



# The production and perception of rhotic metathesis

Rhotic metathesis in CVrC and CrVC syllables is proposed to be driven by the acoustic structure of the alveolar tap [r], which has short vocoids on each side of the rhotic constriction phase [1]. Listeners may misinterpret these vocoids as intended vowels [2]. Rhotic metathesis occurs when, at the same time, the original full vowel is parsed by the listener as the inherent vocoid of the rhotic [3].

## How does the acoustic structure of [r] influence rhotic metathesis?

### 1. Production

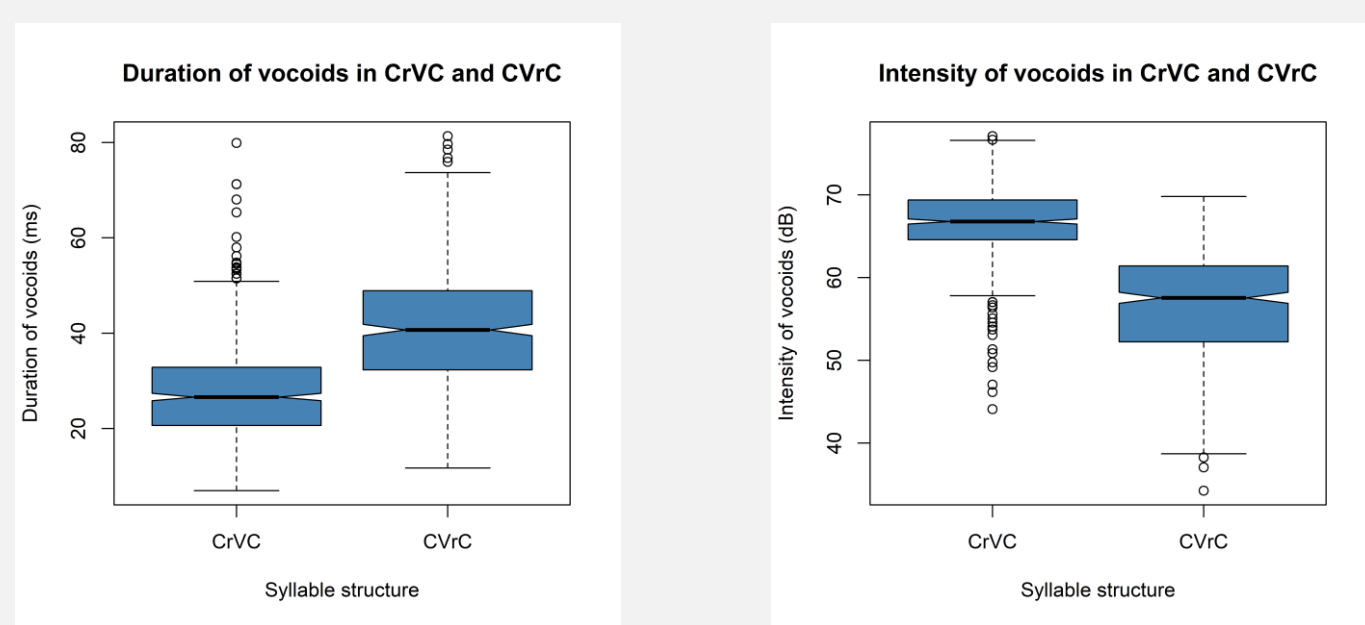
- 33 Croatian-speaking students from the University of Zagreb, all born and raised in Zagreb, took part in the production task (8 analysed so far)
- Alveolar rhotics were elicited in the contexts CVrC, CrVC, and CrC in isolated nonce words, where C was one of /p, t, k/ and V one of /i, ε, a, ɔ, u/
- The audio recordings were segmented and labelled by hand and statistically analysed using linear mixed effects models

### 2. Perception

- 113 Croatian-speaking students from the University of Zagreb were presented with stimuli of the form pV<sub>1</sub>rV<sub>2</sub>p in an 4AFC identification test
- The quality of V<sub>1</sub> and V<sub>2</sub> was identical and varied between the vowels [i, ε, a, ɔ, u] and the vowel [ə], respectively (5x5 steps)
- The duration of V<sub>1</sub> and V<sub>2</sub> varied in opposite directions between 140 ms and 36 ms, while the total duration (V<sub>1</sub>+V<sub>2</sub>) remained constant (5 steps)

### Results

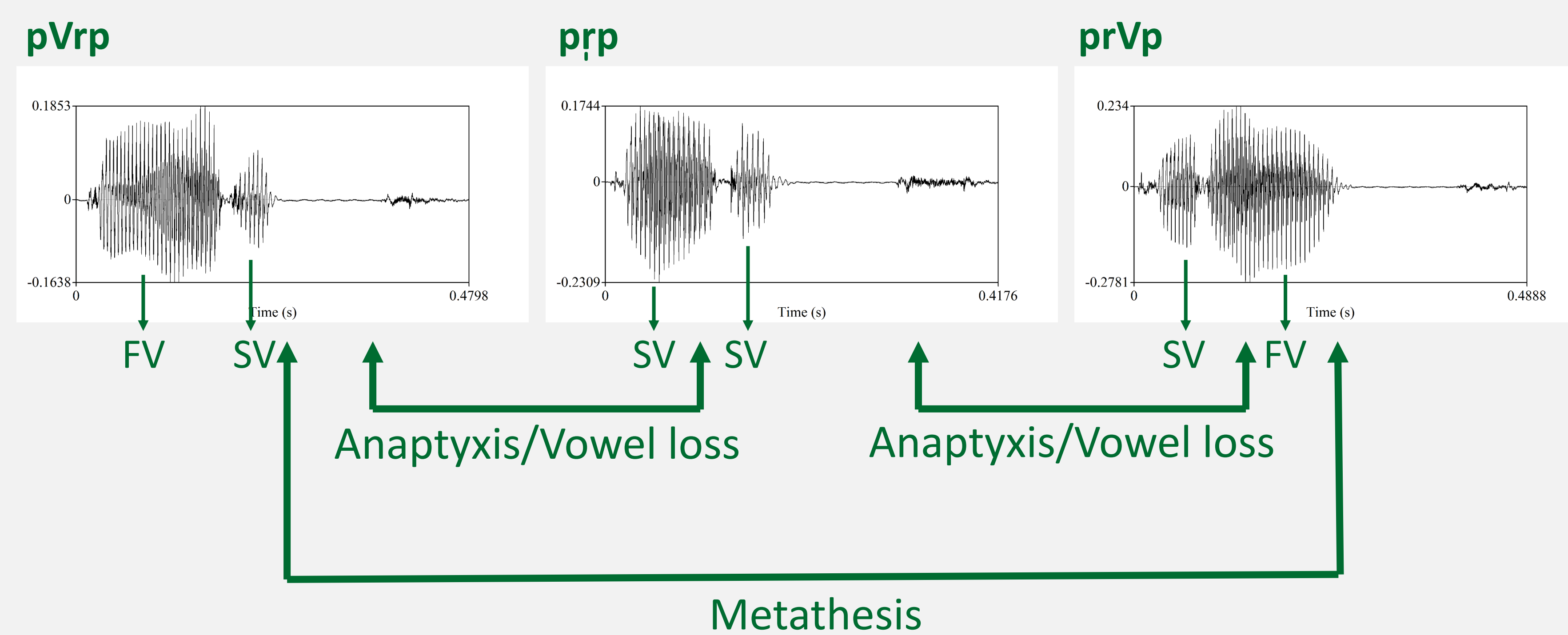
- Both duration and intensity of the vocoids with non-syllabic rhotics were correlated with the position of the tap within the syllable



- With syllabic rhotics, the first vocoids were on average longer and louder than the second vocoids
- The vocoids were produced in the central to high part of the vowel space (v = centroid)
- The first vocoids with syllabic were located lower in the vowel space and approached the quality of /ε/ (s = centroid)
- Whereas the intrinsic duration of full vowels depended on the vowel phoneme, the vocoids showed stable durations

### ACOUSTICS OF RHOTIC-VOWEL INTERACTION

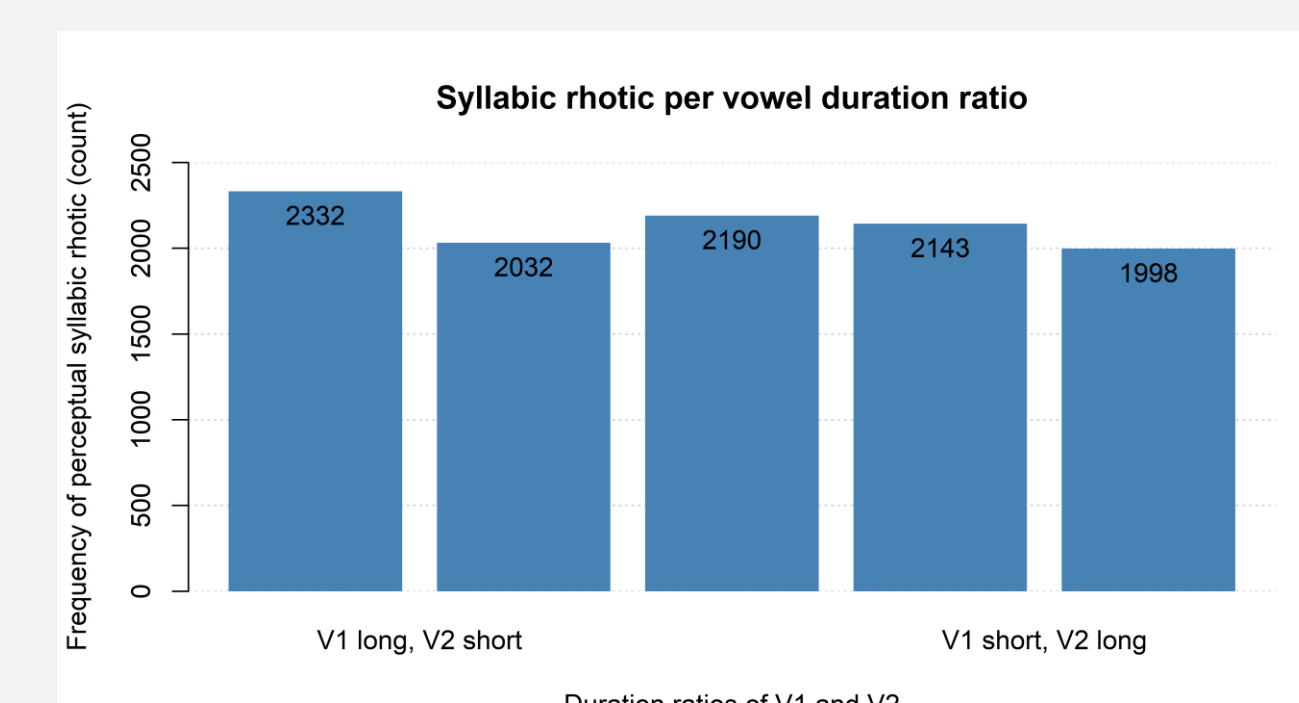
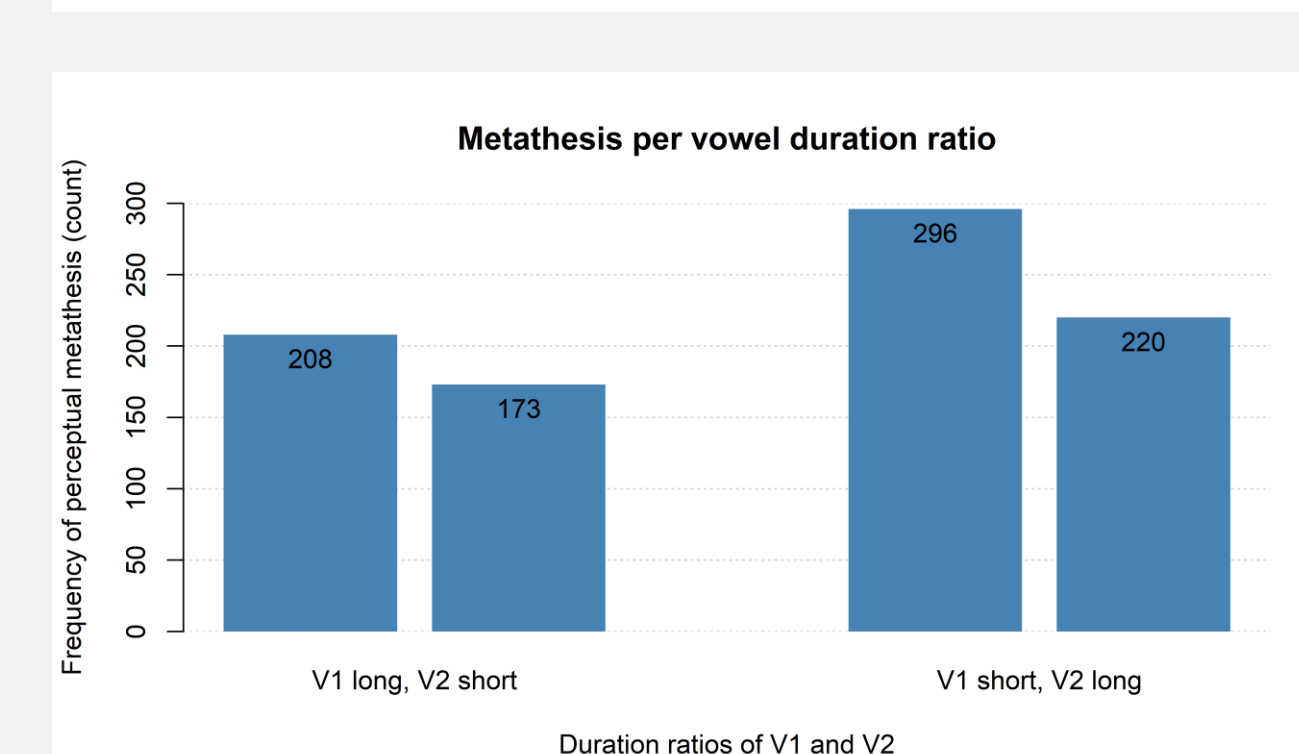
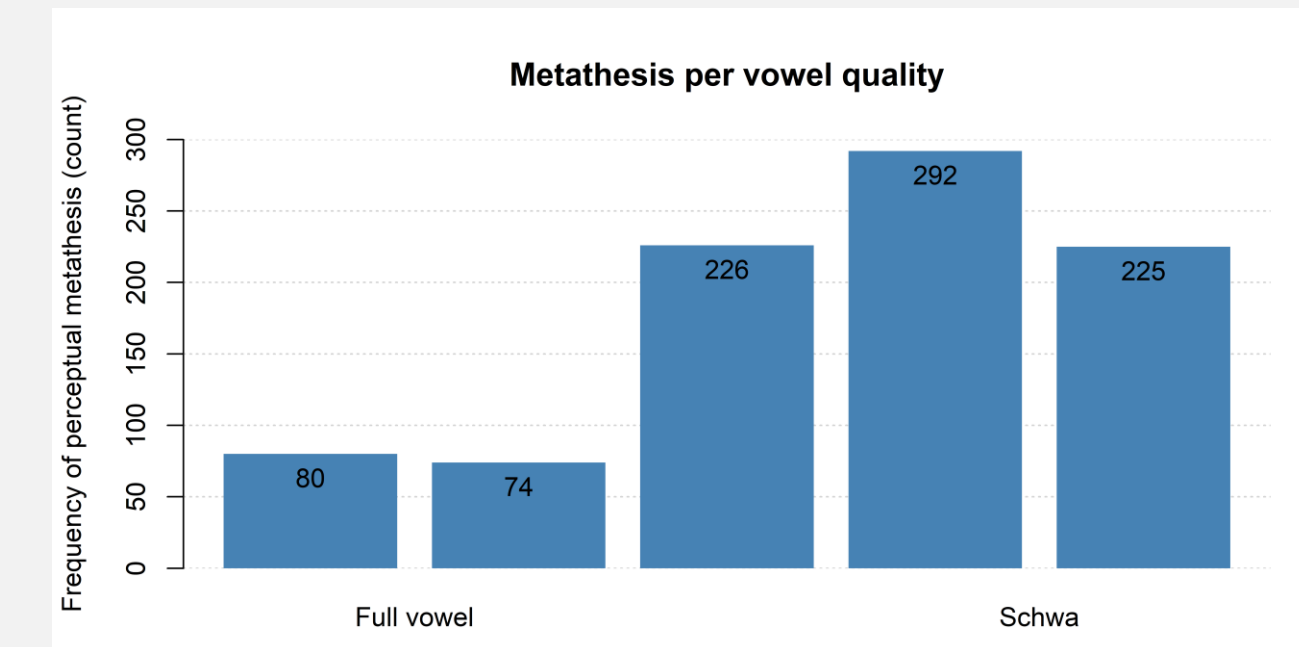
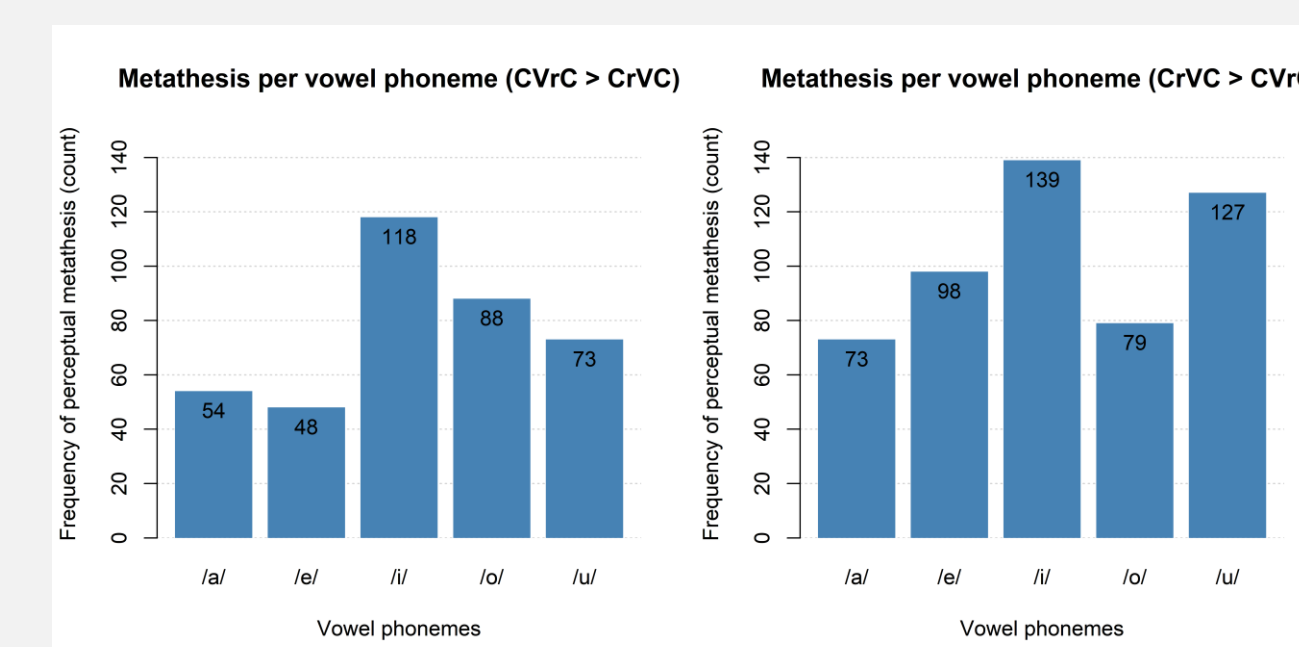
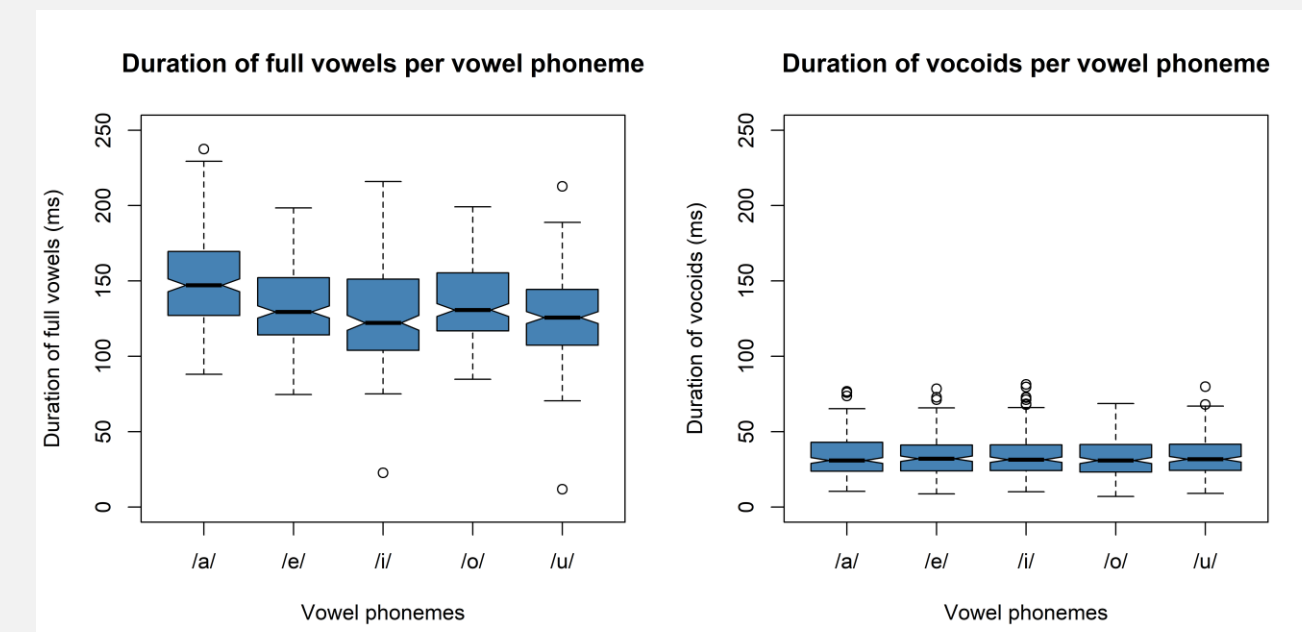
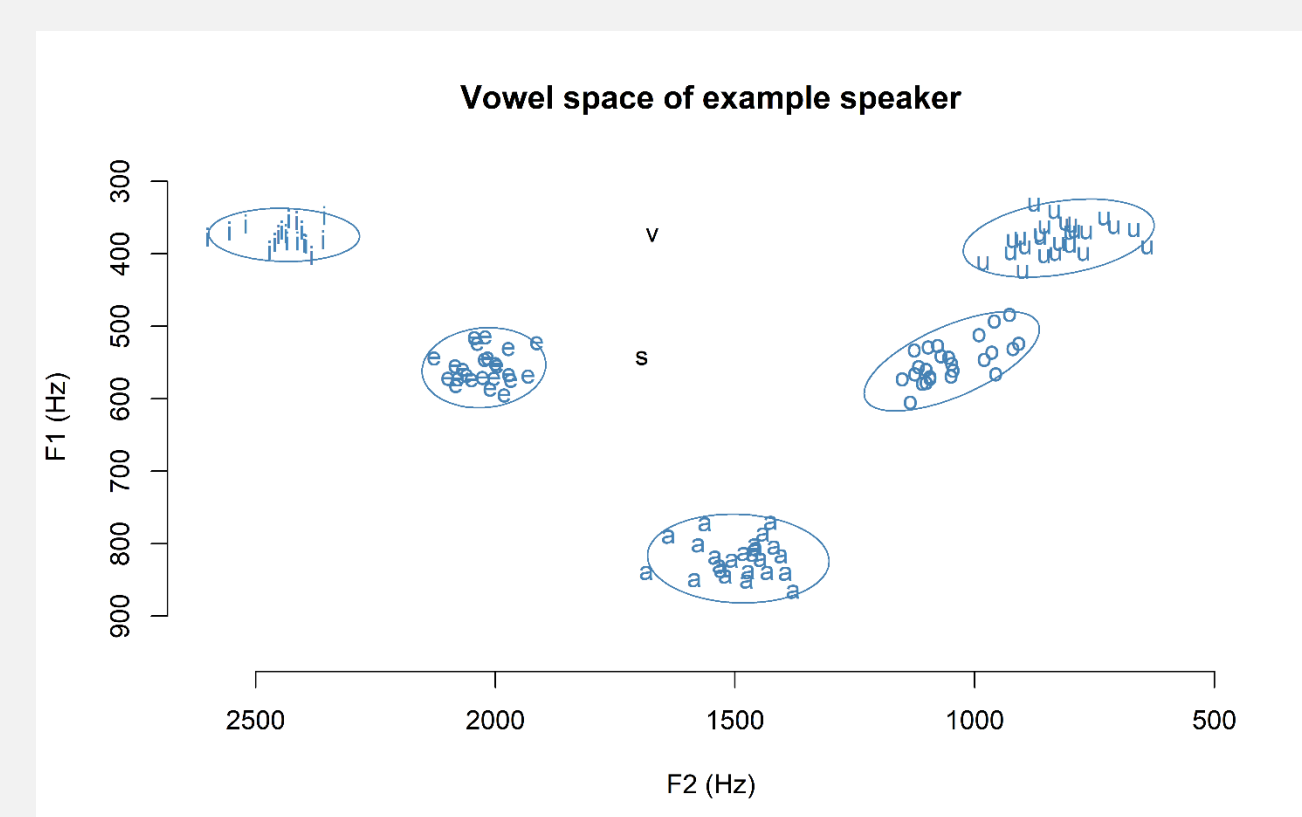
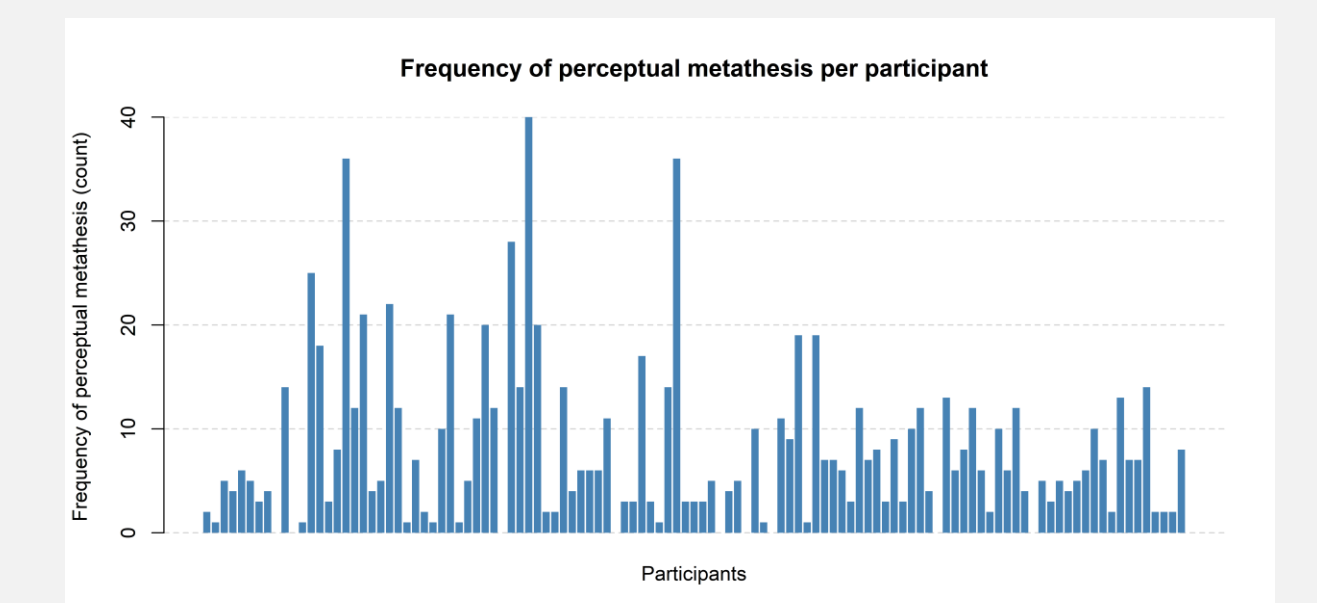
Waveforms of CVrC, CrVC, and CrC syllables with full vowels and vocoids



- Participants had to choose between answers of the form <pVrp>, <prVp>, <pVrVp>, and <prp>
- The data were statistically analysed using binomial logistic regression mixed models (metathesis yes/no)

### Results

- 897 responses were classified as metathesis (2.6% of all data)
- In order for metathesis to take off as a sound change, the community needs enough metathesisers



- Metathesis was most frequent in stimuli containing the high vowel /i/ (in both directions)
- Metathesis predominantly occurred in vowels with more centralised qualities (completely centralised vowels were often categorised as syllabic rhotic)
- Concerning duration ratios, most metatheses occurred in a relatively ambiguous prVp (heard as pVrp)
- 10,695 responses were syllabic rhotics (25.2% of all data)
- Duration ratio did not really have an influence on the perception of syllabic rhotics
- Perception of syllabic rhotics started earliest with /ε/

### 3. Conclusion

- Rhotic metathesis is a cross-linguistically rare and sporadic sound change, which is reflected by the perceptual data
- The quality of the full vowel and the vocoid seems to influence rhotic metathesis more than their duration
- A follow-up study will examine the role of intensity relations between full vowels and vocoids in rhotic metathesis

### References

[1] Proctor, M. 2009. *Gestural characterization of a phonological class: The liquids*. New Haven: Yale University.  
 [2] Ohala, J. 1992. What's cognitive, what's not, in sound change. In Kellermann, G. & Morrissey, M. (eds.), *Diachrony within synchrony*, 309-355. Frankfurt: Peter Lang.  
 [3] Czaplicki, B. 2013. R-metathesis in English: An account based on perception and frequency of use. *Lingua* 137. 172-192.

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