The Phonetic Realization of the PIN-PEN Merger

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The PIN-PEN Merger

- merger of /ɪ/ and /ɛ/ before nasals
- one of the most studied features of Southern dialectology

source: Wikipedia, based on Labov et al. 2006
The PIN-PEN Merger

• also common among African Americans outside of South (Labov et al. 2006)

• in some places, associated with lower social class (Baranowski 2013)
Phonetic Realization

Previous research has offered competing descriptions of the merger's phonetic realization.

- $\varepsilon \rightarrow \text{i} \ (\text{pen } \rightarrow \text{pin})$ (e.g. Wise 1933, Wolfram and Schilling 1998, Hazen and Fluharty 2004)

- $\text{i} \rightarrow \varepsilon \ (\text{pin } \rightarrow \text{pen})$ (e.g. Bigham 2005, Ito and Campbell-Kibler 2011)

- intermediate vowel (e.g. Koops, Gentry, and Pantos 2008)

Unclear to what extent this variation is patterned geographically and/or socially.
Research Questions

1) What is the geographic/social distribution of the merger ...  
   - in production?  
   - in perception?

2) What is the relationship between production and perception of the merger?

3) Among merged speakers, how is the phonetic realization of the merged vowel geographically/socially conditioned?
Methods

Participants: Amazon Mechanical Turk
277 with production & perception
+ 94 with perception only

cmpared to overall US population:
• whiter
• more educated
• younger (median age 34)
Production

- 7 pairs PIN-PEN
- 7 pairs BIT-BET
- 16 fillers
- F1 and F2 measured at midpoint
Perception

- standard-sounding female talker
- 4 pairs PIN-PEN x 2
- 3 pairs control x 2 (1 BIT-BET)

pen / pin
Results

1. merger in production
2. merger in perception
3. production vs perception
4. phonetic realization
Merger in Production

Dependent measure: Pillai score (Hay et al. 2006, Hall-Lew 2010)

- 0 completely overlapping
- 0.4
- 1 completely distinct

Pillai = 0.02

Pillai = 0.95
Merger in Production

Modeled with Generalized Additive Model (GAM), step-up approach

Background contours:
model predictions for 35-year-old white speaker who has attended some high school, from a hometown of population 400
Merger in Production

More merged (lower Pillai score) if:

• Black ($p > .001$)
• older ($p = .01$)
• less educated ($p = .03$)
• from rural area ($p = .01$)
Merger in Production

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• from rural area ($p = .01$)
Merger in Production

Effect of hometown population size

population (log) of speaker hometown

more merged

Pillai score

(~400) (~3000) (~20,000) (~160,000) (~1 million) (~9 million)
Merger in Perception

expectation:

Word Identification Scores

% Words Correctly Identified

No Participants

0 50 100 150

0 25 50 75 100
Merger in Perception

**expectation:**

**reality:**

*Word Identification Scores*

- **% Words Correctly Identified**
  - **No. Participants**
    - 0
    - 50
    - 100
    - 150

- **Word Identification Scores**
  - **No. Participants**
    - 0
    - 50
    - 100
    - 150
  - **% Words Correctly Identified**
    - at chance
    - merged (missed > 1)
    - unclear (missed 1)
    - non-merged (missed 0)
Merger in Perception

Merged speakers can distinguish PIN and PEN probabilistically, but not with perfect accuracy.

non-merged = 100% accurate
merged = 2 or more wrong
Merger in Perception

- modeled as binomial GAM
- more likely to be merged if:
  - Black ($p = .005$)
  - less educated ($p = .01$)

Background contours: model predictions for a white speaker who has attended some college.
# Production vs Perception

<table>
<thead>
<tr>
<th>merged in production?</th>
<th>merged in perception?</th>
</tr>
</thead>
</table>
| yes                   | yes                   | 50  
| no                    | no                    | 138 
|                       | yes                   | 33  
|                       | no                    | 6   

**NUMBER OF PARTICIPANTS**
# Production vs Perception

<table>
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<th></th>
<th></th>
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</thead>
<tbody>
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</tr>
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**NUMBER OF PARTICIPANTS**

- Yes in production: 50
- Yes in perception: 33
- No in both: 138
Production vs Perception

Prediction: Near-merged speakers should be more likely to live in transition zones between areas with and without the merger.
Production vs Perception

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Production vs Perception

Compared to fully merged speakers, near merged speakers are more likely to:

be from urban areas (p=.048)
Production vs Perception

Compared to fully merged speakers, near merged speakers are more likely to:

- be from urban areas ($p = .048$)
- be men ($p = .02$)

![Box plot showing population (log) of speaker hometown for near merged and fully merged speakers.](image1)

![Bar chart showing gender distribution for near merged and fully merged speakers.](image2)
Production vs Perception

Contrary to other near mergers, here near-merged speakers' productions aren't much closer than fully non-merged speakers.
Phonetic Realization

dependent variable: direction score

\[
\text{DirectionScore} = \ln \left( \frac{\text{Pillai}(\text{PIN-PEN : BIT})}{\text{Pillai}(\text{PIN-PEN : BET})} \right)
\]
Phonetic Realization

dependent variable: direction score

\[ \text{DirectionScore} = \ln \left( \frac{\text{Pillai}(\text{PIN-PEN : BIT})}{\text{Pillai}(\text{PIN-PEN : BET})} \right) \]
Phonetic Realization

direction score

towards [ɪ]

< -1

> 1

towards [ɛ]
Phonetic Realization

Age

Education

Population Size

towards [ɛ]

towards [ɪ]

towards [ɛ]

towards [ɪ]
Conclusions

Merger towards [ɛ] \((pin \rightarrow pen)\) relatively common

- Why not reported more often?
  - word frequency?
  - experimental setting?

However, no apparent geographic or social patterning in realization of the merged vowel

Near merger relatively common

- Not previously reported for the PIN-PEN merger
Thanks!