

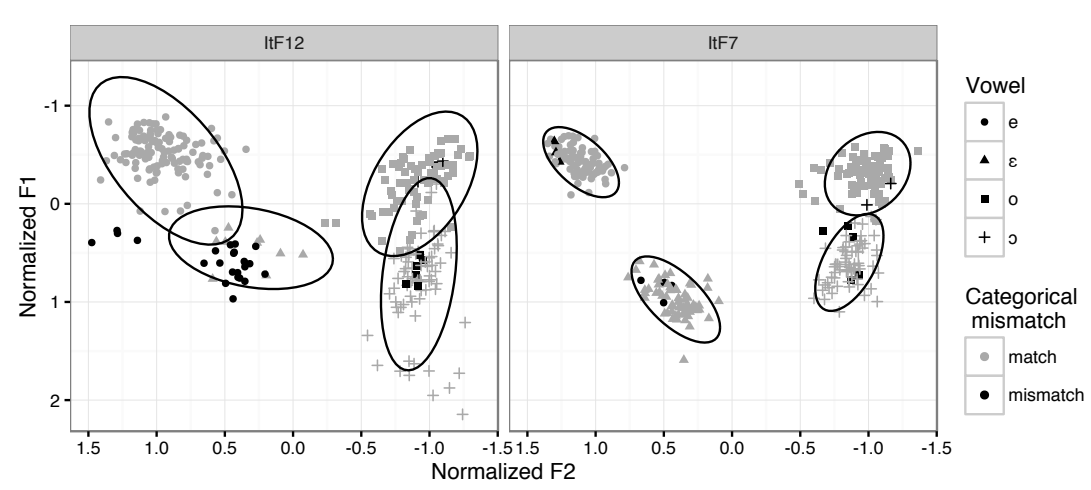
1. Italian mid vowel contrasts

- ❖ /e/ and /o/ *chiuso*: /peska/ *pesca* ‘fishing’ /forɔ/ *foro* ‘hole’
- ❖ /ɛ/ and /ɔ/ *aperto*: /peska/ *pesca* ‘peach’ /forɔ/ *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 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?

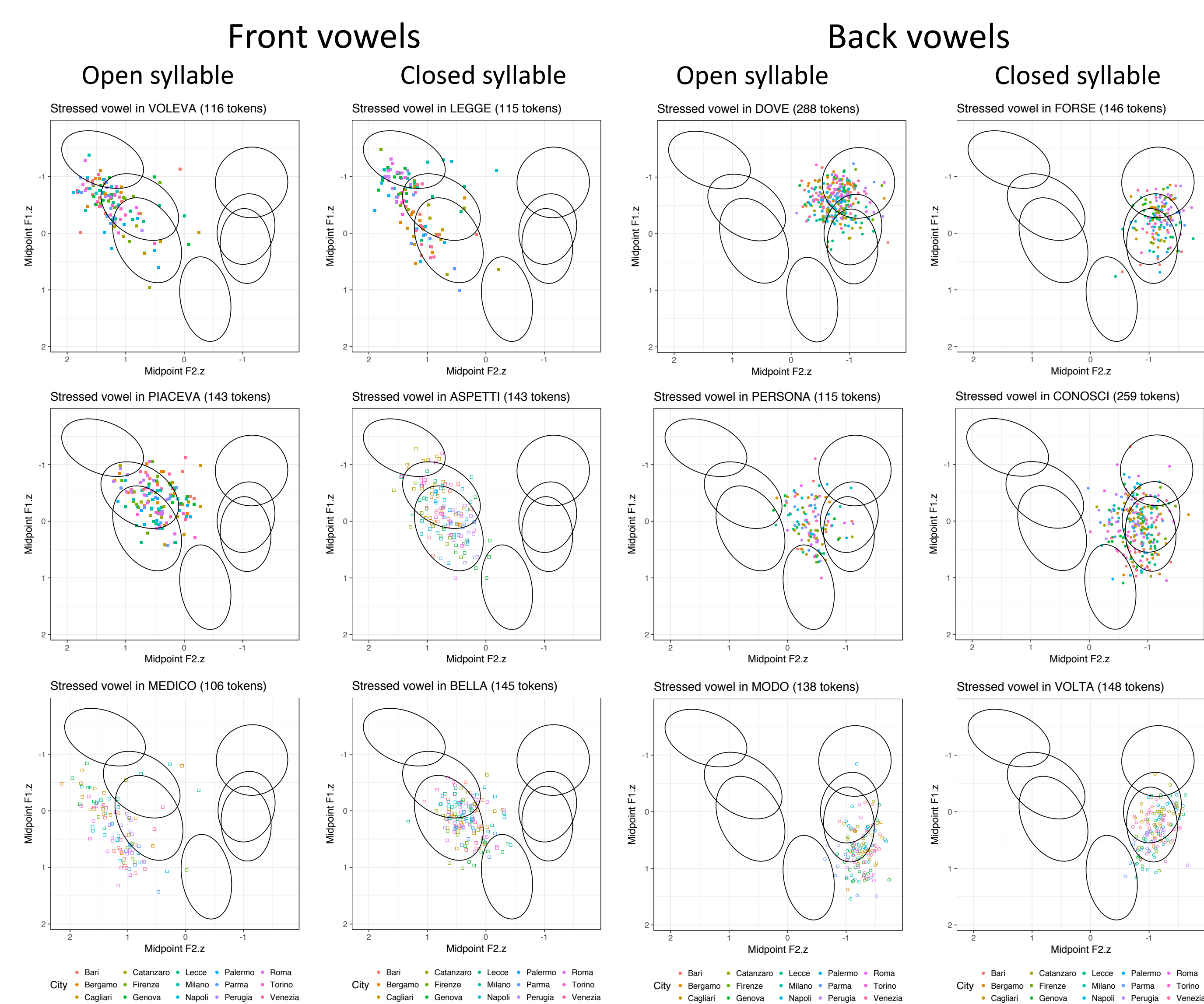
3. Mid vowel variation across Italy: a corpus approach

- ❖ 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; Kessler 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 χ^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 higher mid vowels (top), some with consistently lower mid vowels (bottom), and others variably (center)

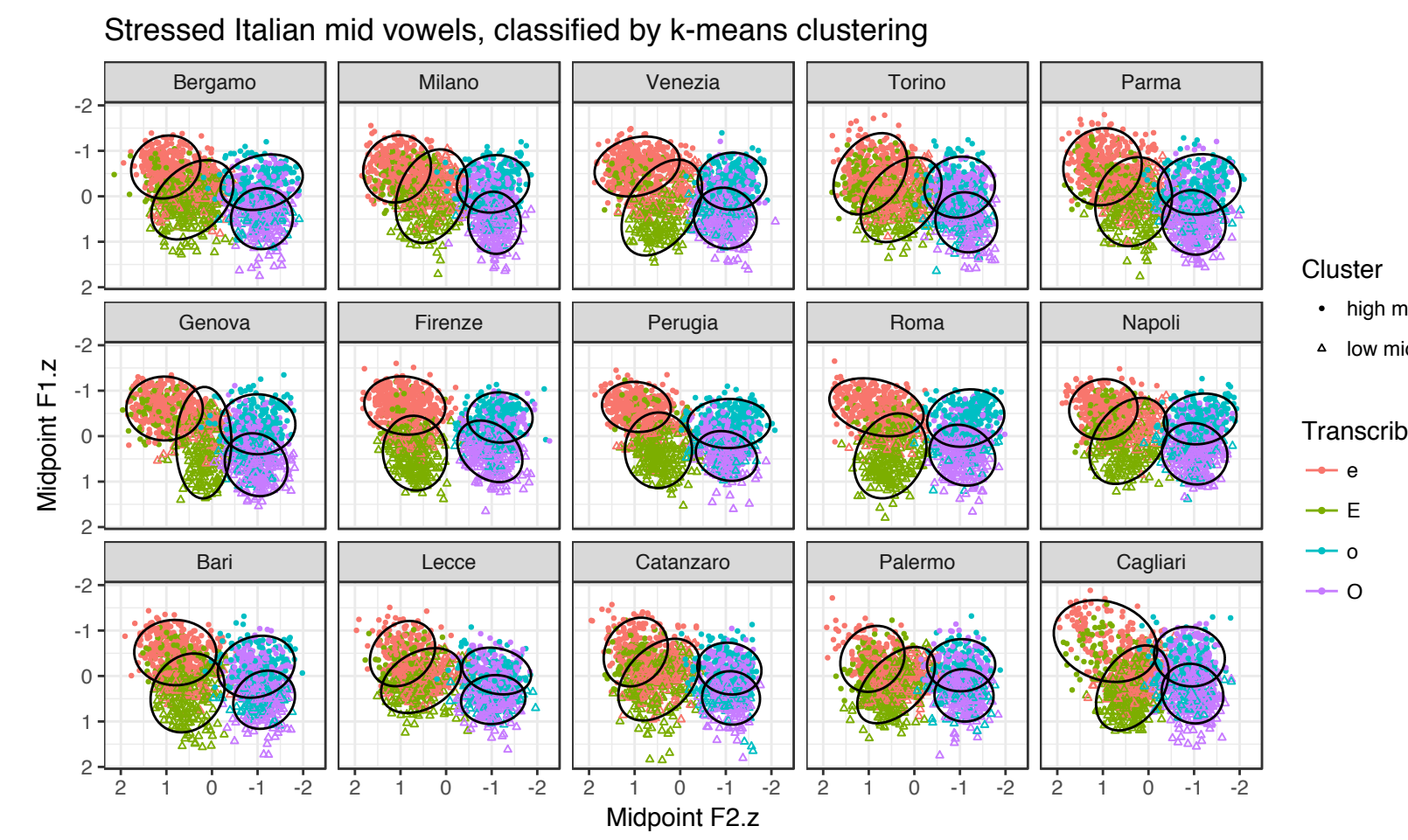


5. Automatic classification of mid vowels

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:** 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
- ❖ Lower (front) vowels expected in closed syllables, in some varieties
- ❖ Longer durations expected in open syllables (e.g. Farnetani & Kori 1986)
- ❖ If neutralization to /e, o/ occurs, higher vowels expected in unstressed syllables

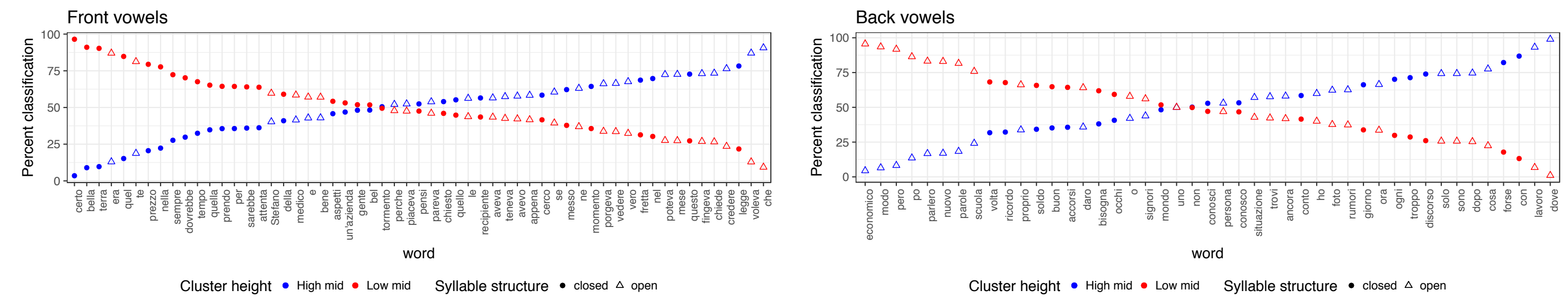
Results of k-means clustering



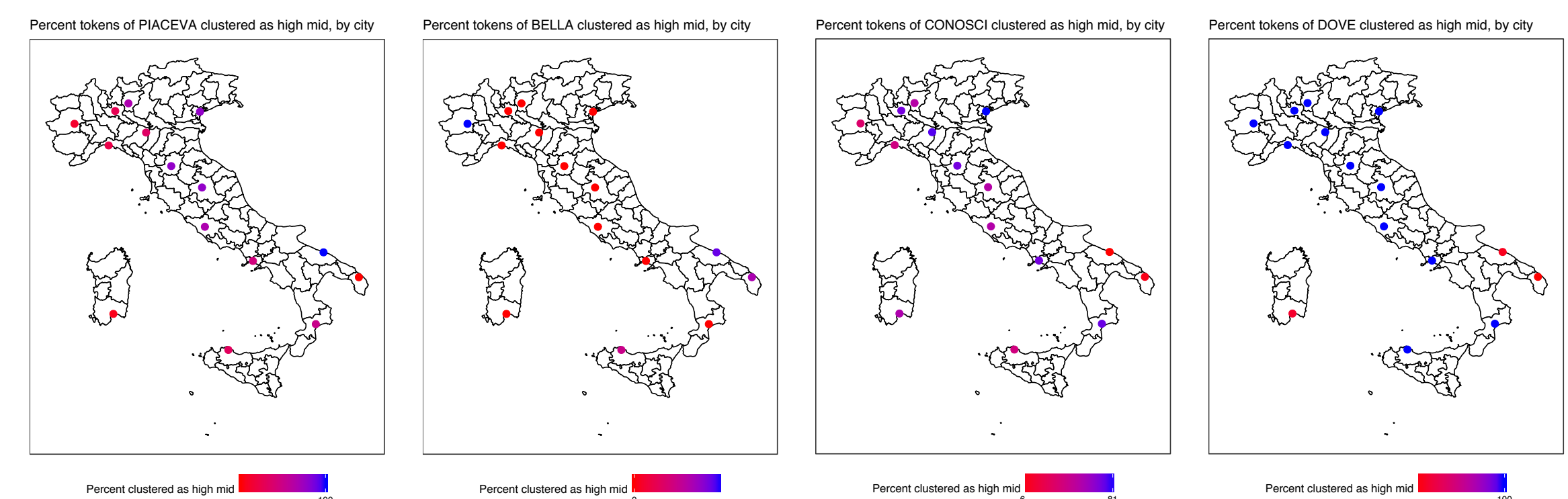
Results of k-means clustering, colored by vowel transcribed by MAUS, for comparison

Hypothesis: Less-variable words appear mostly in one cluster, while more variable words appear across both clusters

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

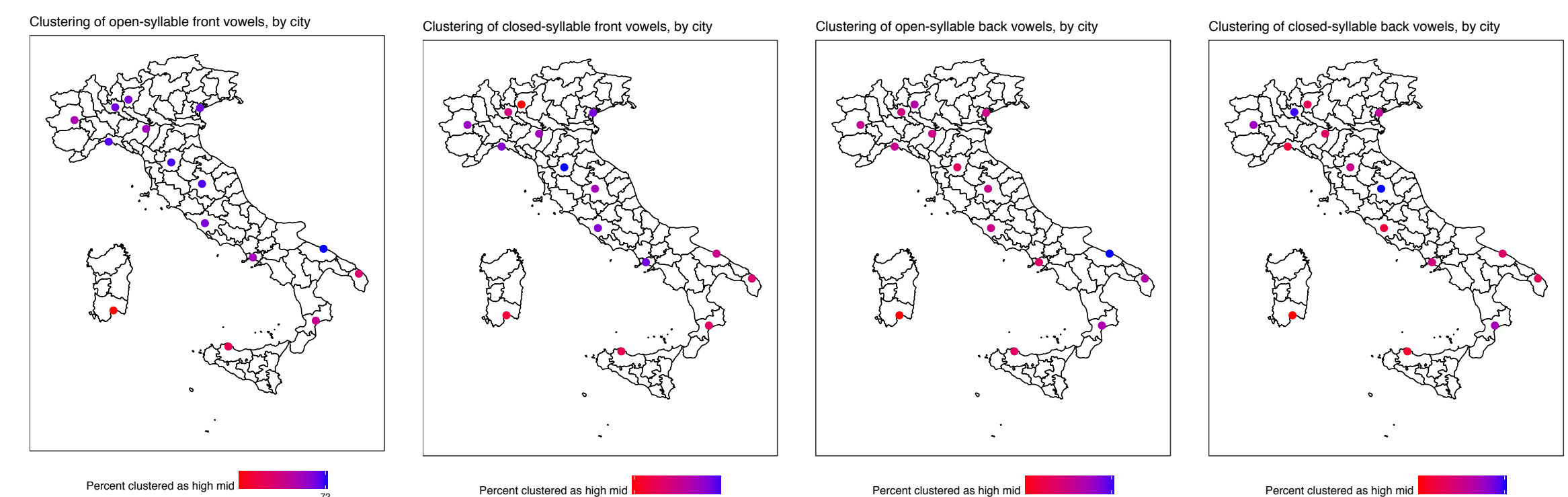


Regional differences in clustering of specific lexical items



While some words are consistently classified, many are variable

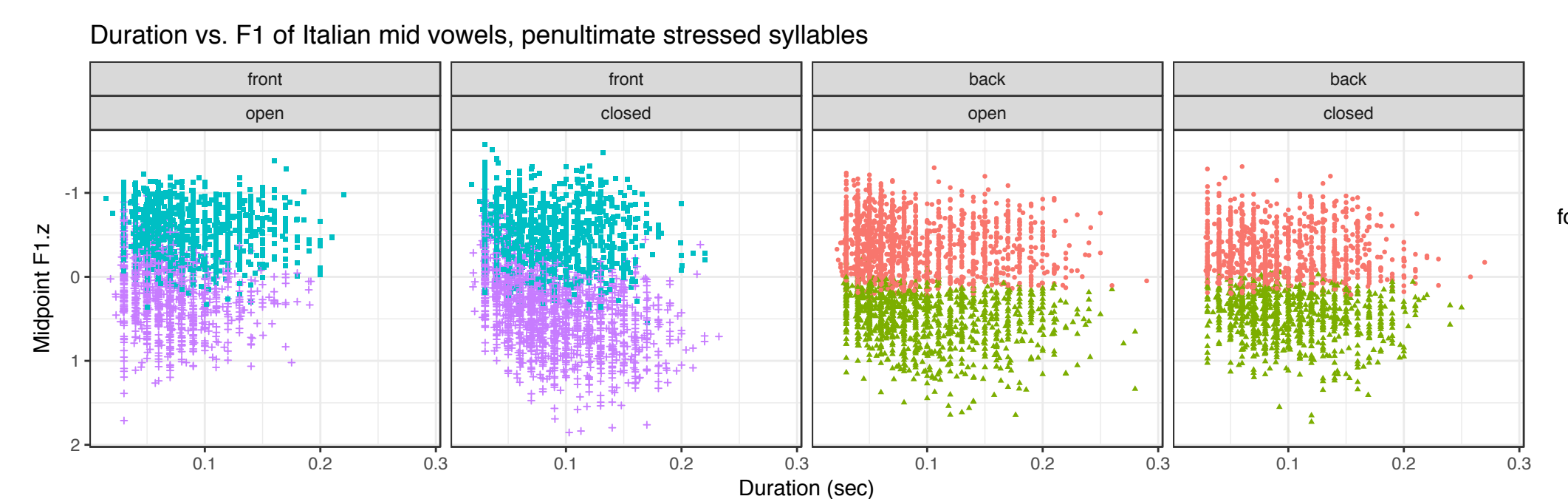
Effects of syllable structure on vowel clustering



In Northern varieties, [ɛ] is conditioned in closed syllables

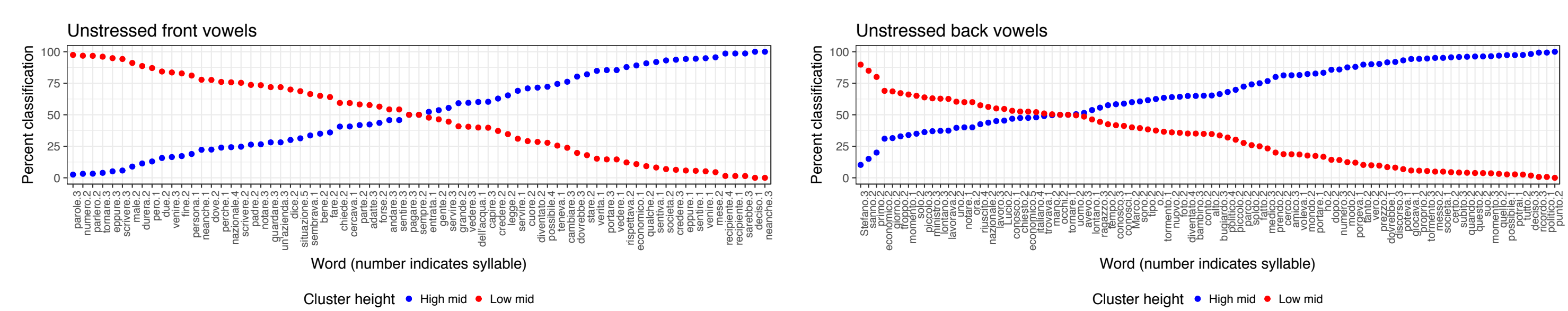
Here, considerable regional variation occurs throughout

Duration: a secondary cue to phonological height?



Cluster	σ structure	Correlation	Cluster	σ structure	Correlation
Higher front	Open	$r^2 = 0.06, p < 0.01$	Higher back	Open	$r^2 = 0.06, p < 0.01$
Higher front	Closed	$r^2 = 0.15, p < 0.001$	Higher back	Closed	$r^2 = 0.04, p = 0.1226$
Lower front	Open	$r^2 = 0.24, p < 0.001$	Lower back	Open	$r^2 = 0.23, p < 0.001$
Lower front	Closed	$r^2 = 0.49, p < 0.001$	Lower back	Closed	$r^2 = 0.14, p < 0.001$

Unstressed vowels: asymmetrical evidence for neutralization



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

7. Acknowledgments and References

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