1. Italian mid vowel contrasts

- /e/ and /o/ chiusa: /peska/ pesca ‘fishing’ /fora/ fora ‘hole’
- /e/ and /o/ aperta: /peska/ pesca ‘peach’ /fora/ fora ‘forum’

Italian /e o/ 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 depend 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 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 vowel height, and its phonetic implementation

A remaining research question: How does a speaker’s regional variety influence the selection and phonetic implementation of mid vowels in Italian?

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 (150 speakers represented here)
- Data analyzed here: 20 read sentences from the “lista frasi” portion of the corpus, containing 284 unique words

4. Phonetic analysis of mid vowels

- Forced alignment (MAUS; Kisler et al. 2016), with hand correction of TextGrids
- F1, F2 extracted by Praat at vowel midpoint: 99,770 vowel tokens
- 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 $\chi^2$ distribution with df = 2) were excluded as outliers.
- Subset of mid vowels identified (39,632 tokens) and marked for stress
- Data Lobanov-normalized (z-score) on a speaker-specific basis

Initial finding: some words are realized with consistently high mid vowels (top), some with consistently low mid vowels (bottom), and others vary (center)

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**: $d$-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** 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

Lower (front) vowels expected in closed syllables, in some varieties

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

If neutralization to /e o/ occurs, higher vowels expected in unstressed syllables

6. 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: 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

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**Results of k-means clustering**

**Regional differences in clustering of specific lexical items**

**Effects of syllable structure on vowel clustering**

**Duration: a secondary cue to phonological height?**

**Unstressed vowels: asymmetrical evidence for neutralization**

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**7. Acknowledgments and References**

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Farneti, Carla & Dino Kori. 1986. Effects of syllable and word structure on segmental diphthongs in spoken Italian. Speech Communication 1(4), 27-44


