Lexical and geographic variation in Italian mid vowels

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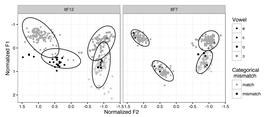
1. Italian mid vowel contrasts

- /e/ and /o/ *chiuso*: /peska/ *pesca* 'fishing' /forɔ/ *foro* 'hole'
- /ɛ/ and /ɔ/ *aperto*: /pɛska/ *pesca* 'peach' /fɔrɔ/ *foro* 'forum'

Italian /e ɛ o ɔ/ are separate phonemes, but the contrast between high and low mid vowels is *marginal*: they have few minimal pairs; vowels neutralize to /e, o/ in unstressed syllables; actual phonetic height may vary; and regional patterns of phonological conditioning decrease reliance on lexical specification.

2. Acoustics vs. intuition (Renwick & Ladd 2016)

- Despite a "particular closeness" between mid vowel pairs (Ladd 2006), Italian mid vowels retain their phonetic and phonological contrasts
  - Speakers are, generally, good judges of their own 4 mid vowels
  - Phonetic separation of mid vowels is strong
- However, the high mid vs. low mid vowel distinctions are also weak
  - Phonological conditioning occurs in some regions, e.g. by syllable structure
  - Widespread lexical variability of "Standard Italian" mid vowels



- All speakers have some mismatches between their intuition of mid vowel height, and its phonetic implementation
- A remaining research question: How does a speaker's **regional variety** of Italian influence their selection and phonetic implementation of mid vowels?

3. Mid vowel variation across Italy: a corpus approach

- CLIPS (*corpora e lessici di italiano parlato e scritto*)
  - Collected 1999 – 2004; team led by Federico Albano Leoni (Leoni et al. 2007)
  - >100 hours of speech, "partially transcribed" by the original team
  - Radio & TV, dialogues (MapTask), reading, telephone, pathological speech
- 15 Italian cities, 16+ speakers/city (185 speakers represented here)
- Data analyzed here: 20 read sentences from the "lista frasi" portion of the corpus, containing 270 unique words

4. Phonetic analysis of CLIPS vowels

- Forced alignment (MAUS; Kisler et al. 2016), with hand correction of TextGrids
- F1, F2 extracted by Praat at vowel midpoint: 123,042 vowel tokens
- All mid vowels (57,852 tokens) marked for stress and syllable structure
- Outliers filtered from raw data
  - Mahalanobis distance (Mahalanobis 1936) calculated, relative to a gender- and vowel-specific centroid. Tokens with high Mahalanobis distance (based on the 95% quantile of a χ2 distribution with *df* = 2) were excluded as outliers.
- Remaining data (*N* = 105,897) Lobanov-normalized on a speaker-specific basis

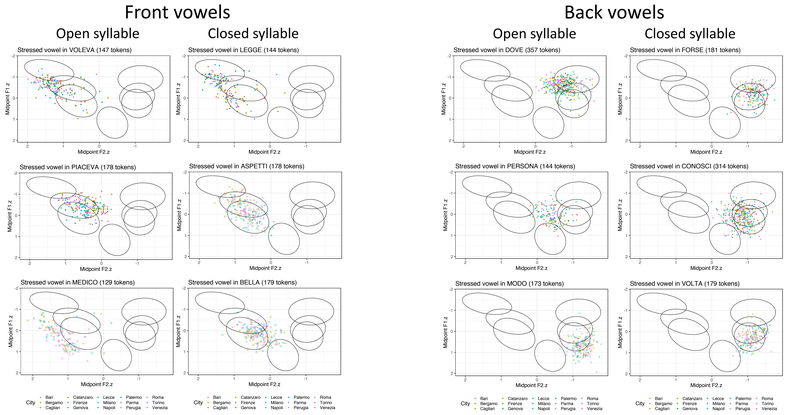
5. Automatic classification of mid vowels

Goal: a measure of vowel height unbiased by prescriptive quality or human intuition, to compare rates of high mid vs. low mid classification, across words, cities & regions

- **Method**: *k*-means clustering in R, a procedure that partitions data points to minimize the sum-of-squares distance between a point and its assigned cluster
  - Normalized front and back mid vowel tokens clustered separately, per city
  - Two clusters permitted, resulting in a higher and a lower cluster
  - Output: a list of cluster assignments for each token
  - The effects of syllable structure, duration, stress are also considered

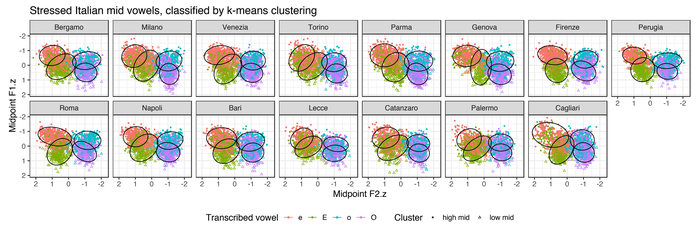
6. Results

Initial observation: some words are consistently realized with phonetically higher mid vowels (top), some with consistently lower mid vowels (bottom), and others variably (center)



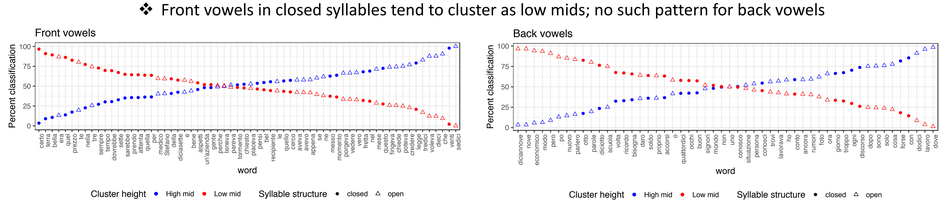
Results of *k*-means clustering

- Results of *k*-means clustering, colored by vowel transcribed by MAUS, for comparison
- **Hypothesis**: Less-variable words appear mostly in one cluster, while words with variable (or intermediate) vowel height appear at similar rates across both clusters



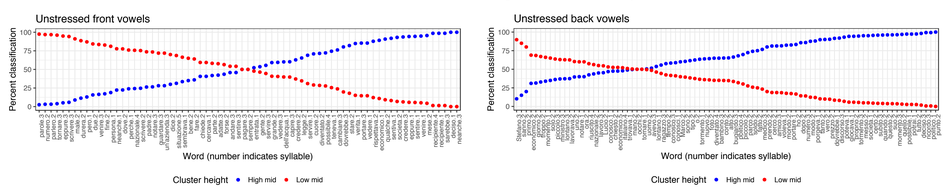
Rates of stressed-vowel classification into higher vs. lower clusters

- Highly variable words appear near the center of each plot; stable words at the edges
- Front vowels in closed syllables tend to cluster as low mids; no such pattern for back vowels



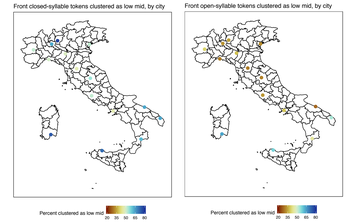
Unstressed vowels: asymmetrical evidence for neutralization

- Neutralization to /e, o/ predicts higher vowels in unstressed syllables
- Unstressed back vowels tend to cluster as high mids; no such pattern for front vowels

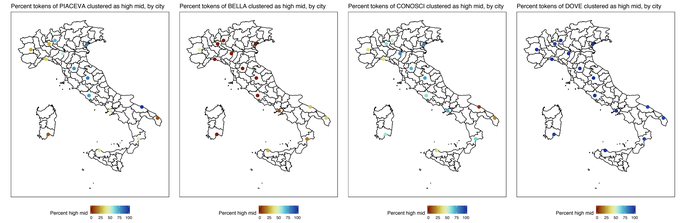


Regional differences in vowel clustering

Effects of syllable structure



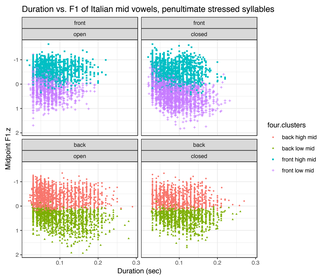
- Lower (front) vowels expected in closed syllables, in some varieties
- In some Northern varieties, [ɛ] is conditioned in closed syllables
- Regional variation occurs throughout, but highest rates of conditioning are in far North (Bergamo, Milano), and South (Bari, Palermo, Catanzaro, Lecce)



Specific lexical items

Some words are consistently classified, but many are variable

Duration: a secondary cue to phonological height?



Cluster	σ structure	Correlation
Higher front	Open	$r^2 = 0.06$, $p < 0.01$
Higher front	Closed	$r^2 = 0.15$, $p < 0.001$
Lower front	Open	$r^2 = 0.23$, $p < 0.001$
Lower front	Closed	$r^2 = 0.47$, $p < 0.001$
Cluster	**σ structure**	**Correlation**
Higher back	Open	$r^2 = 0.027$, $p = 0.1003$
Higher back	Closed	$r^2 = 0.05$, $p = 0.0467$
Lower back	Open	$r^2 = 0.31$, $p < 0.001$
Lower back	Closed	$r^2 = 0.14$, $p < 0.001$

- Longer durations expected in open syllables (e.g. Farnetani & Kori 1986)

7. Conclusions

- Widespread variability of mid vowels: while some words have consistent phonetic height at regional levels, others are highly variable even within single cities
- Areas of regional or lexical inconsistency show that the variable phonetic implementation of mid vowels is not a misleading consequence of pooling across diverse phonological systems – it is a *local* property
- Variability within words and cities suggests the mapping of lexical specification to phonetic category is weak, and contrasts are marginal (cf. Renwick & Ladd 2016)
- Contrastiveness is a matter of degree
  - Goal: adapt phonological theory to diverse dimensions of contrast

8. Acknowledgments and References

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