BAG, BEG, BAGEL: Prevelar raising and merger in Seattle Caucasians

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Problem & Goal

- Pacific Northwest English (PNWE) project noticed /æ/ and /ɛ/ raising before /g/ (BAG, BEG classes)
  - But didn’t target prevelars specifically, so need more data

- Describe prevelars in PNWE: merger or just raising?
  - Seattle Caucasians
  - Target prevelar words
  - Add /eg/ words (BAGEL class)
    - If /eg/ raises, prevelar raising predicted by phonetic factors
    - If /eg/ lowers, evidence of phonological merger
/æɡ/-Raising

/æɡ/-raising in other regions:
- Wisconsin, Minnesota (Zeller 1997; Labov, Ash, & Boberg 2006; Bauer & Parker 2008; Benson, Fox, & Balkman 2011)
- US North (Upper Midwest to PNW) (Labov, Ash, & Boberg 2006)
- Western Canada (Boberg 2008)

/ɛɡ/-raising rarely formally described

PNWE only dialect described as having both /æɡ/- and /ɛɡ/-raising
- Both /æɡ, ɛɡ/ (variably) raised and diphthongal (Reed 1952, 1961; Wassink et al. 2009; Squizzero 2009)
Subjects

- 20 Seattle Caucasians
- 2 age groups x 2 genders

<table>
<thead>
<tr>
<th>Generation</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle-aged “Gen 2”</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>born 1951-1976 (age 37-62)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Younger “Gen 3”</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>born since 1977 (age 18-36)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Elicitation

- Interviewed in field in dyads or alone
- Conversation, Demographics, Linguistic Questionnaire
- Reading Passage, Word List

Target words selected for analysis
  - From Reading Passage & Word List
  - Non-high front vowels before /g/
  - Non-high front vowels in neutral C contexts
    - Exceptions: post-liquids to match plague (lag, leg, drag…)
Measurement

- Transcripts force-aligned (P2FA)
- Vowel boundaries hand-corrected (Praat)
- Vowel measures (extracted via Praat script):
  - Duration (ms)
  - f0, F1, F2, F3 at onset, midpoint, offset
    - 20%, 50%, 80% of vowel duration
- Measures verified/corrected by hand (~¼ of total 2556)
  - Plotted F1xF2 in Hz, checked if > 2 σ from mean
  - Excluded 89 tokens from 20% measure due to aspiration
- F1, F2 normalized with Bark Difference Metric (NORM)
  - Z-score normalized F3-F2 (front-back) and F3-F1 (height)
Overlap & Trajectory

- **VOIS3D**: Overlap fractions of vowel distributions
  - Area/volume of smaller distribution contained within larger
  - 2D: F1 x F2 ellipses of 2σ around means
  - 3D: F1 x F2 x duration ellipsoids of 2σ around means

- **Smoothing-Spline ANOVA**: Models trajectory
  - Best-fit curve connects mean F1 or F2 between time points (onset, midpoint, offset)
  - 95% confidence intervals around means along trajectory
Results: Midpoint

- 2556 tokens
- Bark-normalized
- Ellipses of 2 \( \sigma \) around means
Midpoint: Plain Vowels

- /æ/ and /ɛ/ overlap
  - 39% 2D
  - 23% 3D
  - /ɛ/ shorter
Midpoint: BEG-BAGEL

- /eg/ and /ɛɡ/ merged between /e/ and /ɛ/
  - 91% 2D
  - 87% 3D
  - /ɛɡ/ shorter
Midpoint: BAG

- /æɡ/ raised from /æl/
  - 58% 2D
  - 48% 3D
  - /æɡ/ slightly shorter
Midpoint: BAG

- /æɡ/ raised from /æ/
  - 58% 2D
  - 48% 3D
  - /æɡ/ slightly shorter

- /æɡ/ overlaps /ɛ/
  - 95% 2D
  - 91% 3D
  - /ɛ/ shorter
Midpoint: BAG

- /æg/ raised from /æ/
  - 58% 2D
  - 48% 3D
  - /æg/ slightly shorter

- /æg/ overlaps /ɛ/
  - 95% 2D
  - 91% 3D
  - /ɛ/ shorter

- /æg/ overlaps merged /ɛg-eg/
  - 60%+ each 2D
  - 6-14% less in 3D
  - /ɛg/ shorter
vague
beg
bag
Results: Trajectory

- /eg/ and /εg/ overlap throughout
  - Onsets overlap /ε/
  - Rise, front
- /æɡ/ raised from /æː/
  - Rises, fronts
  - Starts near /æː/
  - F3-F1 crosses, ends near /ɛ/
- All three /æɡ, ɛg, eg/ diphthongal
  - /e/ diphthongal but less change in F2
Results: Trajectory

- All three /æg, ɛg, eg/ diphthongal
- /e/ diphthongal but less change in F2
Results: Duration

- /ɛɡ/ remains shorter
  - /ɛ/ doesn’t lengthen, even when diphthongal /ɛɪɡ/
  - Prevelars merged in F1xF2 might be distinguished by duration

<table>
<thead>
<tr>
<th>Following Environment</th>
<th>/æ/</th>
<th>/e/</th>
<th>/ɛ/</th>
</tr>
</thead>
<tbody>
<tr>
<td>C (plain)</td>
<td>168</td>
<td>167</td>
<td>130</td>
</tr>
<tr>
<td>/ɡ/</td>
<td>151</td>
<td>153</td>
<td>132</td>
</tr>
</tbody>
</table>
Patterns Summary

- All three prevelars are upgliding diphthongs

- /ɛɡ/ and /eg/ are spectrally merged between /ɛ/ and /e/ throughout their trajectories
  - But /ɛɡ/ is slightly shorter in duration

- /æɡ/ raises to overlap with /ɛɡ/ and /eg/
  - Potential merger target = /eg/
    - Consistent with “failure” to reach height of /e/

- /æɡ/ more variable; age x gender effects:
  - Middle-aged men spectrally merge /æɡ/ with /eg-ɛɡ/
  - Young speakers raise /æɡ/ the least
Phonetic Underpinnings

- **Velar pinch** (Zeller 1997; Baker et al. 2008; Purnell 2008; Wassink & Riebold 2013)
  - F2 rises, F3 (and F1) lowers as dorsum rises to velum
  - F2 rising + F1 lowering also occur in upgliding
  - Velar pinch elongated before voiced segments
    - Implicational scale (Baker et al.): raising most common before /ŋ/ (velar pinch exaggerated), then before /g/; not found before /k/ (cf. Freeman 2015 ADS poster)
Phonological Reanalysis

- Phonological reanalysis
  - Velar pinch sounds like upglide
  - Reanalyze phonetic diphthong as nearest phonemic diphthong /e/ (Bauer & Parker 2008)
  - /eg/ lowers to meet raised /ɛg/ – predicted to raise if only subject to effects of exaggerated velar pinch

- Few minimal pairs
  - /eg/ class tiny, /ɛg/ class small, few minimal pairs with /æg/
  - Merging wouldn’t create many homophones
  - Allows /æg-ɛg-eg/ to be treated as one phonological system, potentially a three-way (near-)merger in progress
Social Variation

- BEG-BAGEL (spectral) merger complete
  - For Seattle Caucasians born after 1950 (and other groups, cf. Riebold’s 2014 NWAV talk)
  - Shorter duration of /ɛɡ/: sign of near-merger, incomplete change in progress?

- Middle-aged men most advanced in BAG-raising
  - Might be receding/reversing
    - Older speakers raise somewhat (Wassink & Riebold 2013)
    - Middle-aged speakers raise the most
    - Younger speakers raise the least
  - Local value and/or stigma that youth/women avoid?
Future Work

- **Phonetic factors**
  - Before velar nasal (hyper-raising); before /k/ (backing); before back vowels, /n/ (cf. Freeman 2015 ADS poster)

- **Perception test**
  - Do perceptual categories correlate with production?
  - Manipulate F1xF2, duration, glide, prosody

- **Discourse factors**
  - Interactions with stance, involvement, audience (cf. Freeman 2015 dissertation, ATAROS project)

- **Social, style factors**
  - Urbanness/insularity, network strength, social class…
  - Analyze, compare informal tasks (cf. Riebold 2015 dissertation)
Questions?

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Working paper available at: depts.washington.edu/uwwpl

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  - Alicia Wassink, John Riebold
  - Dan McCloy, Meghan Oxley
  - Richard Wright, Gina-Anne Levow

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References


References

Grand Summary

- Prevelar /ɛɡ/ and /eg/ (BEG and BAGEL):
  - Upgliding diphthongs
  - Merged in F1xF2 space between non-prevelar /ɛ/ and /e/ throughout their trajectories (at onset, midpoint, offset)
  - But BEG is slightly shorter in duration

- Prevelar /æɡ/ (BAG):
  - Raised and upgliding
  - Variation in height between social groups:
    - Middle-aged men raise to merge with BEG-BAGEL in F1xF2
      - But BEG is shorter
    - Middle-aged women raise less, partially overlap BEG-BAGEL
    - Young speakers of both genders raise the least
## Target Words

<table>
<thead>
<tr>
<th>Following Environment</th>
<th>/æ/</th>
<th>/e/</th>
<th>/ɛ/</th>
</tr>
</thead>
<tbody>
<tr>
<td>C (&quot;plain&quot;)</td>
<td>bad</td>
<td>bait</td>
<td>bed</td>
</tr>
<tr>
<td></td>
<td>dad</td>
<td>pace</td>
<td>dead</td>
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<td></td>
<td>hatch</td>
<td></td>
<td>test</td>
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<tr>
<td>/g/</td>
<td>bag</td>
<td>bagel</td>
<td>beg</td>
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<td></td>
<td>brag</td>
<td>pagan</td>
<td>egg</td>
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<td>plague</td>
<td>leg</td>
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<tr>
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<td>vague</td>
<td>leggings</td>
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<td></td>
<td>lag</td>
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<td>negative</td>
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<td>magnet</td>
<td></td>
<td>peg</td>
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<td></td>
<td>nag</td>
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<td>regular</td>
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## Data Set

<table>
<thead>
<tr>
<th>Speakers</th>
<th>Vowel</th>
<th>N</th>
<th>F1 (Hz)</th>
<th>F2 (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All speakers</td>
<td>e</td>
<td>400</td>
<td>424</td>
<td>2283</td>
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<tr>
<td></td>
<td>eg</td>
<td>297</td>
<td>514</td>
<td>2076</td>
</tr>
<tr>
<td></td>
<td>eg</td>
<td>490</td>
<td>505</td>
<td>2043</td>
</tr>
<tr>
<td></td>
<td>e</td>
<td>339</td>
<td>601</td>
<td>1870</td>
</tr>
<tr>
<td></td>
<td>æg</td>
<td>542</td>
<td>622</td>
<td>1901</td>
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<tr>
<td></td>
<td>æ</td>
<td>488</td>
<td>743</td>
<td>1737</td>
</tr>
</tbody>
</table>

All speakers: N = 2556
### Overlap Fractions

<table>
<thead>
<tr>
<th>Vowel Pairs</th>
<th>2D overlap</th>
<th>3D overlap</th>
</tr>
</thead>
<tbody>
<tr>
<td>æ-ε</td>
<td>39%</td>
<td>23%</td>
</tr>
<tr>
<td>εɡ-eg</td>
<td>91%</td>
<td>87%</td>
</tr>
<tr>
<td>εɡ-ɛ</td>
<td>49%</td>
<td>40%</td>
</tr>
<tr>
<td>εɡ-e</td>
<td>49%</td>
<td>36%</td>
</tr>
<tr>
<td>eg-ɛ</td>
<td>52%</td>
<td>38%</td>
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<tr>
<td>eg-e</td>
<td>55%</td>
<td>44%</td>
</tr>
<tr>
<td>æɡ-ɛ</td>
<td>95%</td>
<td>91%</td>
</tr>
<tr>
<td>æɡ-æ</td>
<td>58%</td>
<td>48%</td>
</tr>
<tr>
<td>æɡ-eg</td>
<td>62%</td>
<td>56%</td>
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<tr>
<td>æɡ-ɛɡ</td>
<td>61%</td>
<td>47%</td>
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<tr>
<td>æɡ-e</td>
<td>9%</td>
<td>7%</td>
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