Lexical stress and vowel length in South Tyrolean German

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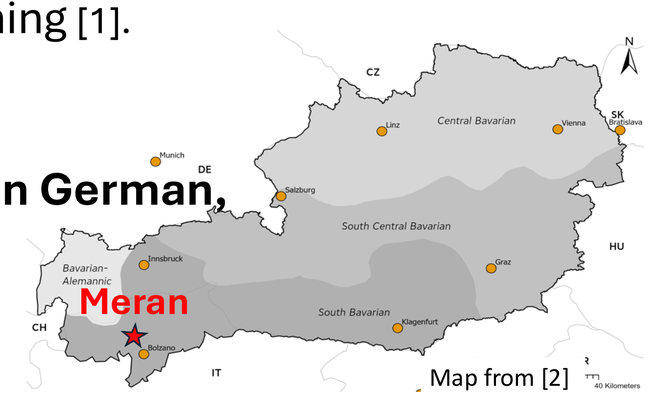
1. BACKGROUND

Lexical stress and **vowel length** can both be encoded through duration, potentially creating competition within syllabic timing [1].

We investigate the dialect of German spoken in **Meran, South Tyrol,** a variety of **Southern Bavarian German,** mainly spoken in Austria and Northern Italy where:

- Vowel length is cued only by duration without a systematic quality difference
- It remains unclear how vowel length contrasts interact with stress
- Whether vowels and consonants in VC sequences are timed independently or as a unit has not yet been examined in this dialect
- In other Bavarian dialects, the complex durational trade-off between segments in VC sequences has been well documented (e.g., [3])



Map from [2]

This study investigates whether duration-based vowel length contrasts are preserved across stress conditions and how stress influences the relative and absolute internal timing of VC sequences.

2. RECORDINGS

Field recordings of **35 native speakers** (22F, 13M) in Meran**,** South Tyrol.
Inventory recorded in **42 words**; VC sequences contained long and short **/i u e o ɛ ɒ a/** and postvocalic plosives **/b p d t g k/**.

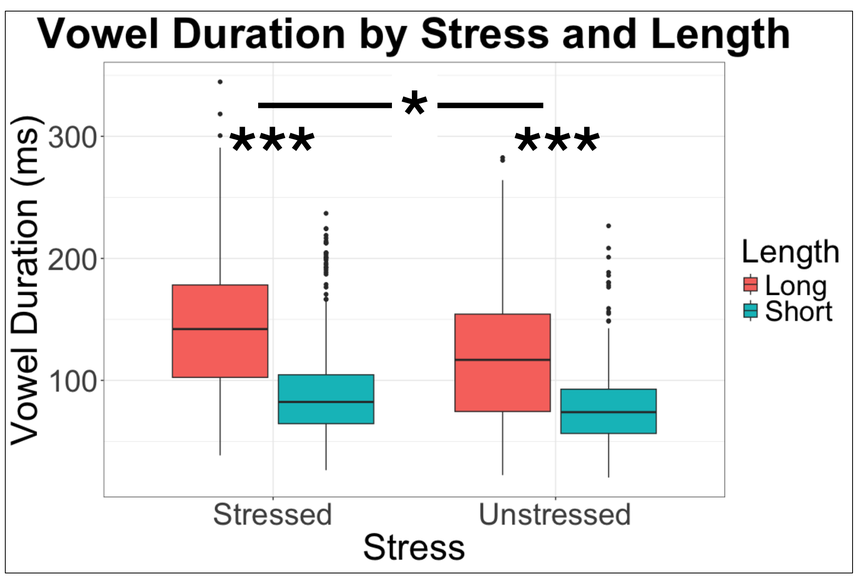
Measures:

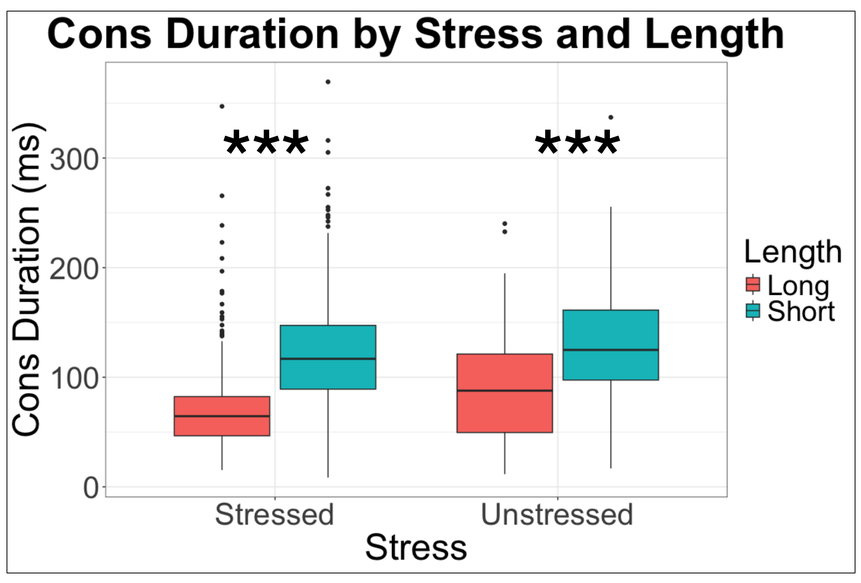
- Absolute segment/cluster duration
- Long-short, stressed-unstressed, and vowel-consonant ratios

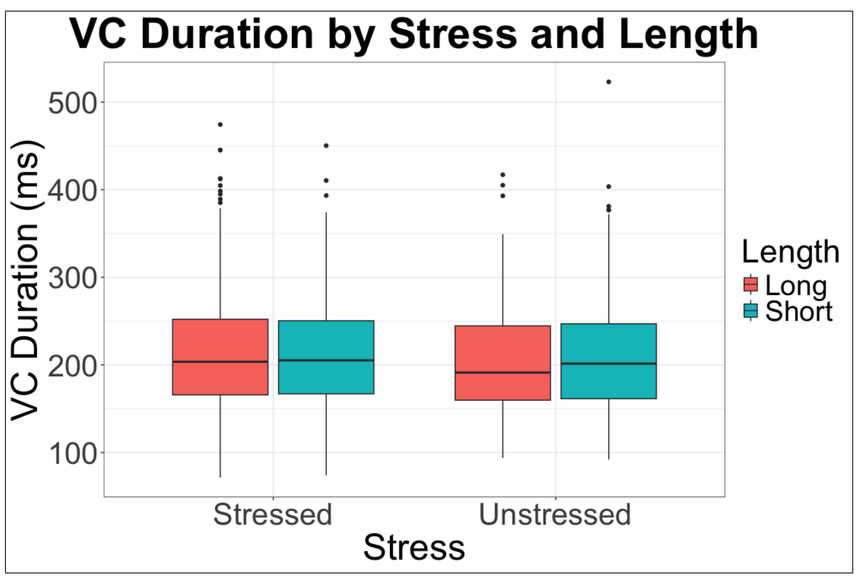
Measures modeled with mixed-effects linear regression [4] and when applicable, Tukey's HSD pairwise comparisons [5].

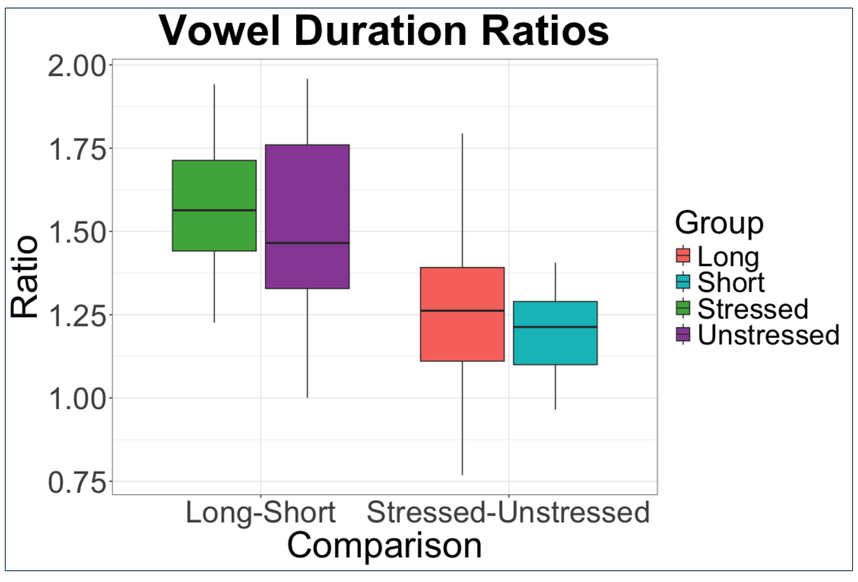
3. RESULTS

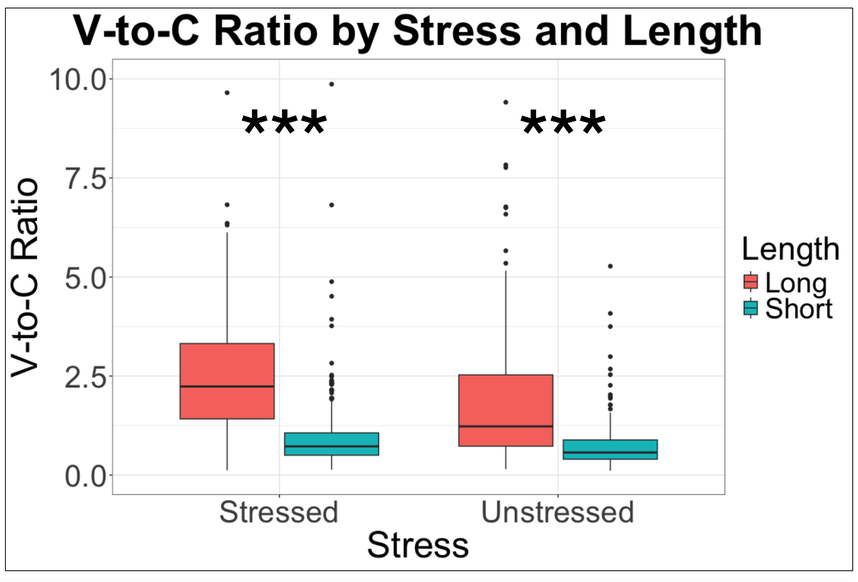
(Note: Length refers to the length of the vowel)











4. DISCUSSION

Vowel length contrasts are durationally preserved across stress conditions: long and short stressed vowels are lengthened proportionally to an equal degree.
Postvocalic consonant duration and vowel duration covary inversely.
Stress affects the segmental durations within a VC sequence, but not the sequence's total duration: VC sequences have constant duration regardless of:

- Phonemic vowel length
- Lexical stress

Our results suggest:

(1) long-short durational contrasts are preserved even in unstressed syllables
(2) VC sequences show consistent durations, indicating they act as timing units, giving insight on prosodic structure in Southern Tyrolean German

Acknowledgements & References

Work funded by the Deutsche Forschungsgemeinschaft (DFG, Grant #469384455) and the Autonome Provinz Bozen, Südtirol (#I83C22000390005). [1] Lehiste, I. (1970). *Suprasegmentals*. Cambridge: M.I.T. Press. [2] Vergeiner, P. C., Luttenberger, J., Bülow, L., Wallner, D., & Britain, D. (2023). Revisiting areal and lexical diffusion: the case of Viennese Monophthongization in Austria's traditional dialects. Linguistics, 61(4), 915-957. [3] Kleber, F. (2020). Complementary length in vowel–consonant sequences: Acoustic and perceptual evidence for a sound change in progress in Bavarian German. Journal of the International Phonetic Association, 50(1), 1-22.[4] Bates, D., Maechler, M., Bolker, B., Walker, S., Christensen, R. H. B., Singmann, H., and Grothendieck, G. (2014). "Package lme4: Linear mixed-effects models using Eigen and S4," CRAN Repos. 1, 1–113. [5] Lenth, R., Herve, M., Love, J., Riebl, H., and Singman, H. (2021). "Package 'emmeans' [software package]".

THE INNER COMPOSITION OF DIPHTHONGS: FIRST INSIGHTS FROM TYROLEAN

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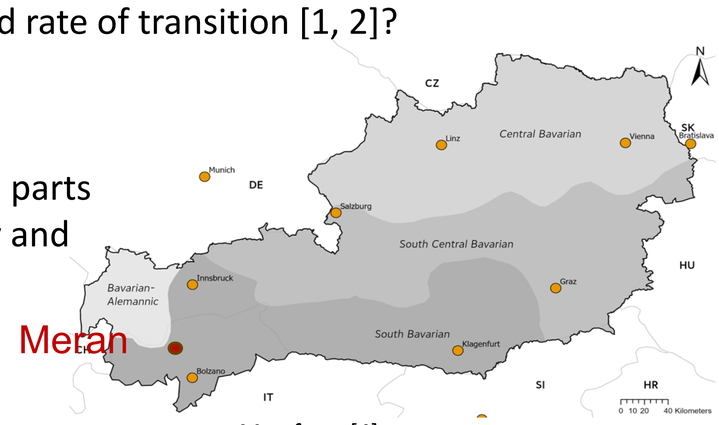
Background

Compositionality of diphthongs:
Combinations of independently available monophthongs or dynamic vowels, defined for onset and rate of transition [1, 2]?

Tyrolean is a South Bavarian dialect of German, spoken in parts of Austria and Northern Italy and is characterized by a rich diphthong inventory [3].



Map from [4]

14 contrastive monophthongs: /i-iː, e-eː, ɛ-ɛː, a-aː, u-uː, o-oː, ɒ-ɒː/
No quantity-quality difference for monophthongs.
9 diphthongs: /ai, au, ui, ia, ua, ɛa, ɒa, ei, ou/

Research approach:
- Relation diphthong **onset/offset frequencies** to monophthong inventory
- Comparing **variability** of diphthong onset, offset frequencies
- Analysis of **movement direction** in formant space

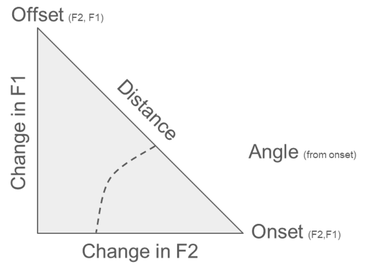
Recordings

Field recordings of **35 speakers** (22F, 13M, 20-86 years) in Meran.
Inventory recorded over 105 **real words in read speech**;
4-6 words per vowel.

Measurements:
- **F1, F2** [5] over 10% window centered at
  50% of vowel duration for monophthongs
  20, 80% of vowel duration for diphthongs
  Normalization by scaling to [0, 1] per speaker
- **Pillai** score
  to assess vowel category overlap in formants
  threshold for distinctness: > 0.3 [6]
- **Trajectory length:** Euclidean distance of normalized F1, F2

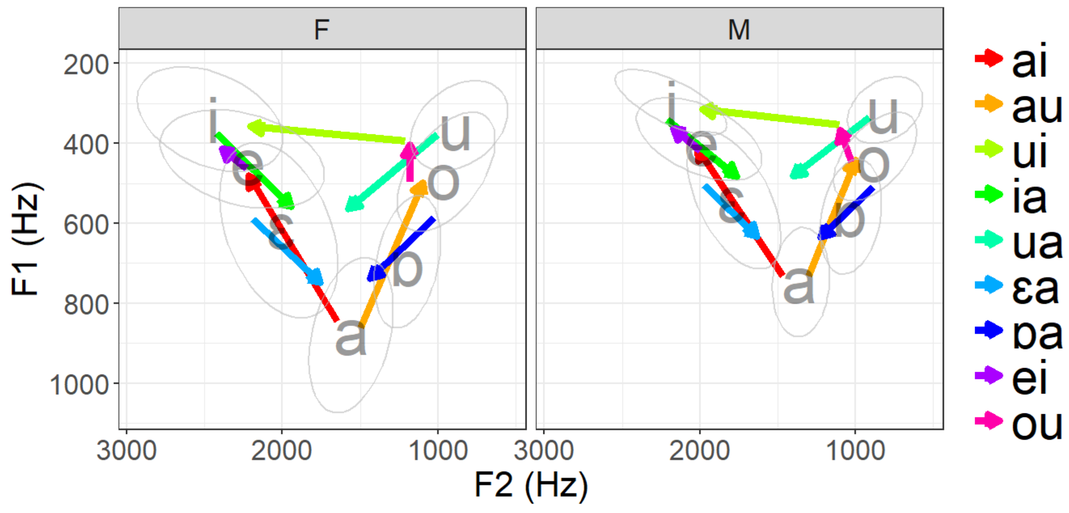
$$ED = \sqrt{\Delta F1_{norm}{}^2 + \Delta F2_{norm}{}^2}$$

- **Direction of movement**
  angle of change in the F1/F2 space toward the offset relative to the onset

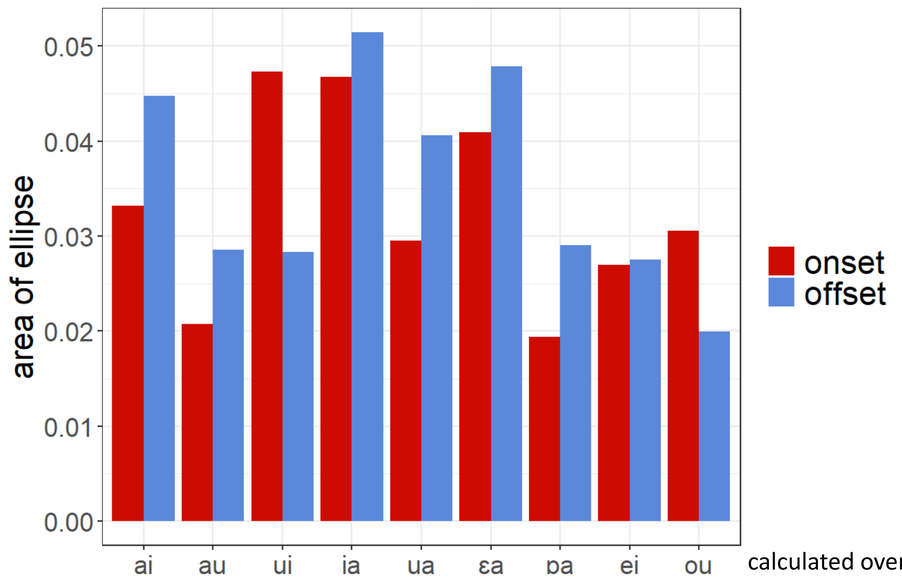


Results

Monophthong and diphthong inventory

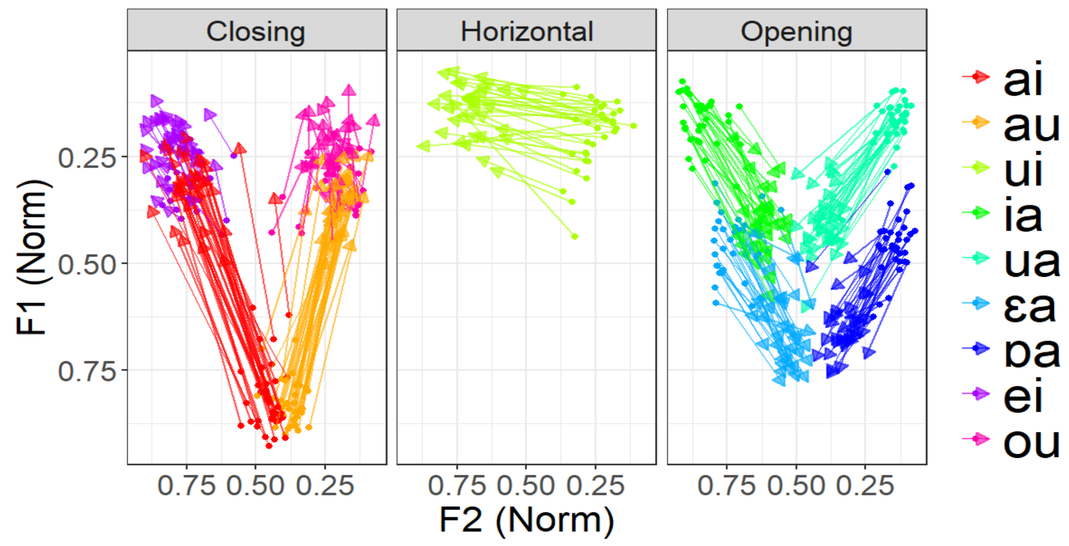


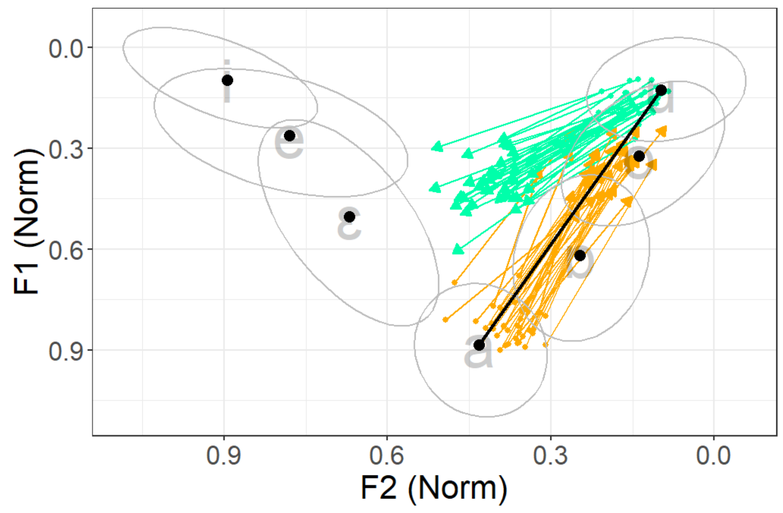
Onset – offset variability across speakers and items



calculated over normalized formants

Diphthongs by speaker





Direction of movement

For all diphthongs but /ei ou ua/, the movement angle does not differ significantly from the angle of a straight line connecting corresponding monophthongs.

Discussion

Relationship to monophthong inventory: Most diphthong onsets are close to what the transcriptions from the literature [3] suggest, but particularly offsets can undershoot their assumed target
- /ai, au/ are closer to /ae, ao/ based on the Pillai score
- /ia, ua/ are mid-centralizing (/iɛ, uə/ rather than wide-opening, and by no means symmetric with /ai, au/.

Onset/offset variability: There is little evidence for the onset being less variable than the offset across diphthong qualities.
Direction of movement: The direction of movement is in most cases statistically identical to the axis connecting the monophthong centroids, with the exception of the narrow diphthong /ei, ou/ and the mid-centralizing diphthong /ua/.

This means that the diphthong inventory of Tyrolean is closely related to the monophthong inventory, with the exception of /ua/.
Onset frequencies are well described by the monophthong inventory, offset differences mostly seem to arise from undershoot.
The direction of movement in formant space is generally similar to the axis of independently available monophthong. Exceptions are /ua, ei, ou/.

Acknowledgments & References

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References:[1] Gay, T. (1968). Effect of Speaking Rate on Diphthong Formant Movements. *The Journal of the Acoustical Society of America, 44(6), 1570-1573. doi:10.1121/1.1911298*. [2] Petersen, S. (2018). Accounting for diphthongs: duration as contrast in vowel dispersion theory. *PhD Dissertation, Georgetown University, Washington D.C., USA*. [3] Insam, M. (1936). *Der Lautstand des Burggrafenamtes von Meran*. Leipzig: Hirzel. [4] Vergeiner, P. C., Luttenberger, J., Bülow, L., Wallner, D., & Britain, D. (2023). Revisiting areal and lexical diffusion: the case of Viennese Monophthongization in Austria's traditional dialects. *Linguistics*, 61(4), 915-957. doi:doi:10.1515/ling-2021-0105 [5] Barreda, S. (2021). Fast Track: fast (nearly) automatic formant-tracking using Praat. Linguistics Vanguard, 7(1). [6] Hay, J., Warren, P., & Drager, K. (2006). Factors influencing speech perception in the context of a merger-in-progress. *Journal of Phonetics*, 34(4), 458-484. doi:https://doi.org/10.1016/j.wocn.2005.10.001.