Prosodic variation as a phonetic precursor to diachronic vowel shift

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WCCFL 2010
Variability of North American English vowels

- English vowels are notoriously variable
- Largely the result of diachronic/ongoing vowel shifts

Labov1994; Labov, Ash & Boberg 2005
Vowel shifts are different from other sound changes

Many sound changes are initiated in the most frequent words, a fact consistent with exemplar models

Bybee 2002; Pierrehumbert 2002

But Labov has repeatedly observed that the vowel shifts taking place in North American English are largely unconditioned by lexical frequency

Labov 2006

\( \text{pin} = \text{pinafore} \)
Word-frequency and vowel shifts


Short vowels under Northern Cities Shift:
Prediction: tokens of /æ/ that are leading the change should have higher F2 (more fronted), and leading tokens of /ɛ/, /ɪ/, and /ʌ/ should have lower F2 (more retracted).

Results are not consistent: vowels in frequent words are more centralized (regardless of the direction of the shift in progress).
- Also true in all other dialect areas (not only NC)
Dinkin (2008), cont.

• Frequency effects may be a feature of lenitions, but not of vowel shifts (cf. Phillips, 1984).

• BUT Clopper & Pierrehumbert (2008) find evidence for a link (if highly predictable = more frequent).
Vowel shifts target stressed vowels (different from lenitions, which affect segments in prosodically weak positions first)

Cf.

Latin *te:*la > French *toile* [twal]

Final vowel: a > ə > ∅ (lenition)

Stressed vowel: eː > ei > əi > oi > we > wa
Vowel shifts are not lenitions
That’s why they do not show frequency effects

Q1: What causes vowel shifts?
Q2: Are there any factors (other than segmental context) under which we should expect more advanced realizations in the direction of the shift?
Labov’s observation

• Vowels in syllables with primary stress show targets that are more advanced along the path of the shift than vowels in syllables with secondary stress.

• Stressed vowels in words under emphasis are most advanced.
More stress = more duration
Latin phonologically short mid vowels

\[^{\prime}\text{per.do} > \text{Sp. pierdo}\]
\[^{\prime}\text{de.mus} > \text{Sp. perdemos}\]
\[^{\prime}\text{vo.lo} > \text{Sp. vuelo}\]
\[^{\prime}\text{la.mus} > \text{Sp. volamos}\]

\[\text{[œ]} > \text{[œə]} > \text{[wa]} > \text{[we]}\]

• stress-induced lengthening triggered diphthongization of etymological short vowels
<table>
<thead>
<tr>
<th>Latin</th>
<th>Spanish</th>
<th>French</th>
</tr>
</thead>
<tbody>
<tr>
<td>pede(m)</td>
<td>pie</td>
<td>pied</td>
</tr>
<tr>
<td>perdit</td>
<td>pierde</td>
<td>perd</td>
</tr>
</tbody>
</table>

Greater lengthening in open stressed syllables
Diphthongization only in stressed syllables.
In French, only in stressed open syllables.

Why? Greater length recategorization of monophthongs as diphthongs happened first in positions with greatest prosodic prominence (where we expect the greatest amount of stress-induced lengthening).
Opposite effects of prosody in lenitions and vowel shifts

• In lenitions we expect more reduction under weaker stress (word-frequency effects, including greater weakening of function words, follow from less stress)

• In shifts we expect greater shift under stronger stress

Predictions

From Labov’s *Principles of Vowel Shifting*

Principle I: tense vowels rise
Principle II: lax vowels fall
Principle IIa: the nuclei of upgliding diphthongs fall
Principle III': tense vowels move to the front, lax vowels move to the back

All of the above shifts will be more advanced in positions of prosodic prominence.
Example

• The diphthongs /aɪ/, /au/ < breaking of /iː/ /uː/ (dissimilation of first and second morae).

• This internal dissimilation is still in progress, /au/ showing a more fronted nucleus than /aɪ/ (Labov 1994: 167-170).

• Prediction: the distance in vowel space between the first and second mora of the diphthong will be greater under phrasal prominence.
Method

• Does the pattern of variation in vowels that is induced by prosodic prominence resemble diachronic vowel shift?

• Investigate effects of prosodic prominence on vowel frontness (F2) and height (F1).

• Data from our prior corpus studies on acoustic correlates of prosody in American English
## Two corpora

<table>
<thead>
<tr>
<th>Boston U Radio News Corpus</th>
<th>Buckeye Corpus (Ohio)</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Ostendorf, Price, Shattuck-Hufnagel 1995]</td>
<td>[Pitt, et al., 2005]</td>
</tr>
<tr>
<td>• professional radio announcers</td>
<td>• ordinary speakers</td>
</tr>
<tr>
<td>• four speakers</td>
<td>• 38 speakers</td>
</tr>
<tr>
<td>• read speech</td>
<td>• conversational, spontaneous speech</td>
</tr>
<tr>
<td>• ToBI prosody labels, produced by expert transcribers</td>
<td>• coarse-grained labels for prosody as perceived by non-expert transcribers</td>
</tr>
<tr>
<td>• 9 vowels: /i æ a u/ tense/long</td>
<td>• 14 vowels (all vowel phonemes)</td>
</tr>
<tr>
<td>/ɪ ɛ ʌ/ lax/short</td>
<td>• portion analyzed includes 3,398 vowel tokens</td>
</tr>
<tr>
<td>/ei ou/ diphthong</td>
<td></td>
</tr>
<tr>
<td>• 1,540 vowel tokens</td>
<td></td>
</tr>
</tbody>
</table>
Two kinds of prosody data

<table>
<thead>
<tr>
<th>Boston U Radio News Corpus</th>
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<tbody>
<tr>
<td>discrete prosody labels</td>
<td>probabilistic prosody labels</td>
</tr>
<tr>
<td>• Prominence assigned to each word (Accented vs. Unaccented)</td>
<td>• numeric Prominence value assigned to each word (0.0-1.0)</td>
</tr>
<tr>
<td>• codes the judgment of the expert transcriber (or consensus label among small group of transcribers)</td>
<td>• codes the probability that a listener will judge that word as prominent (15-20 transcribers)</td>
</tr>
<tr>
<td>ANOVAs test effect of prominence on F1, F2</td>
<td>Correlation analyses test relationship between perceived prominence and F1, F2</td>
</tr>
<tr>
<td>- <em>Unaccented includes stressed and unstressed vowels</em></td>
<td>- only stressed vowels analyzed</td>
</tr>
</tbody>
</table>

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Results: BU Radio News

Effects of prominence on F1 and F2 of lax vowels

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Results: BU Radio News

Effects of prominence on F1 and F2 of tense (long) vowels
Results: BU Radio News

The distance between the nucleus and offglide in F1xF2 space is significantly greater under prominence: increased diphthongization.

Effects of prominence on F1 and F2 of diphthongs
Interim summary: BU Radio News

Robust effects of prominence on F1, F2

- Lax vowels are lower: /ɪ ɛ ʌ /
- Tense vowels are more peripheral (fronter/backer): /i æ a u /
- Tense low vowels are lower: /æ a /
- Diphthongization is greater: /ei əʊ /
Results: Buckeye

correlates of prominence for lax vowels
Results: Buckeye

correlates of prominence for tense (long) vowels
Results: Buckeye

No evidence of increased diphthongization for prominent vowels

correlates of prominence for diphthongs
Results: Buckeye

Increased diphthongization with prominence, especially for /au/

correlates of prominence for diphthongs
Interim summary: Buckeye

Robust correlates of perceived prominence in F1, F2

- Lax vowels are lower: /i ɛ æ ɔ u/
- Tense corner vowels are more peripheral (fronter/backer): /i a u /
  - Tense low vowel becomes lower: /æ /
- Diphthongization is greater: /ai au /
  - but not for /ei əu /

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<tr>
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<tbody>
<tr>
<td><strong>Lax Vs: lower</strong></td>
<td>/ɪ ɛ ʌ /</td>
<td>/ɪ ɛ ʌ ɔ ʊ /</td>
</tr>
<tr>
<td><strong>Tense Vs: more peripheral</strong></td>
<td>/i æ a u /</td>
<td>/i a u /</td>
</tr>
<tr>
<td><strong>Low Vs: lower</strong></td>
<td>/æ a /</td>
<td>/æ /</td>
</tr>
<tr>
<td><strong>Diphthongs: increased distance</strong></td>
<td>/ei ou /</td>
<td>/ai au /</td>
</tr>
<tr>
<td><strong>Diphthongs: lower nucleus</strong></td>
<td>/ei ou /</td>
<td>/ai au /</td>
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Prominence and Shift

Two of Labov’s *Principles of Vowel Shift* are reflected in the pattern of prominence effects:

- **Principle II**: lax vowels fall

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- **Principle IIa**: nuclei of upgliding diphthongs fall

| Diphthongs: lower nucleus | /ei əʊ / | /aɪ əʊ / |

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Prominence and Shift

• Principle III': lax vowels move to the back under prominence:

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<th>Buckeye</th>
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<tbody>
<tr>
<td>Lax Vs: retracted</td>
<td>/ɪ /</td>
<td>/ɛʌ /</td>
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What about tense vowels? (Principle I)
Labov predicts all tense vowels will move to front under vowel shift.

We find tense vowels become more peripheral.
Summary & Conclusion

• Three of Labov’s Principles of Vowel Shift are reflected in our data, under the hypothesis that more prominent tokens are more advanced along the trajectory of the shift.

• The prediction of tense vowels raising under prominence is not confirmed.

• ... tense and lax vowel shifts a unified system?
Acknowledgments

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