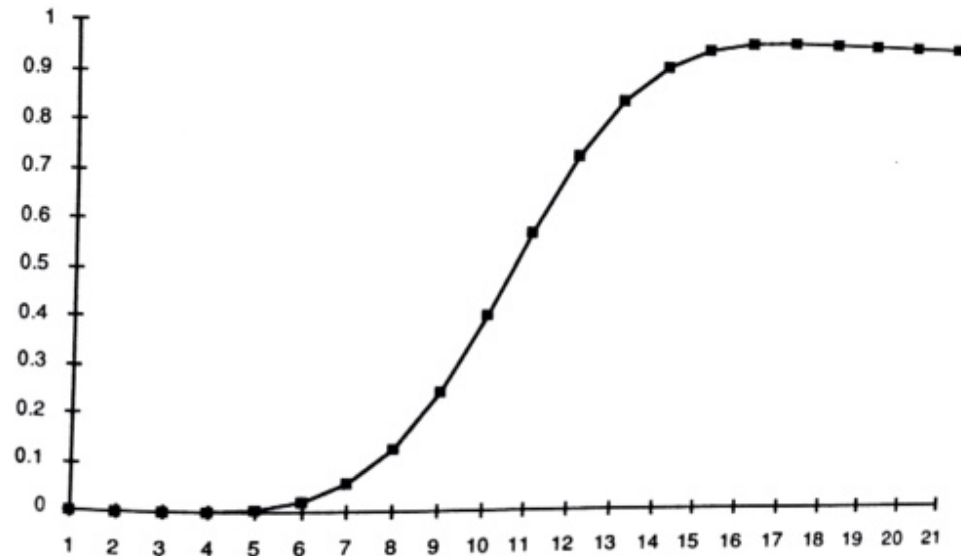
- Do not infer from individual frequencies
- **Conventionalization:** Community-wide stabilization following a typically *non-linear* pattern of generational change, establishing a new community vernacular



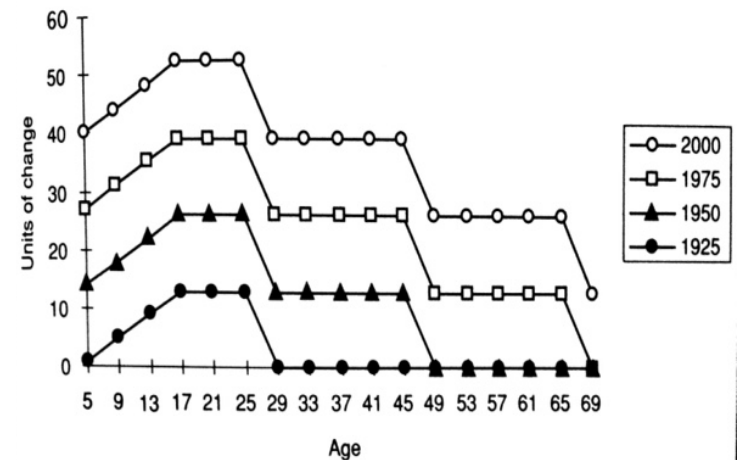
source: Chambers (1998), *Social Embedding of Changes in Progress*

Conventionalization

- Some level of prevalence is achieved
- But, variability likely remains, preventing 100% saturation (marking between-group and stylistic projection)
- **Incrementation** – “the mechanism by which changes advance in a step-by-step pattern in the individual.” (Labov, 2001:447-465)




Labov, W. (1994:65) *Principles of Linguistic Change: Internal Factors*



Labov, W. (2001:454) *Principles of Linguistic Change: Social Factors*

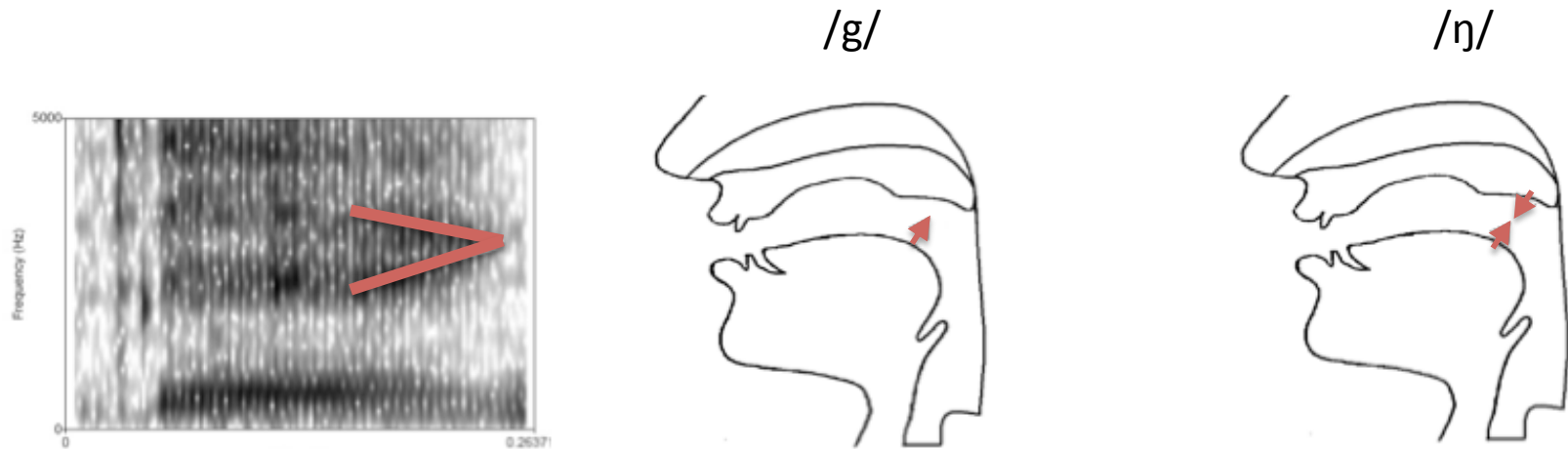
Roadmap

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 - (æɛɹ) in PNWE: from imperceptible universal to dialect marker
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 - **Coarticulation: automatic context-dependent adaptation**
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- 
- **Coarticulation:** “the influence of one speech segment upon another, that is the influence of a phonetic context upon a given segment.”

(Daniloff and Hammarberg, 1973)

Phonetic Foundations: Velar Pinch



Acoustic outcome of an adaptive articulatory configuration.

English, Tlingit, Dutch, Spanish (Fant, 1960).

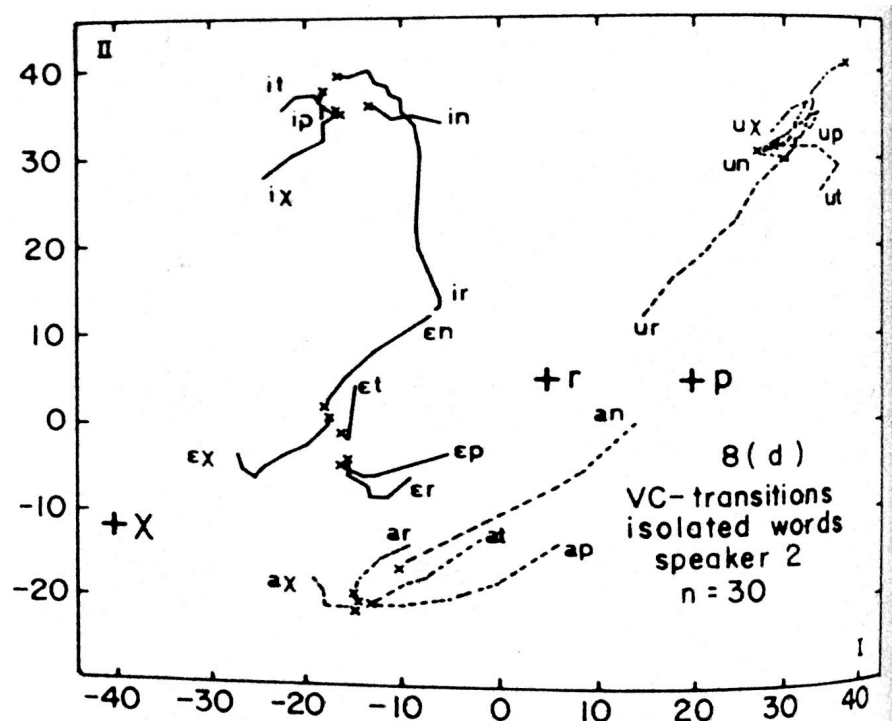
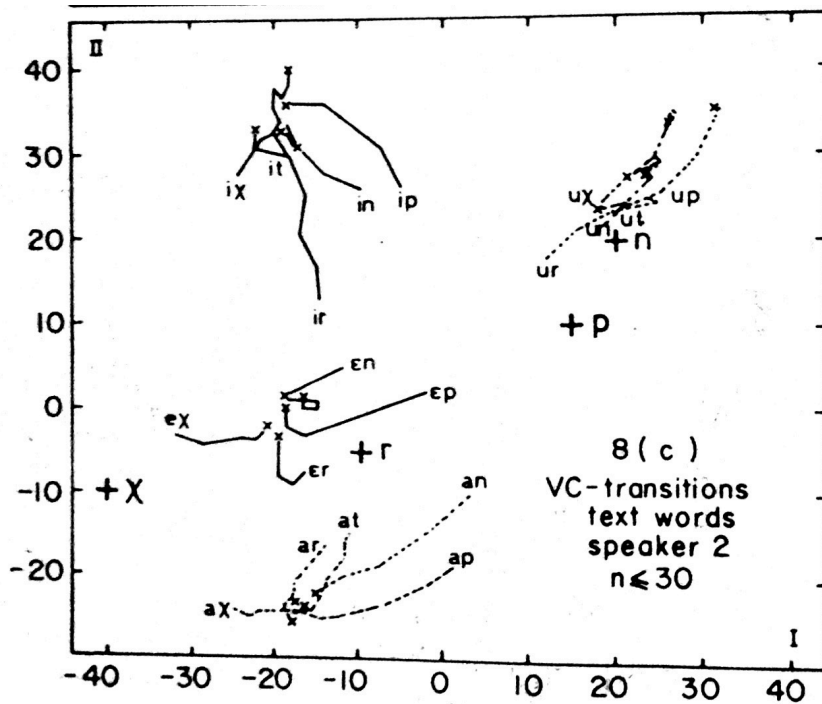
Acoustic record: Visible in transition from V to C, F2 approximates F3.

Articulatory mechanism: the tongue dorsum rises, and the velum lowers.

Low vowel raising may occur (Stevens, 2000:367).

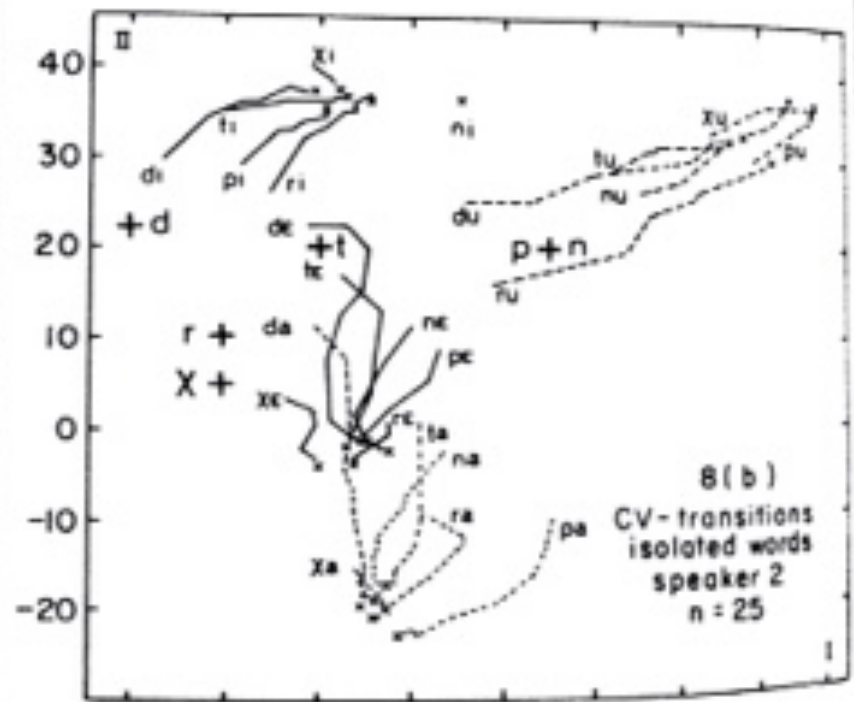
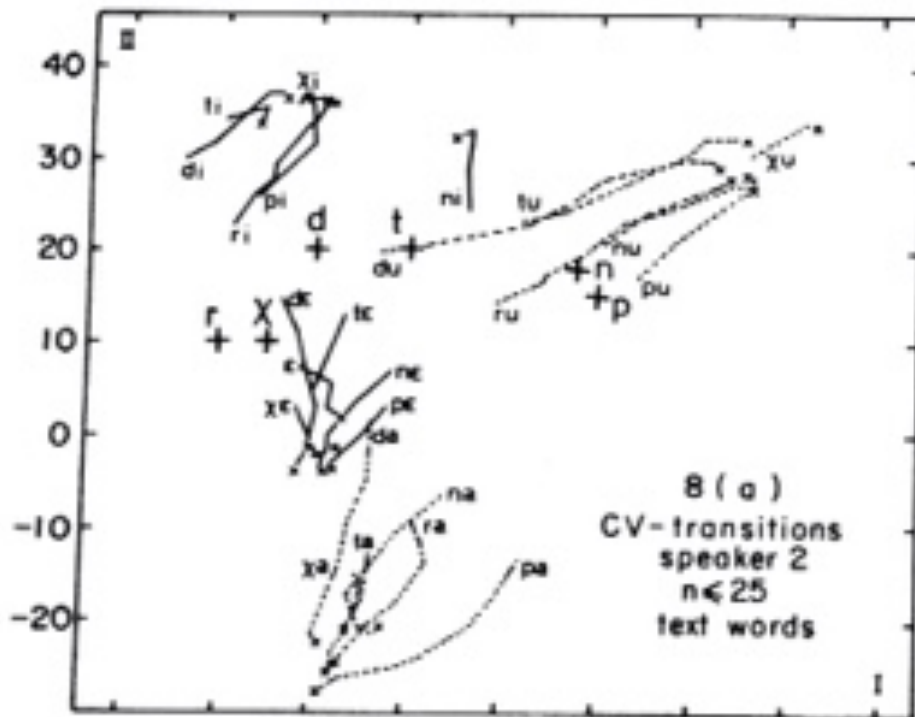
Auditory percept: diphthongization possible (dynamic trajectory).

source: Baker et al. (2008)



- Monophthongs do not appear monophthongal
- However, “every CVC word can be described as a trace in the vowel space from an initial-consonant locus, via a vowel area to a final consonant locus”
- Coarticulatory effects are quite regular
- Velars tend to raise F2
- General agreement between reading and word tasks

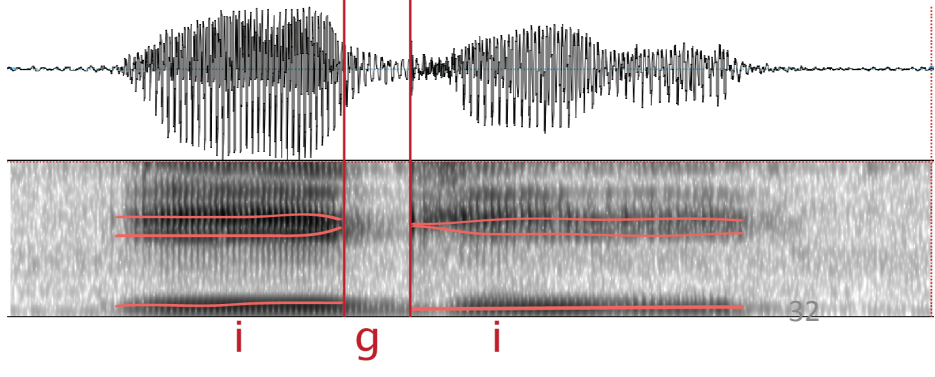
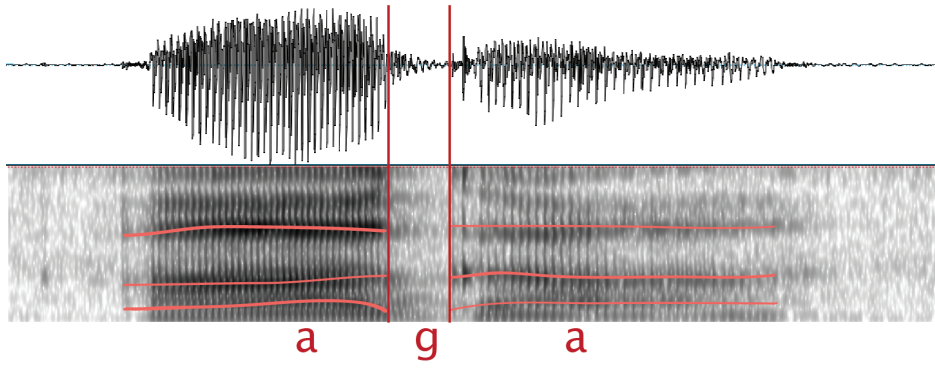
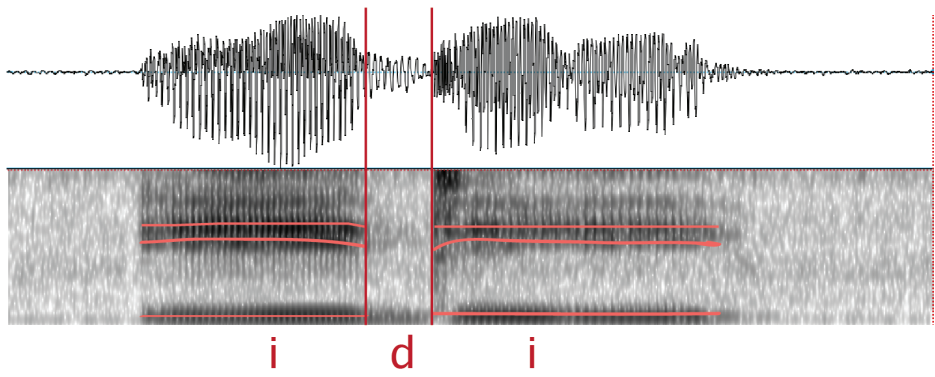
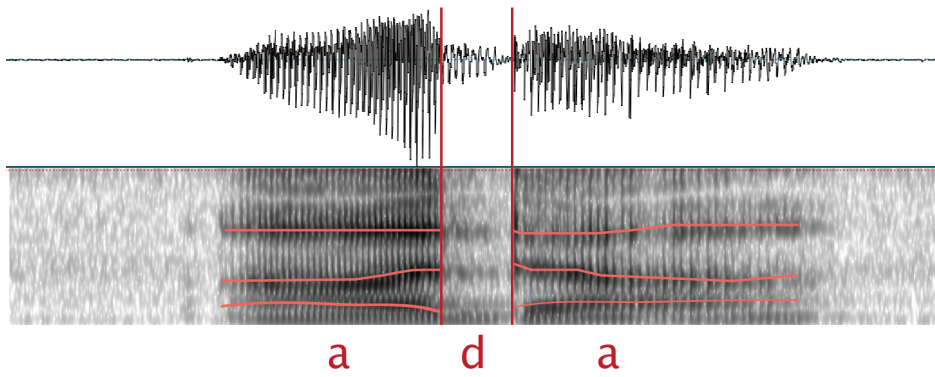
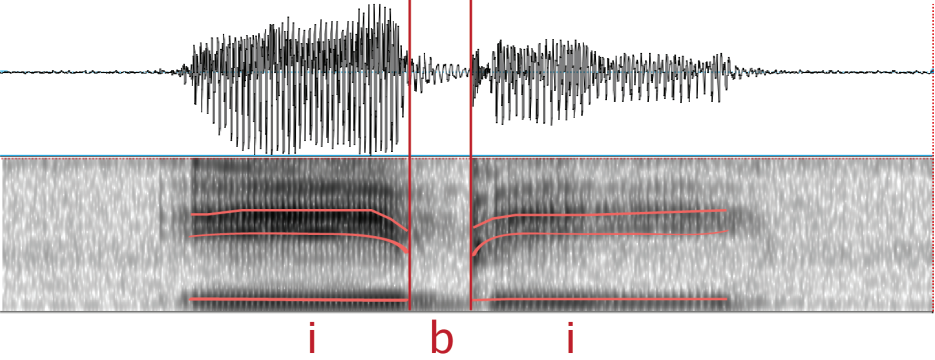
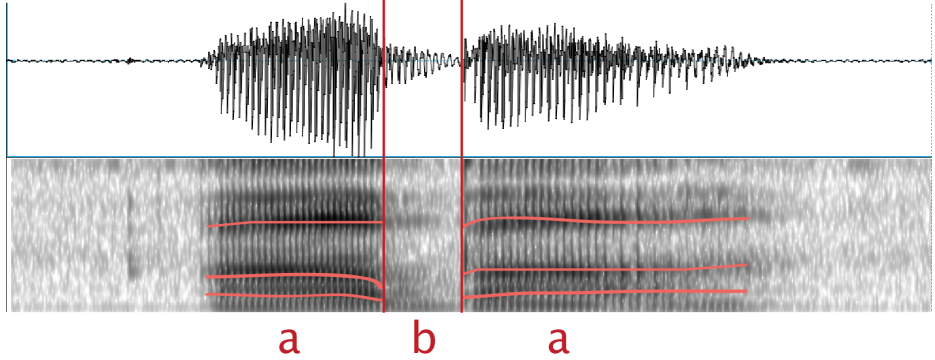
source: M.E.H. Schouten and Pols, L. (1979) “A spectral study of Coarticulation —Part I”, *Journal of Phonetics* (7)1: 1-23



- Finals (VC) more variable than initials (CV)
- (Hammarberg, 1976; Farnetani, 1997; Fletcher & Harrington 1999; Recasens, 1999)
- Broad and Clermont (1987) some success describing classes of contours for CVs and VCs

source: M.E.H. Schouten and Pols, L. (1979) "A spectral study of Coarticulation —Part I", *Journal of Phonetics* (7)1: 1-23

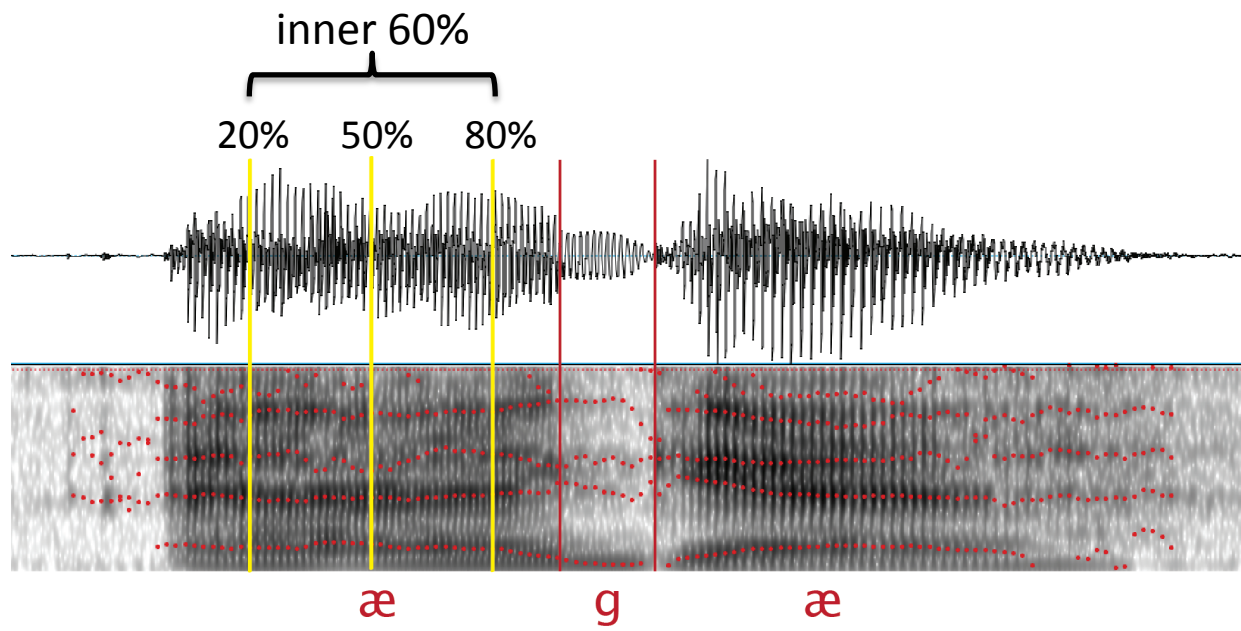
VC Coarticulatory Patterns

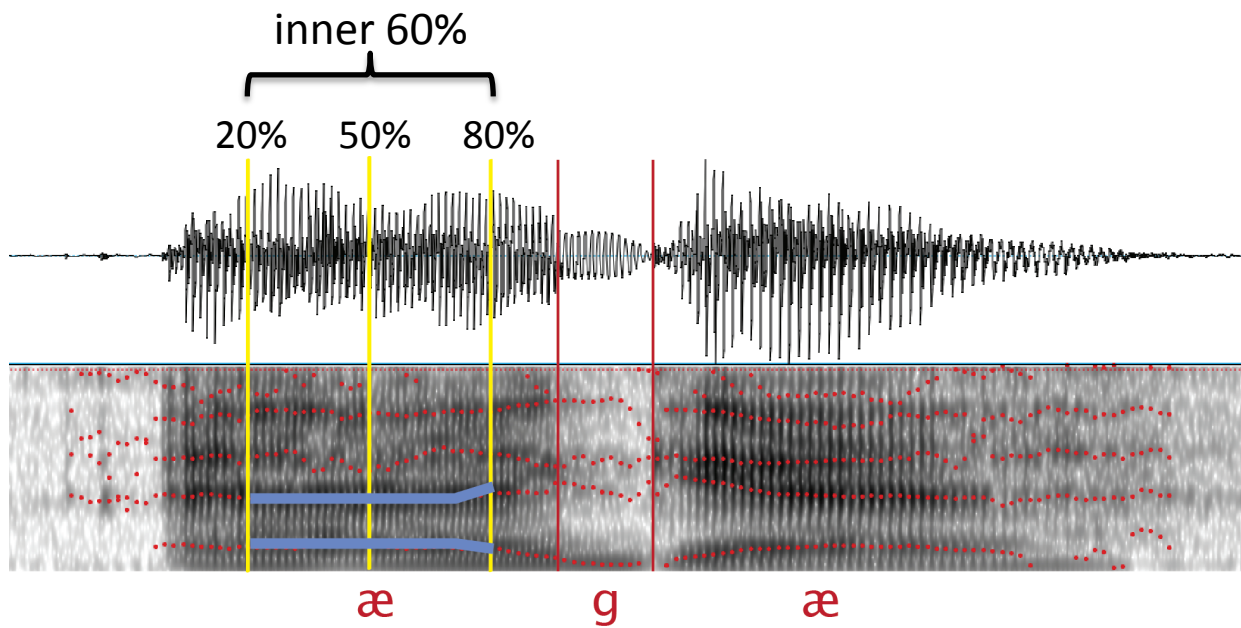


Coarticulation: Hypothesis

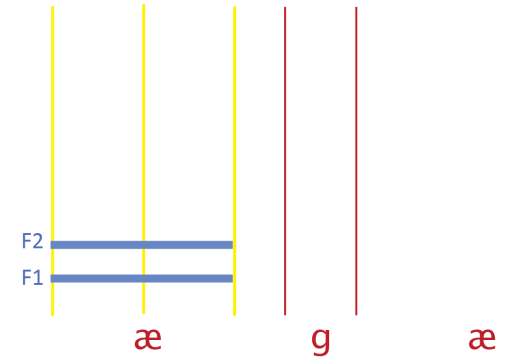
As PNWE (æg)-raising advances, /æ/ breaks free of context-dependent coarticulatory conditioning

- Raising is not limited to the (hyper)raising environment
- (æ) is becoming phonetically reanalyzed as a raised vowel (in some cases, with a front offglide)

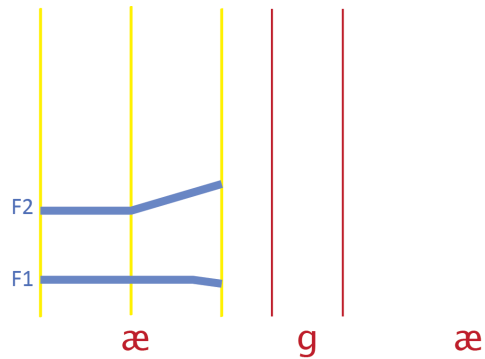




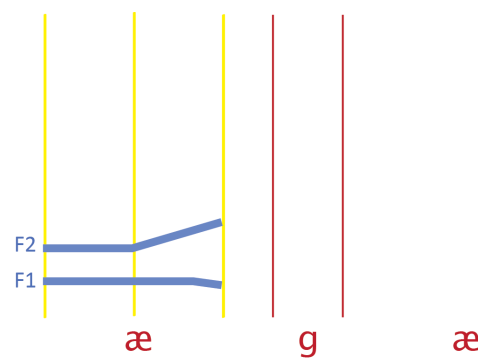
(1) canonical AmE unraised + steady-state



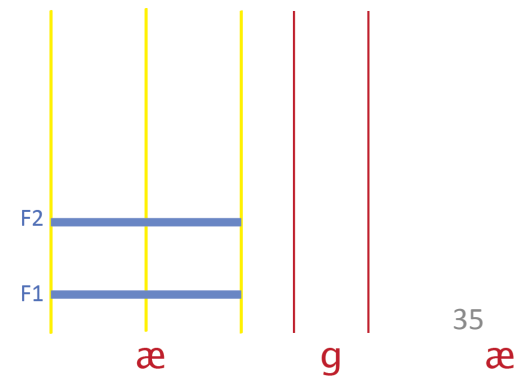
(4) raised + sloping

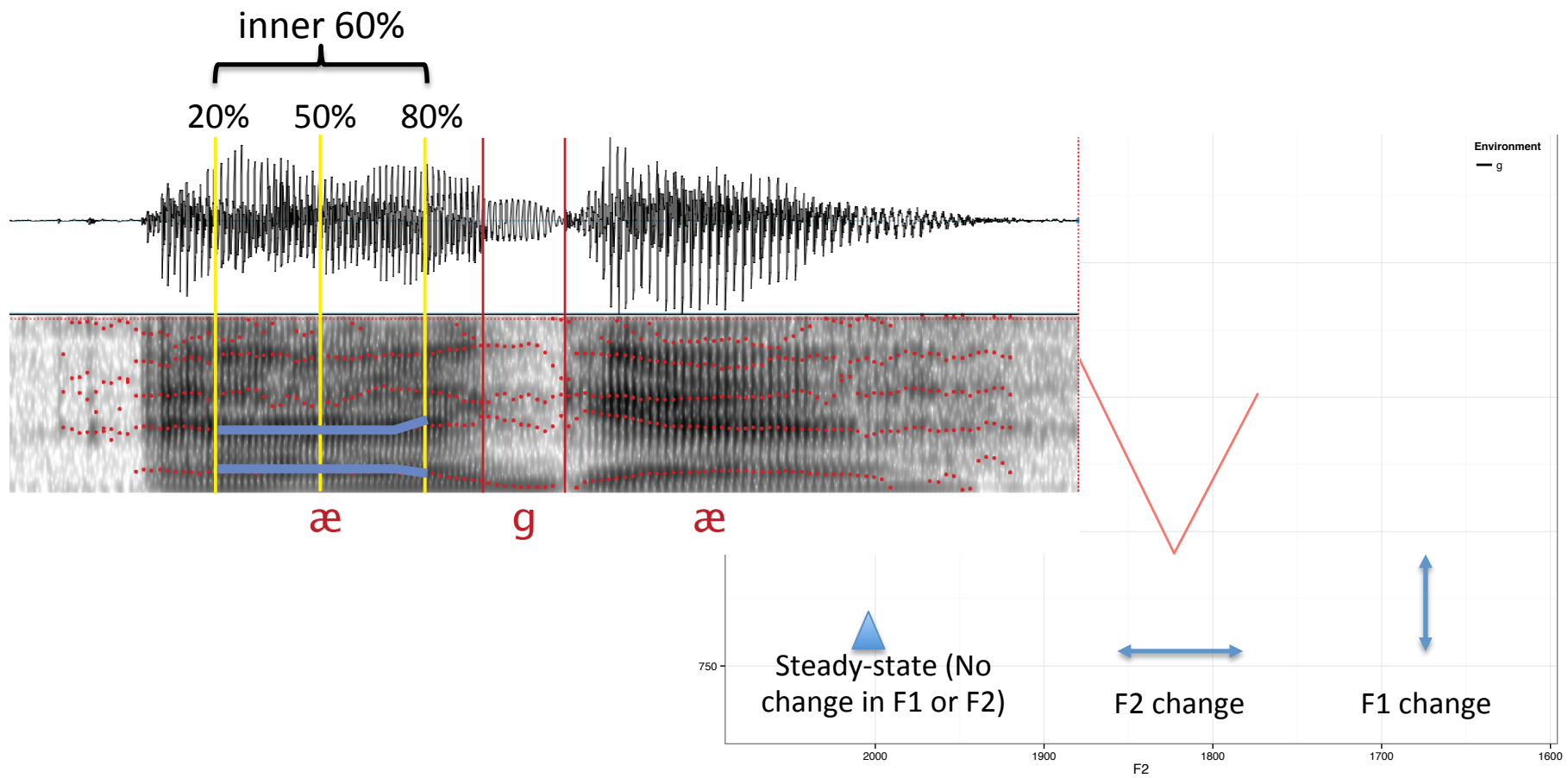


(3) unraised + sloping



(2) raised + steady-state





Vowel-inherent spectral change (VISC)

“Vowel-inherent spectral change refers to the relatively slowly varying changes in formant frequencies associated with vowels themselves, even in the absence of consonantal context.”

Nearey and Assmann (1986:1297)

- *Vowel dynamics*. Changes across the duration of the vowel, perhaps particularly at transitions such as vowel offset, serve as an important perceptual cue for listener perceptions (Nearey & Assmann, 1986; Morrison & Nearey, 2007)
- Listeners do not merely attend to a single point in time to determine vowel identity (Kleunder, Diehl & Wright, 1988; Beddor, 2012)
- “steady-states” excised from their transitions can successfully cue vowel identity (Strange, Jenkins & Johnson, 1983)
- Conversely, setting a “steady-state” in an unexpected context can lead to listener misidentifications (Nearey & Assmann, 1986)

Quantification of VISC

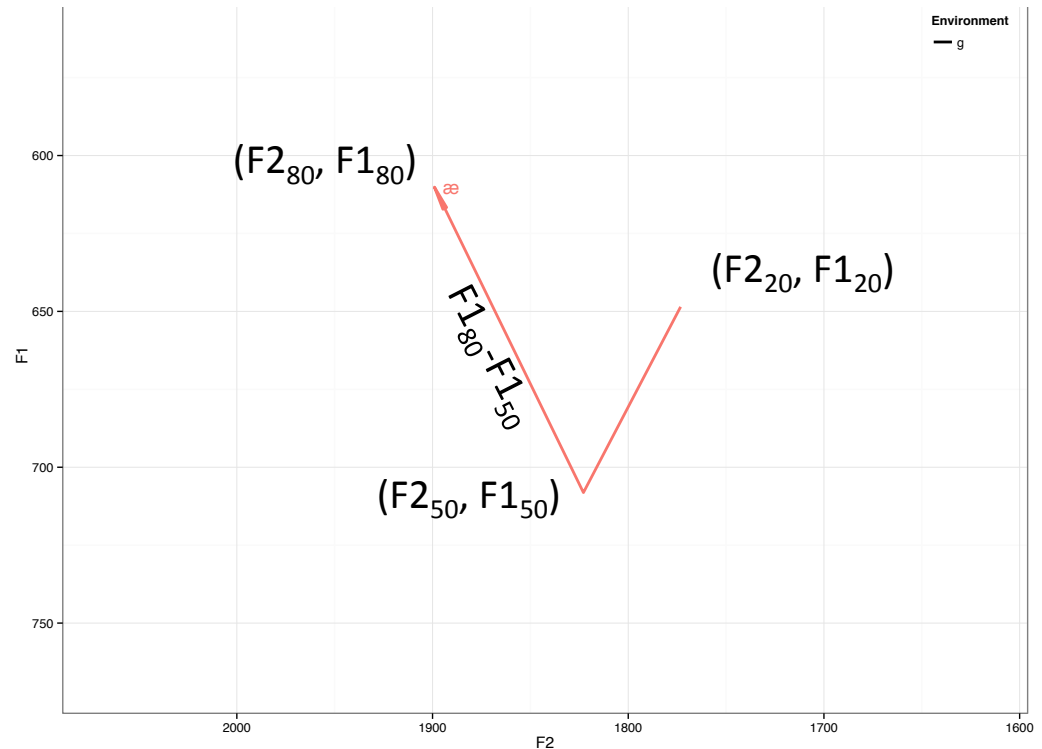
1. Change in F1 or F2 alone

$$\Delta F1_n = F1_{n+1} - F1_n$$

2. Onset + Slope *

3. Onset + Direction

4. Trajectory Length †



Nearey & Assmann (1986) "Modeling the role of inherent spectral change in vowel identification"

Jacewicz & Fox (2013) "Cross-Dialectal Differences in Dynamic Formant Patterns in American English Vowels"

Quantification of VISC

1. Change in F1 or F2 alone

2. Onset + Slope *

$$S1 = \frac{\Delta F1}{\Delta t}$$

$$S2 = \frac{\Delta F2}{\Delta t}$$

3. Onset + Direction *

4. Trajectory Length †



$$c = \sqrt{(\Delta F1)^2 + (\Delta F2)^2}$$

Nearey & Assmann (1986) "Modeling the role of inherent spectral change in vowel identification"

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Quantification of VISC

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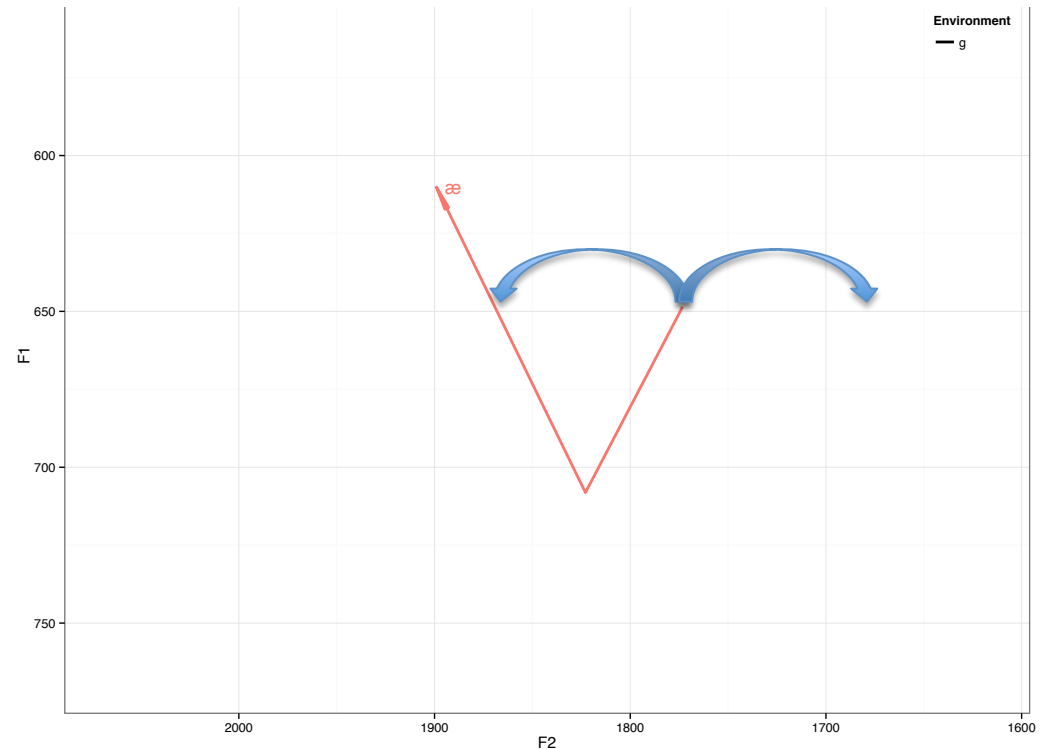
3. Onset + Direction *

$$C1 = \frac{\Delta F1}{L}$$

$$C2 = \frac{\Delta F2}{L}$$

$$L = [(\Delta F1)^2 + (\Delta F2)^2]^{1/2}$$

4. Trajectory Length †



Nearey & Assmann (1986) "Modeling the role of inherent spectral change in vowel identification"

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Quantification of VISC

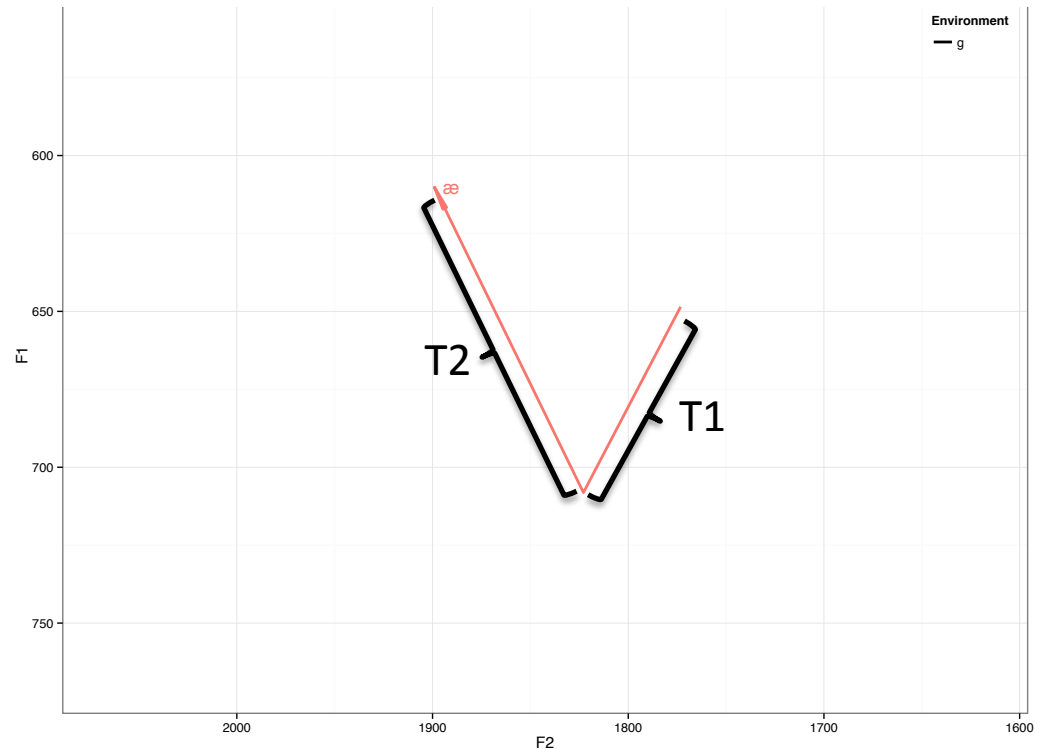
1. Change in F1 or F2 alone

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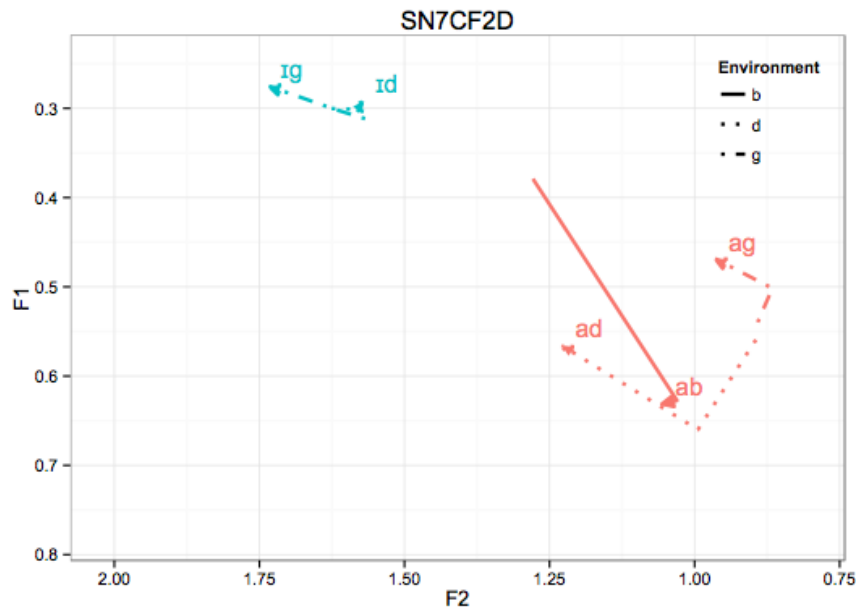
4. Trajectory Length †

$$TL = \sqrt{(F180 - F150)^2 + (F280 - F250)^2} + \sqrt{(F150 - F120)^2 + (F250 - F220)^2}$$

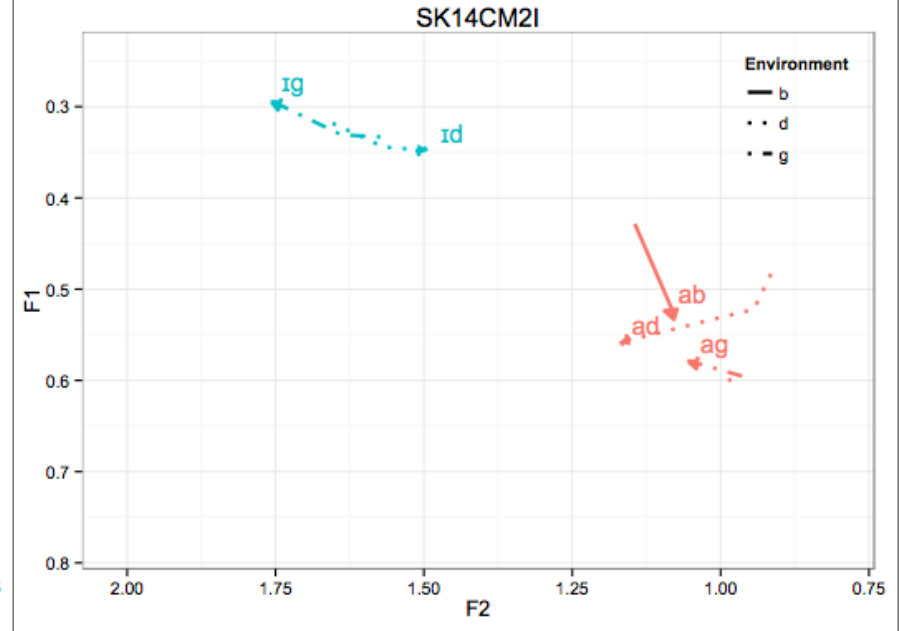


Typical coarticulatory effects in stable Vs /ɪ, ʌ/

Female

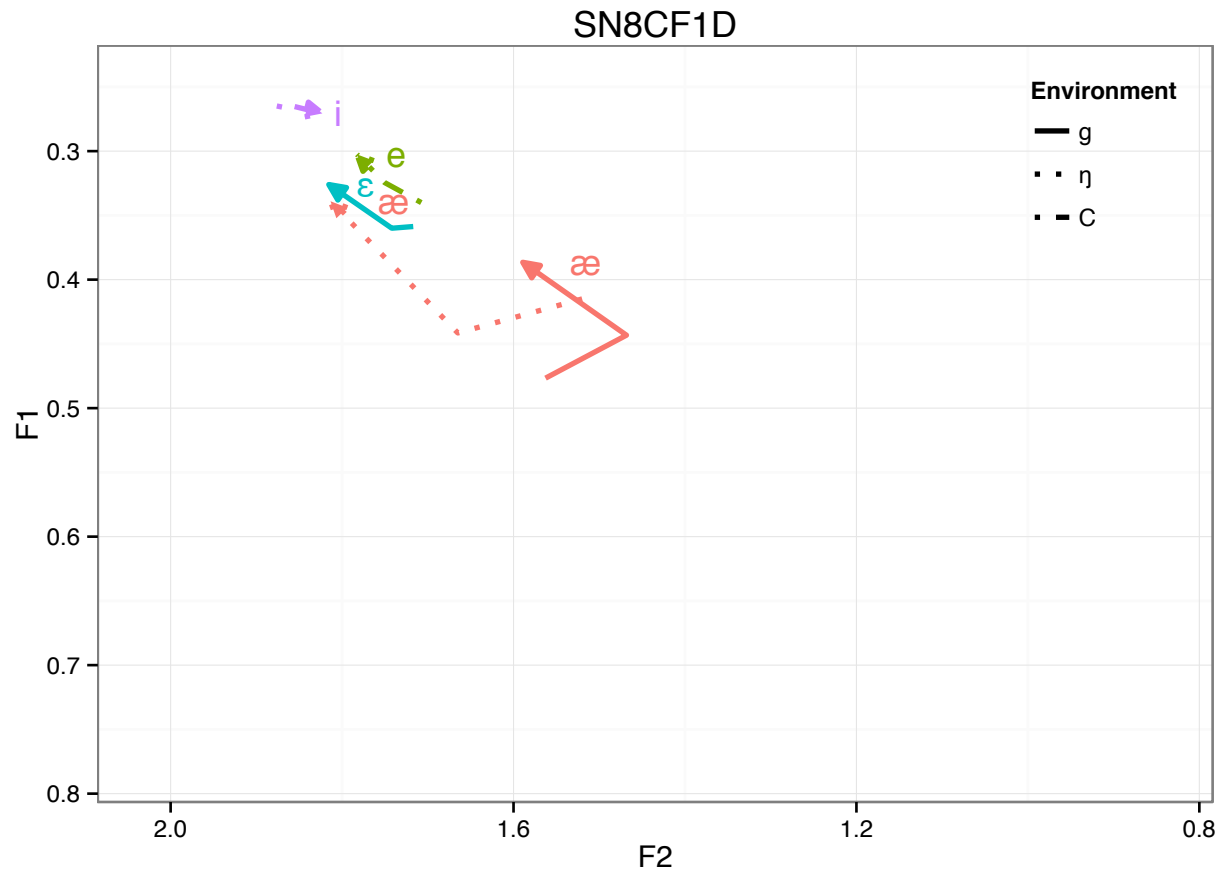


Male



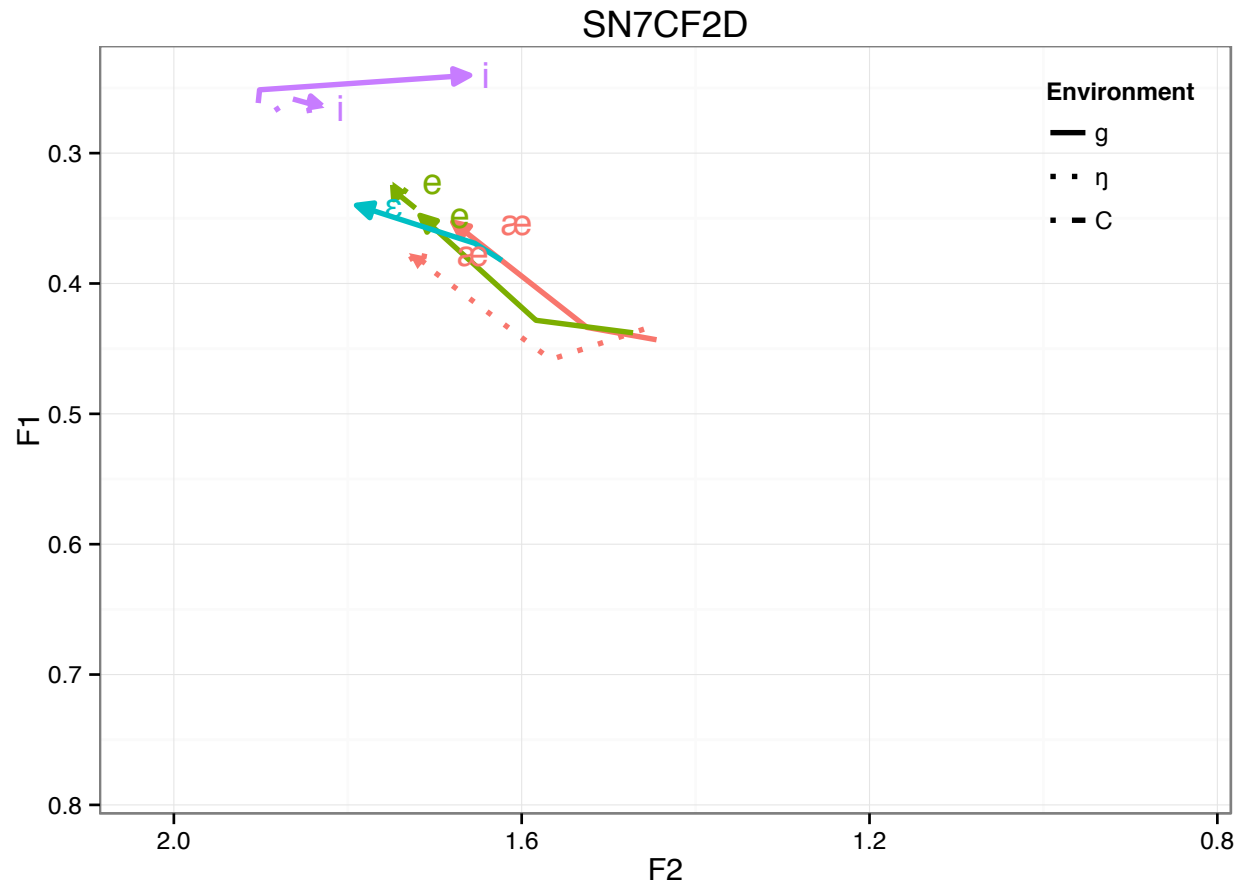
Variation is lawful. Pre-labial trajectories show characteristic lowering. Alveolar trajectories show a characteristic fronting. Velar trajectories (both /ɪ, ʌ/) raise and front. Note that for the female speaker, some raising in prevelar /a/ is observed, but vector is short.

Oldest Generation (Speaker 8, Female)



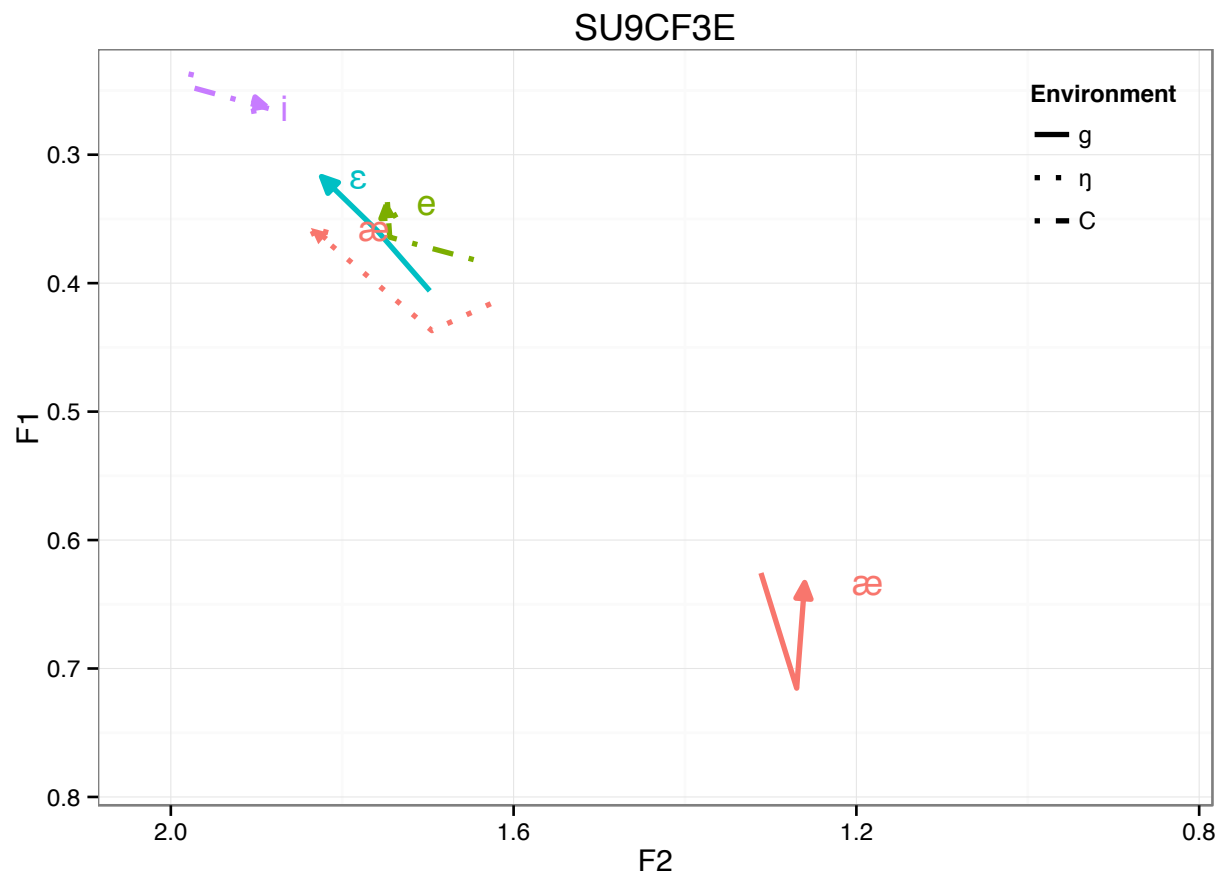
- (æg)-raising already evident in Gen1
- /η/ is hyperraising environment, but NOT for all speakers

Middle Generation: (Speaker 7, Female)



- late trajectory tends to be longer, indicating Gen 2 utilization of fronting with raising (slope of F2/F1)

Youngest Generation (Speaker 30, Female)



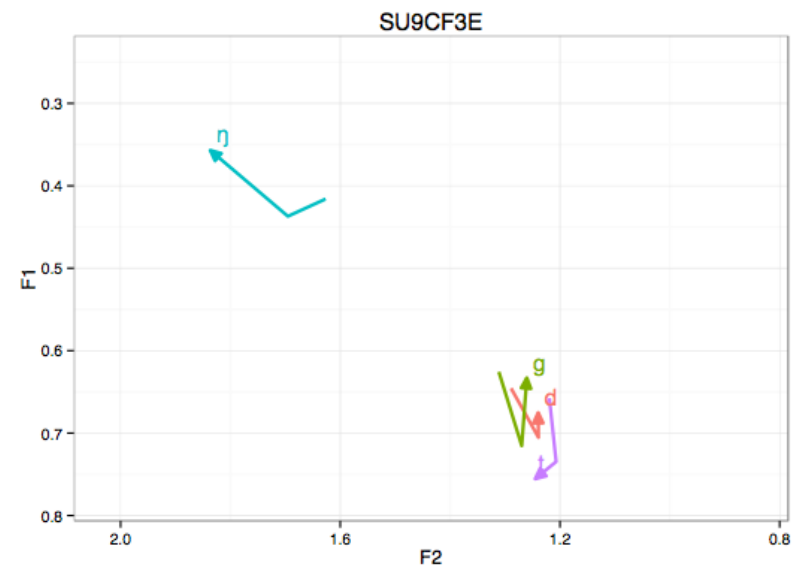
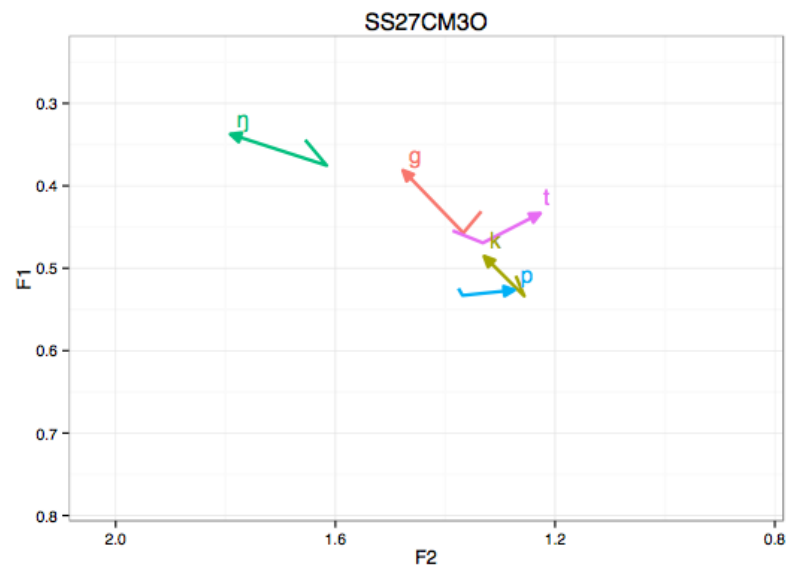
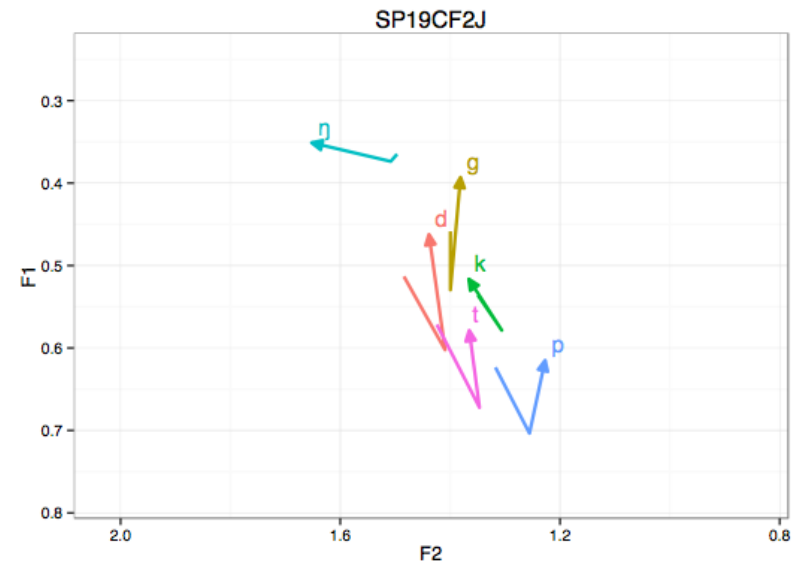
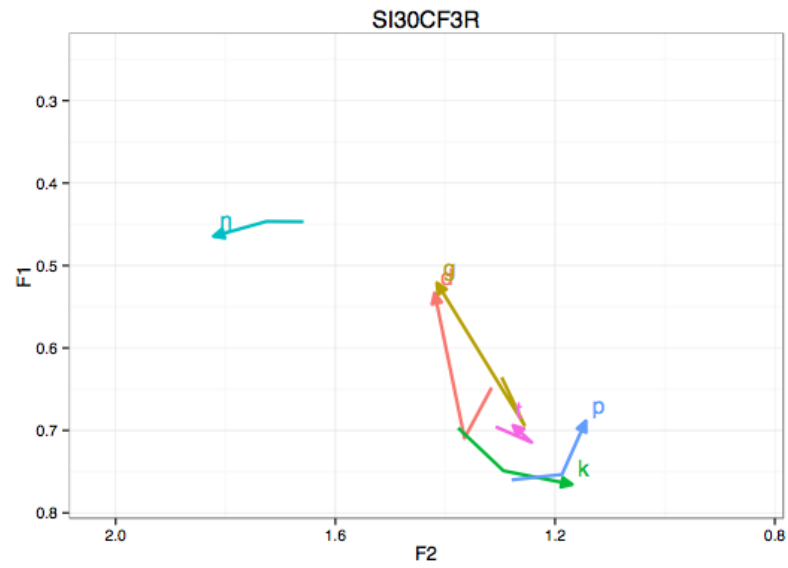
- late trajectory tends to be longer, indicating Gen 3 also utilizing fronting with raising (slope of F2/F1)
- raising is variable. Hypercorrection possible.

Principal Components Analysis /æ/

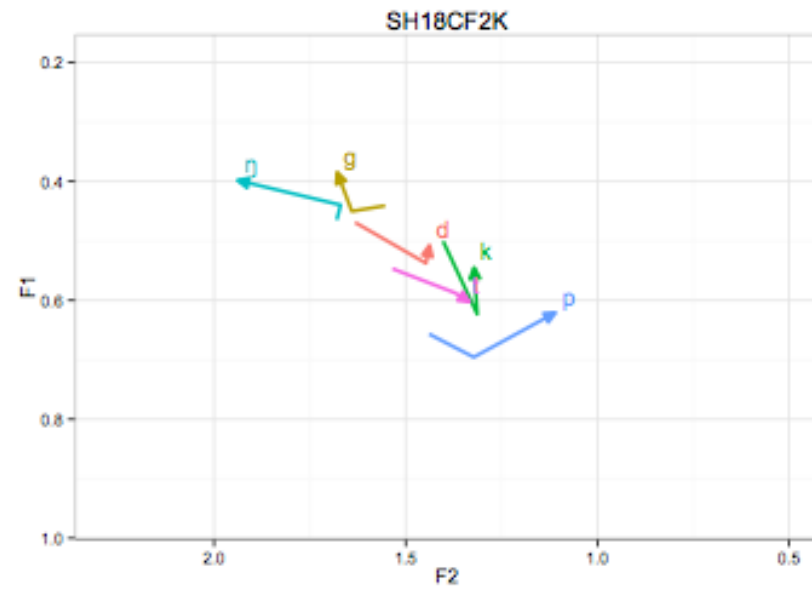
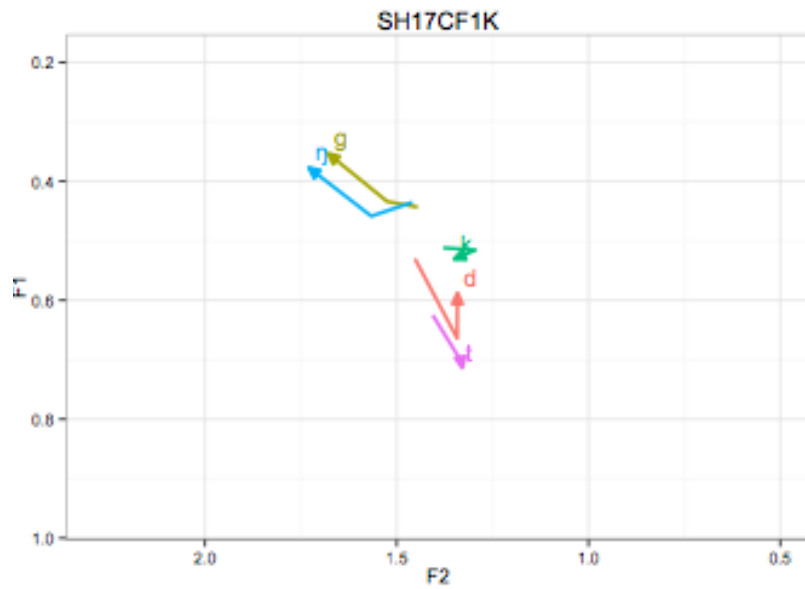
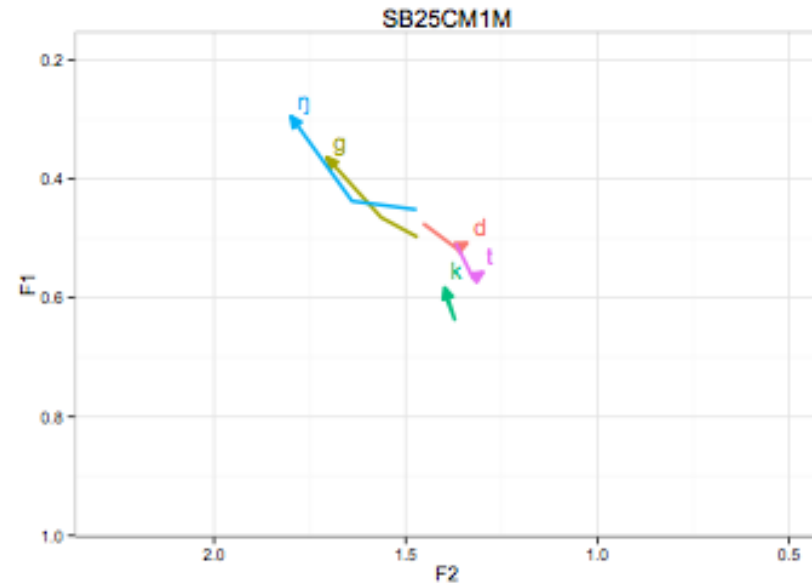
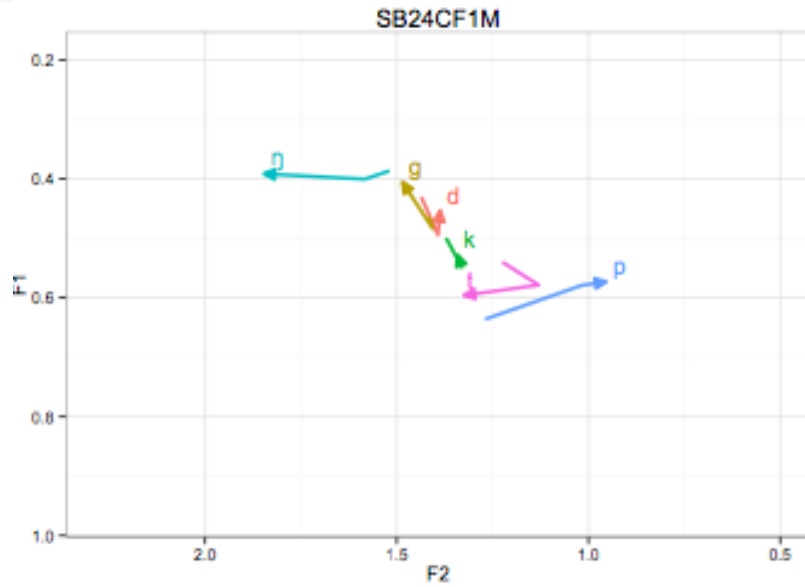
Pearson correlations between variables and synthetic factors

	F1	F2	F3	F4	F5
Generation	-0.295	0.757	0.289	-0.487	-0.132
FollowingPhone	0.875	0.167	0.052	-0.224	0.391
Nearey2*F150	-0.870	0.370	-0.099	0.097	0.162
OverallΔF1	-0.906	0.240	-0.107	0.198	0.153
OverallΔF2	0.942	0.269	-0.125	0.066	-0.078
Direction	0.190	0.149	0.894	0.376	0.017
TL	0.495	0.675	-0.394	0.368	-0.064

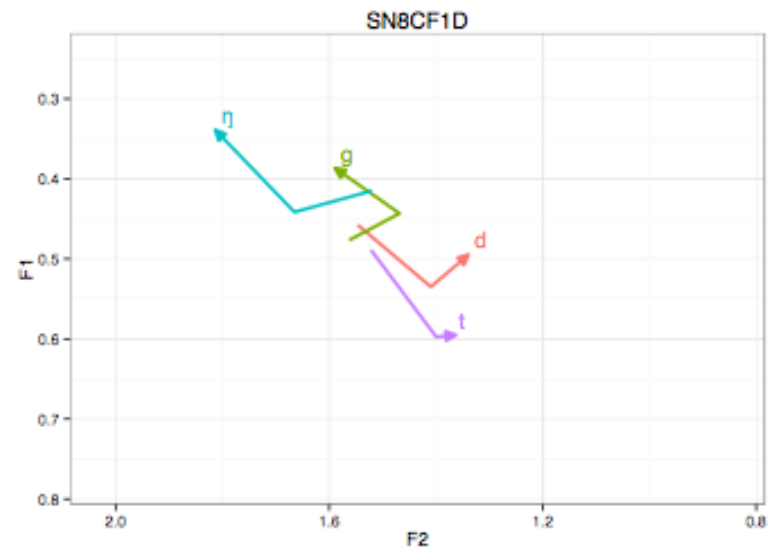
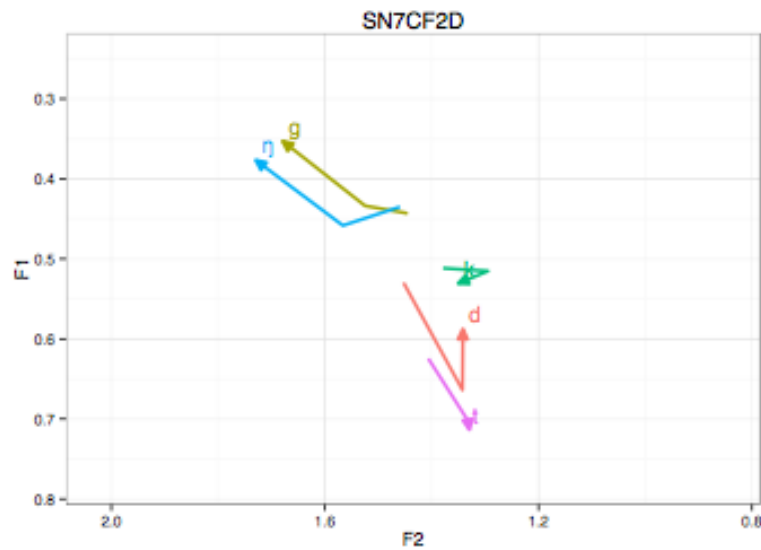
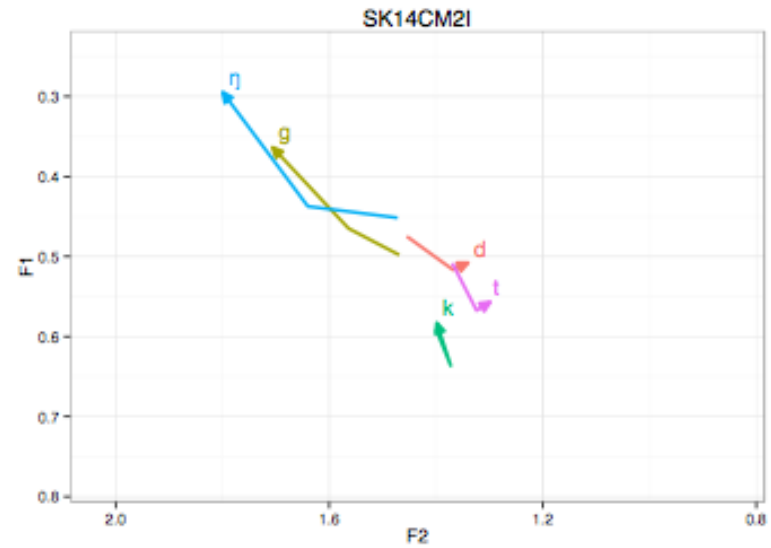
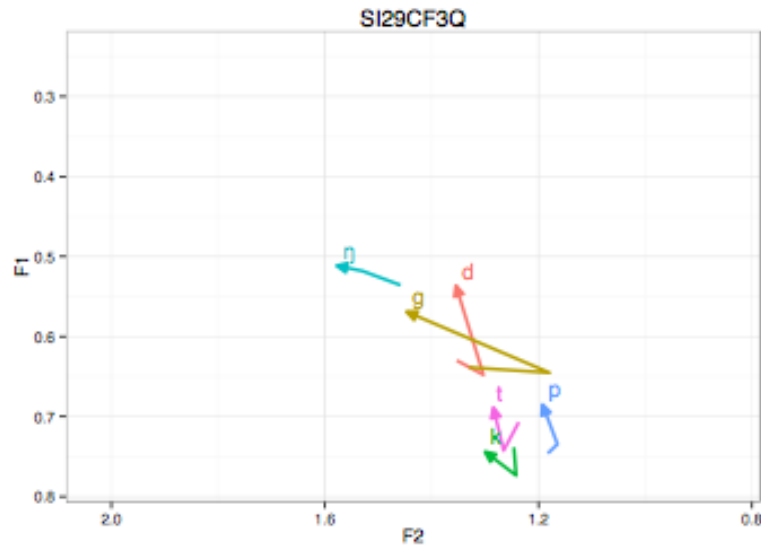
PCA Cluster 1: F1/F2/Following Phone Strategy



PCA Cluster 2: Trajectory Length Strategy



PCA Cluster 3: Onset + Direction Strategy



Generational strategies

		Gen 1 (n=9)	Gen 2 (n=11)	Gen 3 (n=5)	
Unraised + Monophthongal		11%	27%	60%	*
Unraised + Sloping:	F1	0%	0%	0%	
	F2	33%	18%	0%	
Raised + Monophthongal		0%	0%	0%	
Raised + Sloping:	F1	11%	0	0%	
	F2	44%	55%	40%	

*F1 of (ey) lower than average F1

Coarticulation and Sound Change

T1:

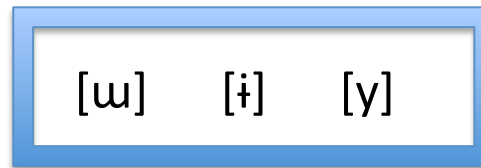
/u/



Production:

/u/ + /t/

Percept:



T2:

/ʊ/
reanalysis
Or
/u/

Ohala (1981, 2003)

Coarticulation and Sound Change

T1:

/u/



Production:

/u/ + /t/

Percept:



Production:

[ʊ] [ʊ] [ʊ] [y]
[ʊ] [ʊ] [ʊ] [ʊ]



T2:

/ʊ/

Beddor (2009, 2012)

Perception of PNWE (æg)

T1:

/æ/



Production:

/æ/ + /g,ŋ/

Percept:

ISOLATION		
[æ]	0%	
[ɛ]	71%	
[ei]	21%	

BIGRAM		
[æ]	77%	
[ɛ]	8%	
[ei]	8%	



Production:

[ɛ] [ɛ] [ɛ] [ɛ] [ɛ] [ei] [ɛ] [ei]



T2:

/ɛ/

Roadmap

PNWE Study

- (æg) in PNWE: from imperceptible universal to dialect marker

Foundations from Sociolinguistics

- Variation in apparent time as indication of community change (conventionalization)

Foundations from Phonetics

- Coarticulation: automatic context-dependent adaptation
- Vowel-inherent spectral change (VISC): characterizing vowel trajectory and primary acoustic cues to vowel identity

Conclusion

- What we learn from between-group and within-speaker variation (Public manifestation) of variable patterns
- How sound change “goes public” (Conventionalization)

Public Manifestation of Transitional Variants



- **Connection to Sociolinguistics:** Apparent time view represents not just progression toward adoption of innovative form, but also types of strategies for phone production to which listeners will be exposed (inputs for next generation). (Labov, 2001)
 - Compatible with usage-based models (Pierrehumbert, 2001; MacKenzie & Yang, 2013; MacKenzie 2014).
- **Connection to coarticulation research:** We observe reorganization of time-varying cues to velar place (earlier in trajectory, new following environments).
 - return of /ŋ/ as a hyperraising environment
- **Connection to VISC research:** Speakers within a single community utilize different VISC strategies
 - PNWE research provides evidence of certain combinations of time-varying cues “going public”, i.e., conventionalization of a new pattern in the community.
 - For PNWE (æg) not just new of midpoint values, but of transitional trajectories used as the change progresses.



Thank you!

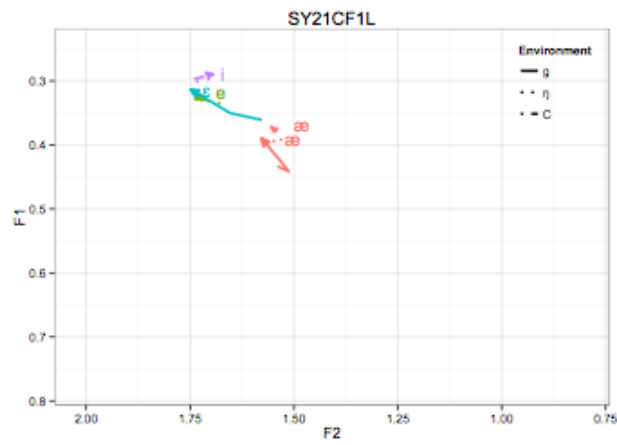
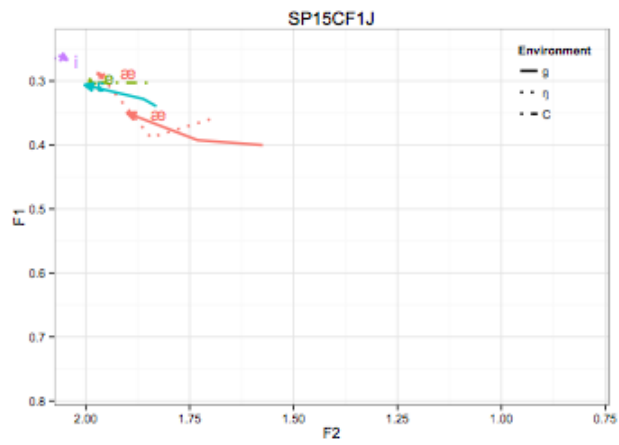
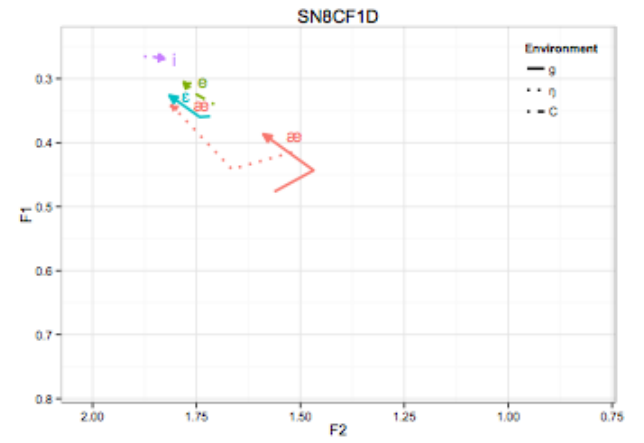
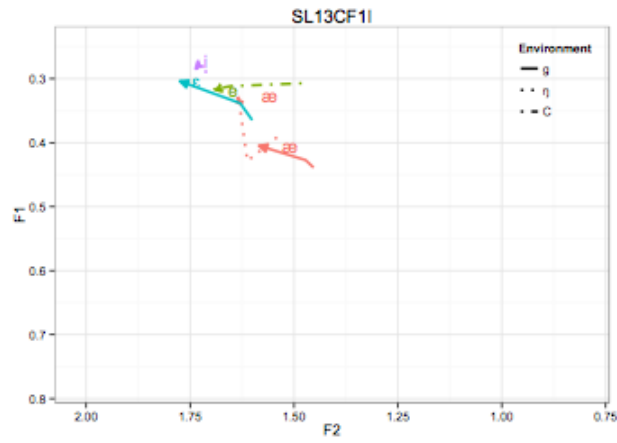
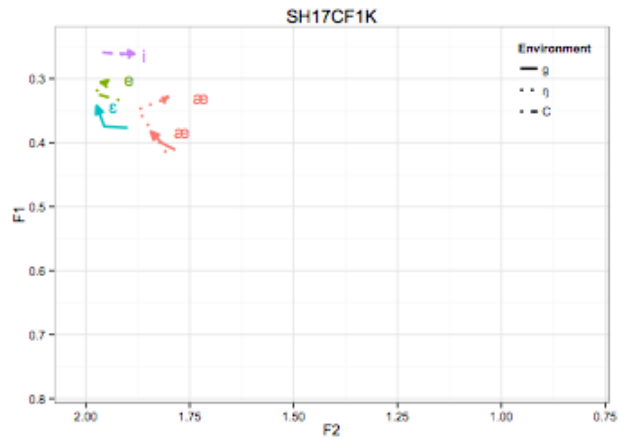
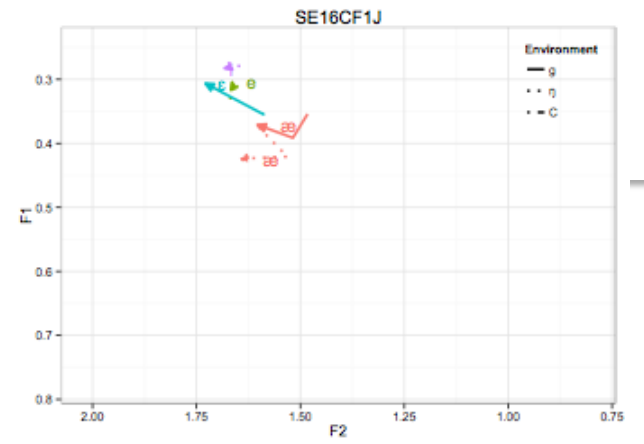
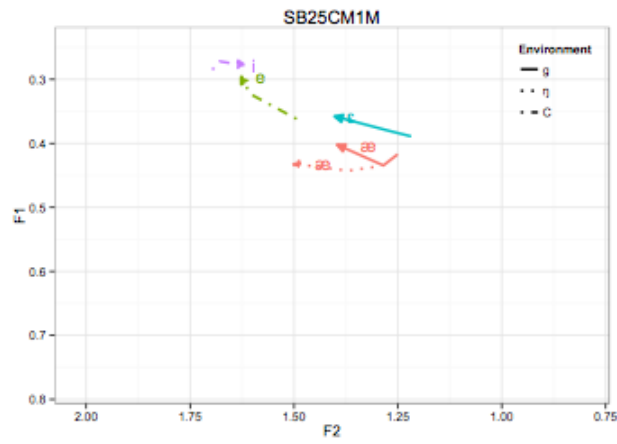
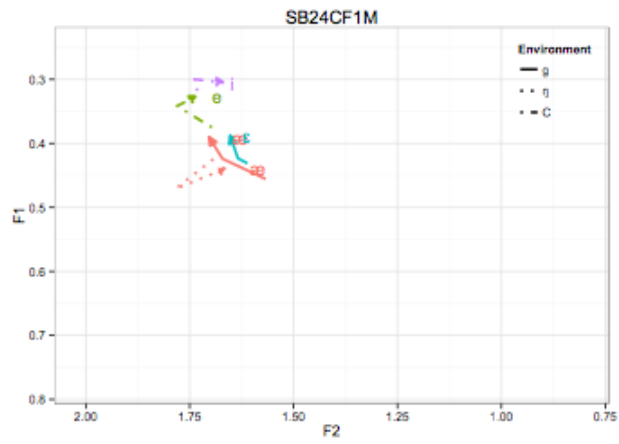
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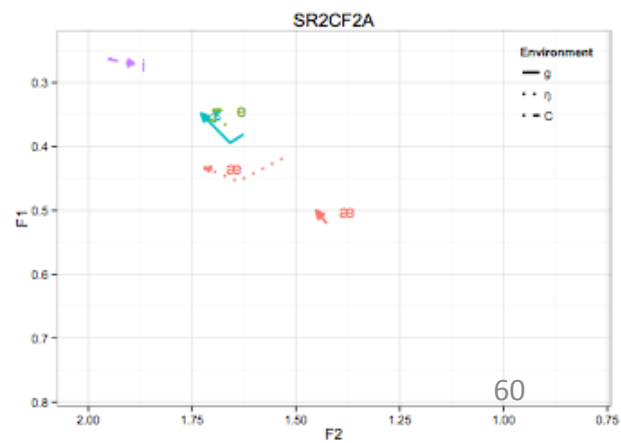
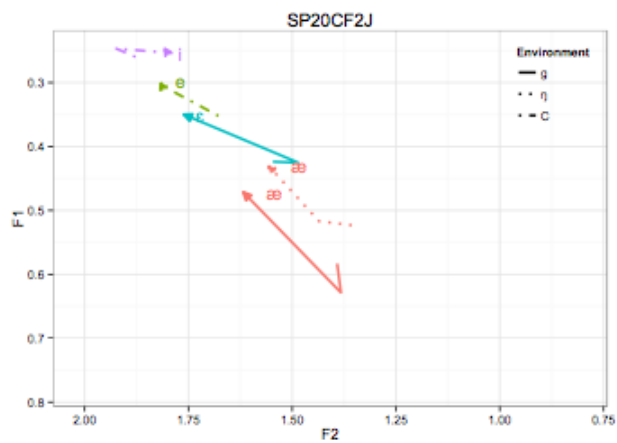
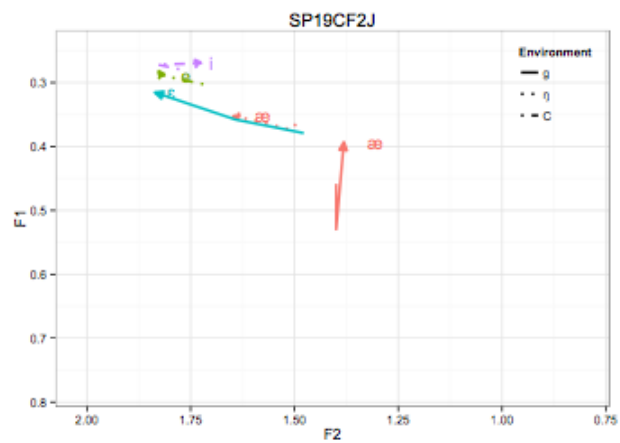
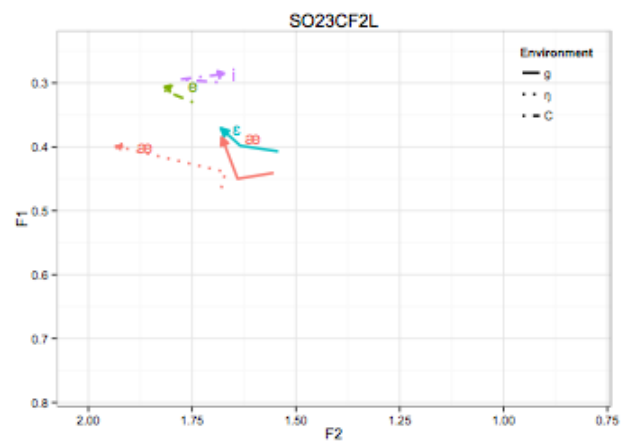
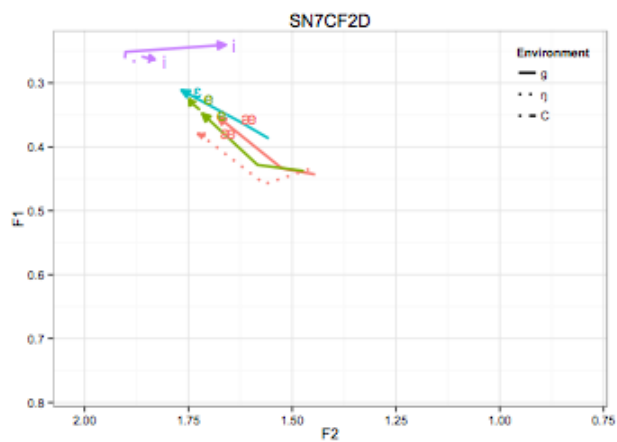
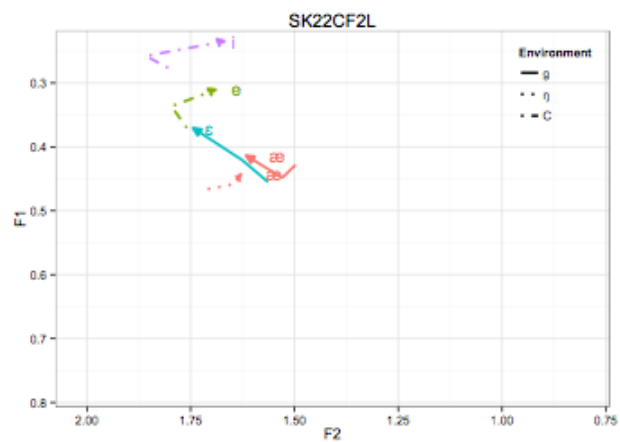
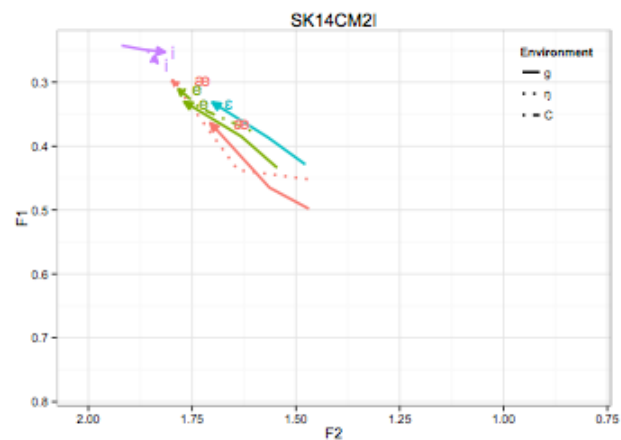
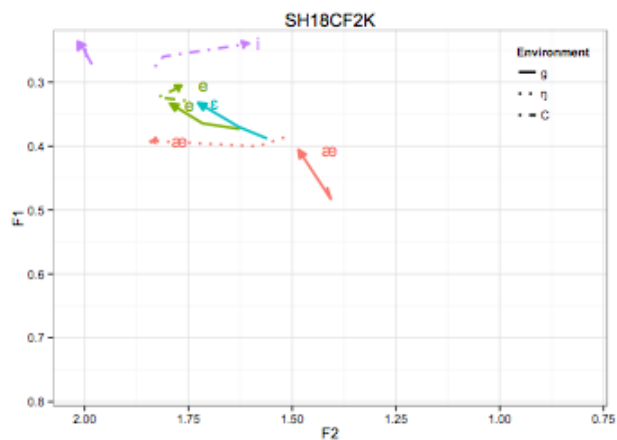
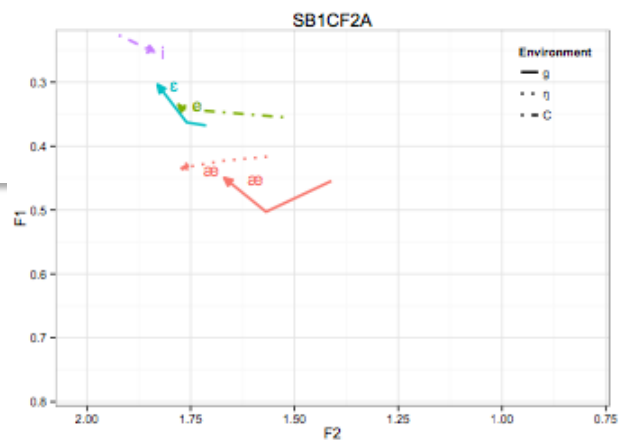
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Generation 1



Generation 2



Generation 3

