Perceptual distribution of merging phonemes

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Overview

- PNWE BAG-BEG-BAGEL merger in production
- Question: What about perceptual categories?
  - Merged or unmerged? Like production or not?
    - Goal: Map the perceptual pre-g vowel space for Pacific Northwesterners
- Perception experiment
  - Design & Stimuli
  - Presentation & Subjects
  - Results
- Summary & Future work
Production: Pre-coronal Vowels

- Pre-coronal non-high front vowels
  \(/æ/, /ɛ/, /e/\)

See also: Riebold (2014), Wassink et al. (2009)

From Freeman (2014)
Production: BEG-BAGEL

- /eg/ and /ɛɡ/ merged between /e/ and /ɛ/

See also: Riebold (2014)

From Freeman (2014)
Production: BAG

- /æg/ raised from /æ/ 

See also: Riebold (2014), Wassink et al. (2009)

From Freeman (2014)
Production: BAG-BEG-BAGEL

- /æɡ/ raised from /æ/
- /æɡ/ overlaps merged /ɛɡ-eg/

See also: Riebold (2014)

From Freeman (2014)
Production: Prevelar Diphthongs

- /æg, ɛg, eg, e/ rising diphthongs
- /ɛ, ɛg/ shorter in duration

See also: Riebold (2014)

From Freeman (2014)
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Motivation

- Merger as change over time...

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Motivation

- Merger-in-progress involves variation in the community

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- Near-merger (cf. e.g., Di Paolo (1998))
- Sensitive to stigma, style-shifting (cf. e.g., Labov (1994))
- Change in progress (e.g., Herold (1990))
Hypotheses

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- Hypothesis (εg-eg): (Near-)complete merger in production →
  - Merger in perception, in same location as in production
Hypotheses

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  - Merger in perception, in same location as in production
- Hypotheses ($\æg$): Variation produced in the community →
  - Lost distinction in perception ("accept everything as /æg/")
Hypotheses

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  - Merger in perception, in same location as in production
- Hypotheses (æg): Variation produced in the community →
  - Lost distinction in perception ("accept everything as /æg/")
  - Variation in perception, mirroring variation in production
How to Test?

• “Listen to these sounds. Are they the same or different?”
  ✗ May test auditory perception, not phonological categorization

• “Is this sound a P or a B?”
  ✗ Avoids lexical access to get at phonological categories
  ✗ Needs 1:1 sound-symbol relationship
  ✗ Works for phonetically unconditioned alternatives
  ✗ If uses words instead of letters, may get lexical (frequency, density, etc.) interference
How to Test?

• “Say these words. Do they sound the same/rhyme?”
  ✖ Sensitive to awareness, stigma
  ✖ Focuses on own pronunciation

• “Listen to these words. Do they sound the same/rhyme?”
  ✖ Sensitive to awareness, stigma
  ✖ Requires minimal pairs

• “Listen to this word. Which word is it?”
  ✖ Requires minimal pairs (or plausible competitors)

• “Listen to this piece of a word. Which word is it?”
  ✓ Avoids need for minimal pairs
  ✓ Works for phonetically conditioned alternatives by forcing lexical access (“Imagine you’re hearing a word…”)
Stimuli

• Synthetic stimuli modeled after a real PNWE speaker’s F1xF2 front-vowel space
  • Independent control of features
  • This study: Isolate just F1xF2
    – /b/-initial, followed by steady-state front vowel
      • 10-ms release + 40-ms voiced transition + 120-ms vowel
      • SynthWorks (Scicon R&D 2004), a Klatt-based synthesizer
    – Vary F1xF2
    – Same duration, pitch contour for all
      • 170ms, slightly rising pitch as in word list style
    – No coda consonant or coda formant transitions
Caucasian male, mid-50s, Seattle. Front vowels in non-liquid, non-nasal contexts, word list style. Ellipses: 2 standard deviations around means. Plot created with phonR (McCloy 2012).
Stimulus Grid

Black dots: F1xF2 values (Hz) of synthesized stimuli. Ellipses: ~2 standard deviations around means of model speaker.
Experiment Presentation

• After short demographic questionnaire, seated at computer screen with circumaural headphones

• Instructions to subjects: You’ll hear a “computerized” voice saying a word that’s been cut off in the middle. Choose which word you heard using the button box.
  • Begin with practice session of 3 words
  • After a button press, the next word will play
  • Answer as quick as you can, but still be accurate
Experiment Presentation

• Conditions: Same stimuli, different choices:
  – Condition “D” – word choices are b__d:
    • \textit{bad, bid, bayed, bed, bead}
    • Hear 3 blocks of all 24 stimuli in random orders
    • Short break to change response options
  – Condition “G” – word choices are b__g(...):
    • \textit{bag, big, bagel, beg, beagle}
    • Again hear 3 blocks of all 24 randomly-ordered stimuli
    • Recall that stimuli have no cues to coda, glide, or duration
Subjects

- 20 Pacific Northwesterners
  - Grew up in WA, OR, ID

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<tr>
<th>Ages</th>
<th>Female</th>
<th>Male</th>
<th>Totals</th>
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<tr>
<td>18-29</td>
<td>4</td>
<td>3</td>
<td>7</td>
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<tr>
<td>30-59</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>60-75</td>
<td>6</td>
<td>2</td>
<td>8</td>
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<tr>
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<td>8</td>
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Outlines mark stimulus values (dots) with ≥ 20% responses as the vowel:
pink /i/, gold /ɪ/, green /e/, blue /ɛ/, red /æ/
Results

Outlines mark stimulus values (dots) with ≥ 20% responses as the vowel:
- pink /i/,
- gold /ɪ/,
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Hypotheses Revisited

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- Hypothesis (εg-eg): (Near-)complete merger in production →
  - Merger in perception, in same location as in production
  - More overlap: /eg/ shifted down as expected, but /εg/ expanded upward rather than shifting
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  ✗ Lost distinction in perception ("accept everything as /æɡ/"
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- Hypotheses ($\æg$): Variation produced in the community →
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    - With all subjects pooled, $\æd = \æg$
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  - Lost distinction in perception (“accept everything as /æg/”)
    - With all subjects pooled, æd = æg
- Variation in perception, mirroring variation in production
  - For about a third of subjects, æg > æd (expands upward)
Next Questions

• Does individual perception reflect own production?
  – After perception procedure, subjects read a word list
    • Compare with perception responses

• What about duration and glide?
  – In production, all prevelars are upgliding, but [ɛ, ɛg] are shorter in duration
    • Manipulate in synthetic stimuli

• Other methods to try:
  • More repetitions of stimuli
  • Use natural and/or edited stimuli
  • Sorting task
Summary

• **εg-eg**: The reduction in perceptual distinctions further supports the characterization of /εg-eg/ as spectrally merged or merging in PNWE

• **æg**: Variation between subjects is consistent with variable production (and change in progress)

• Study design: can adapt/combine methods to encourage desired levels of pre/post-lexical access, social awareness, self-monitoring, etc. to study phonological changes in progress
References

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