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

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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)
Roadmap

PNWE Study

- (aeg) 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)
• 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
• 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)
• (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)

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)
Speaker 24 (Oldest Generation Female)

- **bait** /eɪ/  
- **bang** /æŋ/  
- **bag** /æg/  
- **beg** /ɛg/
How to care for your leg bag
“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)
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Random variation: no constancy in use of innovative form across cohorts. No speech community-wide language change is observed.
**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)
**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 (actual language change). Incoming variant occurs with higher frequency in younger than older, speakers.
**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 (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, $$)
**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)


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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)
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).
- 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
- 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

VC Coarticulatory Patterns

V C V

a b a

i b i

a d a

i d i

a g a

i g i
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)
inner 60%

20%  50%  80%  

Steady-state (No change in F1 or F2)  F2 change  F1 change
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 ♦

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 *
   \[ S_1 = \frac{\Delta F_1}{\Delta t} \]
   \[ S_2 = \frac{\Delta F_2}{\Delta t} \]

3. Onset + Direction *

4. Trajectory Length +

\[ c = \sqrt{(\Delta F_1)^2 + (\Delta F_2)^2} \]

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 *

3. Onset + Direction *
   \[ C1 = \frac{\Delta F1}{L} \]
   \[ C2 = \frac{\Delta F2}{L} \]
   \[ L = \left( (\Delta F1)^2 + (\Delta F2)^2 \right)^{1/2} \]

4. Trajectory Length ♦

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 *

3. Onset + Direction *

4. Trajectory Length ↩️

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

Jacewicz & Fox (2013) “Cross-Dialectal Differences in Dynamic Formant Patterns in American English Vowels”
Typical coarticulatory effects in stable Vs /ɪ, ɑ/.

Variation is lawful. Pre-labial trajectories show characteristic lowering. Alveolar trajectories show a characteristic fronting. Velar trajectories (both /ɪ, ɑ/) raise and front. Note that for the female speaker, some raising in prevelar /ɑ/ is observed, but vector is short.
Oldest Generation (Speaker 8, Female)

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

<table>
<thead>
<tr>
<th></th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
<th>F5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generation</td>
<td>-0.295</td>
<td><strong>0.757</strong></td>
<td>0.289</td>
<td>-0.487</td>
<td>-0.132</td>
</tr>
<tr>
<td>FollowingPhone</td>
<td><strong>0.875</strong></td>
<td>0.167</td>
<td>0.052</td>
<td>-0.224</td>
<td>0.391</td>
</tr>
<tr>
<td>Nearey2*F150</td>
<td>-0.870</td>
<td>0.370</td>
<td>-0.099</td>
<td>0.097</td>
<td>0.162</td>
</tr>
<tr>
<td>OverallΔF1</td>
<td>-0.906</td>
<td>0.240</td>
<td>-0.107</td>
<td>0.198</td>
<td>0.153</td>
</tr>
<tr>
<td>OverallΔF2</td>
<td><strong>0.942</strong></td>
<td>0.269</td>
<td>-0.125</td>
<td>0.066</td>
<td>-0.078</td>
</tr>
<tr>
<td>Direction</td>
<td>0.190</td>
<td>0.149</td>
<td><strong>0.894</strong></td>
<td>0.376</td>
<td>0.017</td>
</tr>
<tr>
<td>TL</td>
<td>0.495</td>
<td><strong>0.675</strong></td>
<td>-0.394</td>
<td>0.368</td>
<td>-0.064</td>
</tr>
</tbody>
</table>
PCA Cluster 1: F1/F2/Following Phone Strategy
PCA Cluster 2: Trajectory Length Strategy
PCA Cluster 3: Onset + Direction Strategy
## Generational strategies

<table>
<thead>
<tr>
<th></th>
<th>Gen 1 (n=9)</th>
<th>Gen 2 (n=11)</th>
<th>Gen 3 (n=5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unraised + Monophthongal</td>
<td>11%</td>
<td>27%</td>
<td>60%</td>
</tr>
<tr>
<td>Unraised + Sloping:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F1</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>F2</td>
<td>33%</td>
<td>18%</td>
<td>0%</td>
</tr>
<tr>
<td>Raised + Monophthongal</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Raised + Sloping:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F1</td>
<td>11%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>F2</td>
<td>44%</td>
<td>55%</td>
<td>40%</td>
</tr>
</tbody>
</table>

*F1 of (ey) lower than average F1
Coarticulation and Sound Change

T1:

Production:

/u/ + /t/

Percept:

[ɯ] [ɨ] [y]

T2:

/reanalysis

Or

/u/

Coarticulation and Sound Change

T1:

Production: /u/ + /t/

Percept: 

Production: 

T2:

/ʊ/
Perception of PNWE (æg)

T1: /æ/

Production: /æ/ + /g,ŋ/

Percept: [æ] 0%  [ɛ] 71%  [ei] 21%

Production: [ɛ]  [ɛ]  [ɛ]  [ɛ]  [ɛ]  [ɛ]  [ei]  [ei]

T2: /ɛ/

ISOLATION

BIGRAM

[æ] 77%  [ɛ] 8%  [ei] 8%
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• **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)

• **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!
References


References


