

Sociophonetic Variations in Afrikaans Vowel Production

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Introduction

Afrikaans is split on two main social groups: coloureds and whites. The project aims to address the following questions:

- How do coloured and whites vowel realizations differ in place of articulation?
- How can differences between two vowel spaces quantitatively be compared with regard to: effect size, dispersion and contribution of single vowels?

Data

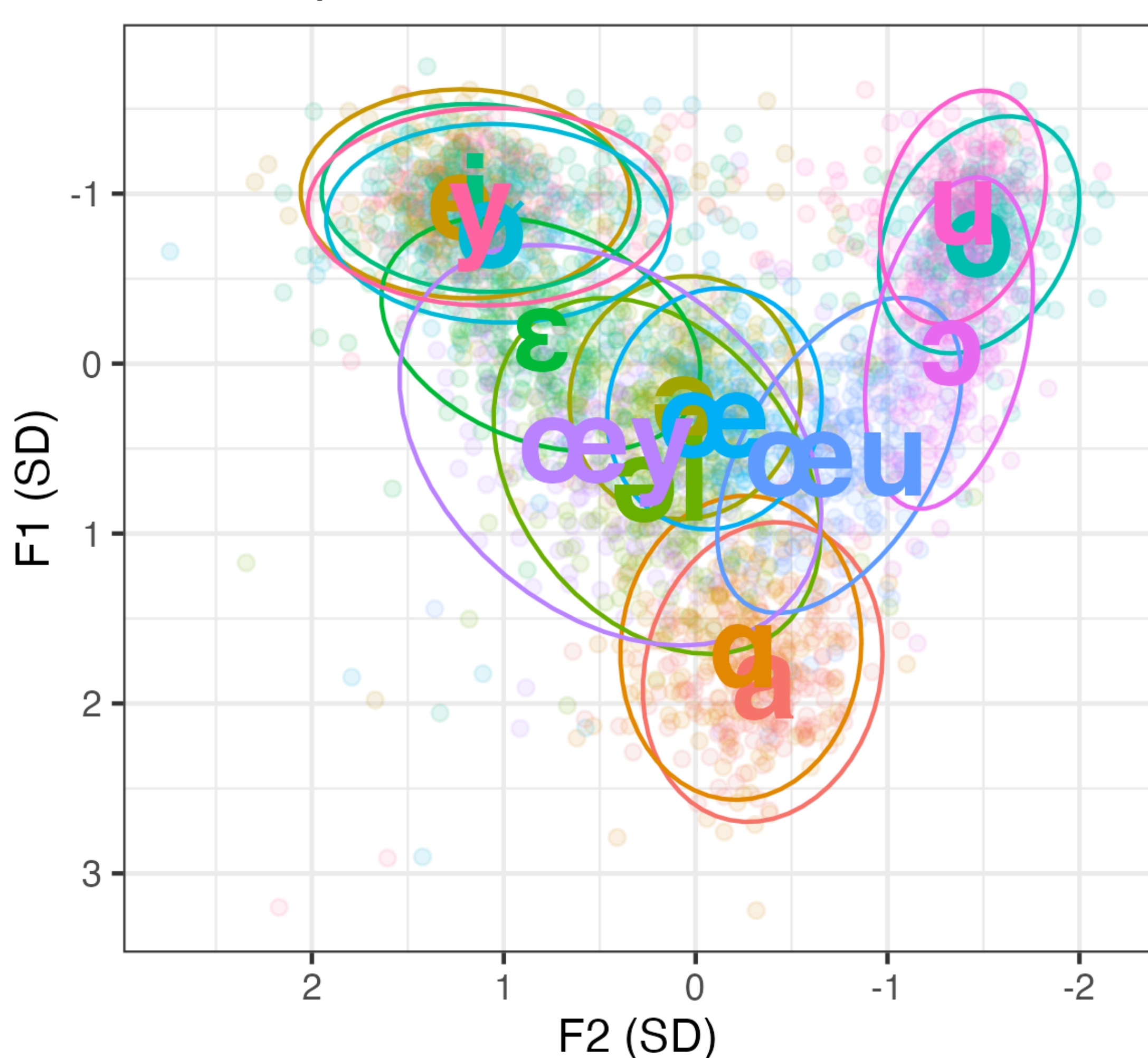
The data used were collected and supplied by Daan Wissing from North-West University, South Africa, and consist of first (F1) and second (F2) formants from whites (W) and Coloureds (C). Formants are measures used to characterize the place of articulation regarding open and closedness (F1) and front and backness (F2).

Vowels Studied:
/ə/, /a/, /ɑ/, /ɛ/, /e/, /ɛi/, /ø/, /i/, /ɔ/, /u/, /œ/, /œy/, /o/, /œu/, /y/

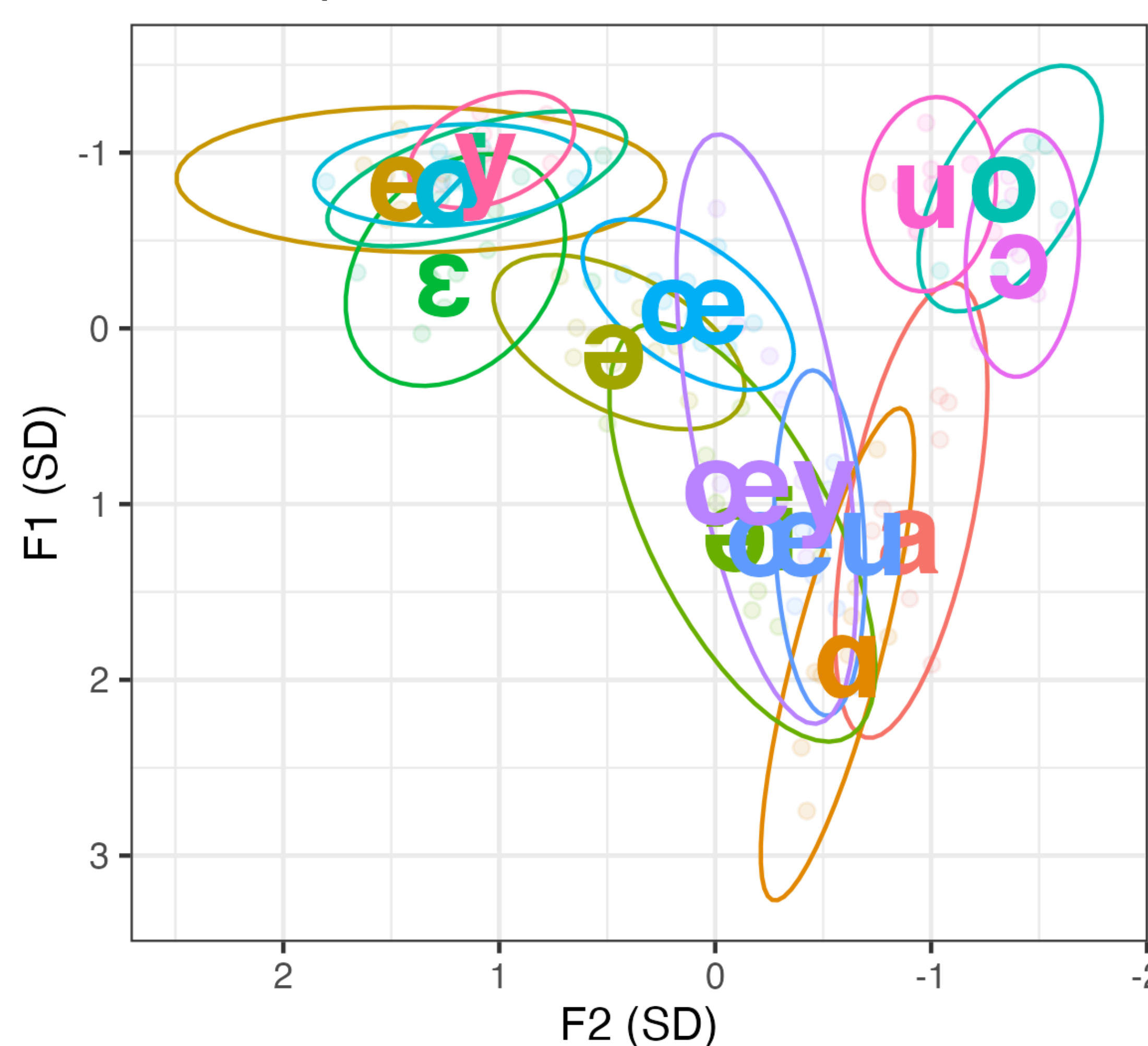
Lobanov-normalization (1971):
Units in standard deviations, reduce inter-speaker variability

The Normalized Vowel spaces where visualized and compared

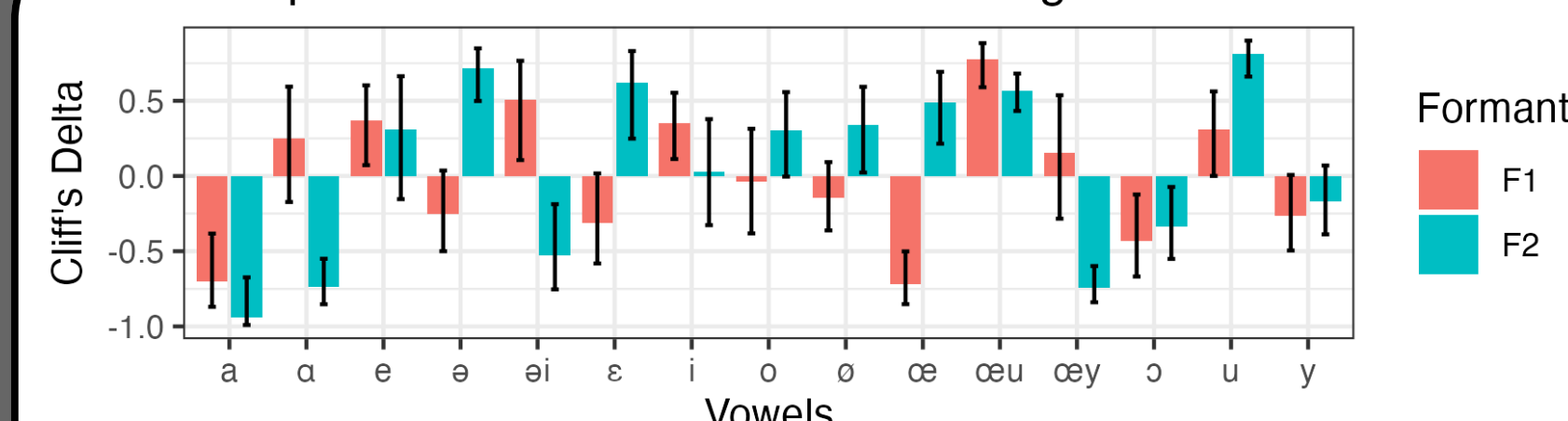
Vowel space of Coloureds, n = 3246



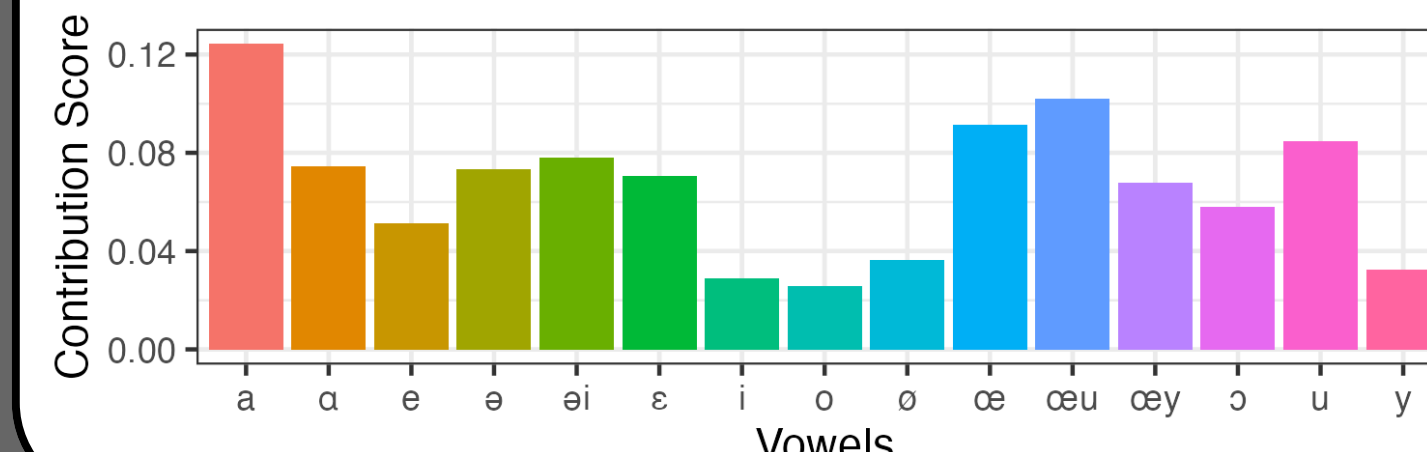
Vowel space of Whites, n = 134



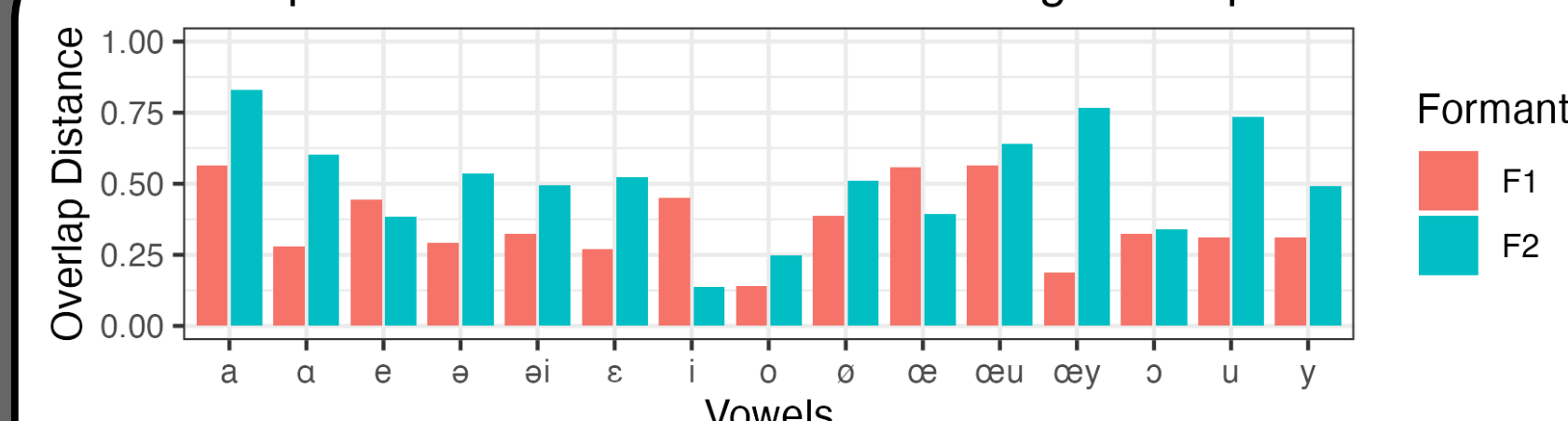
Comparison of Vowels in C and W using Cliff's Delta



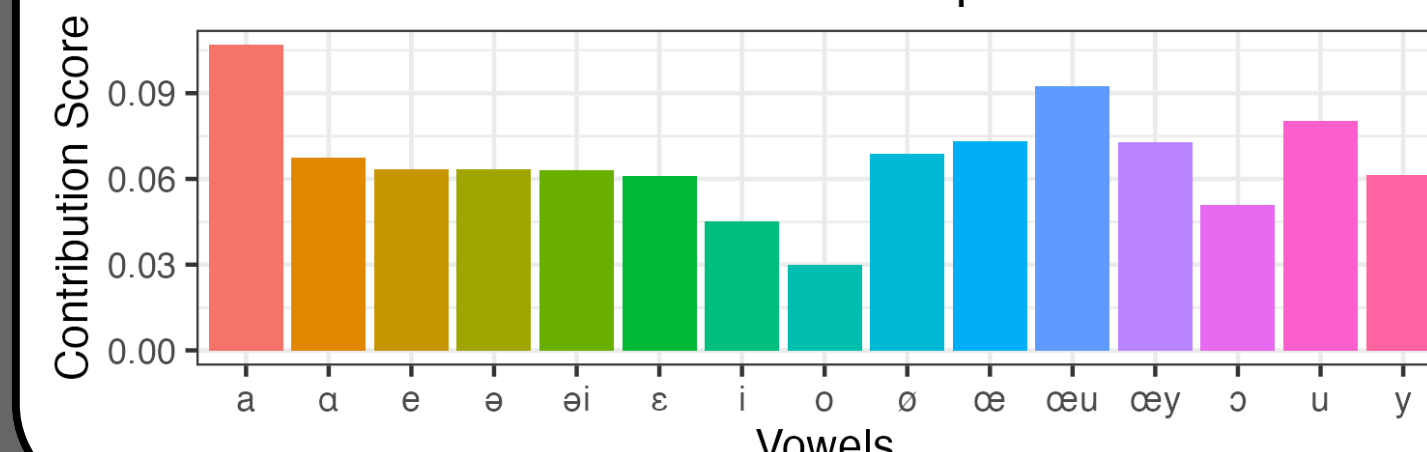
Contribution of vowels to Cliffs Index



Comparison of Vowels in C and W using Overlap Distance



Contribution of Vowels to Overlap Index



Analysis

- Determine the distributional non-overlap between single vowels (v).
- Create an index for the entire vowel space (V) to enable large scale comparisons

Overlap Distance (Pastore & Calcagni, 2019)

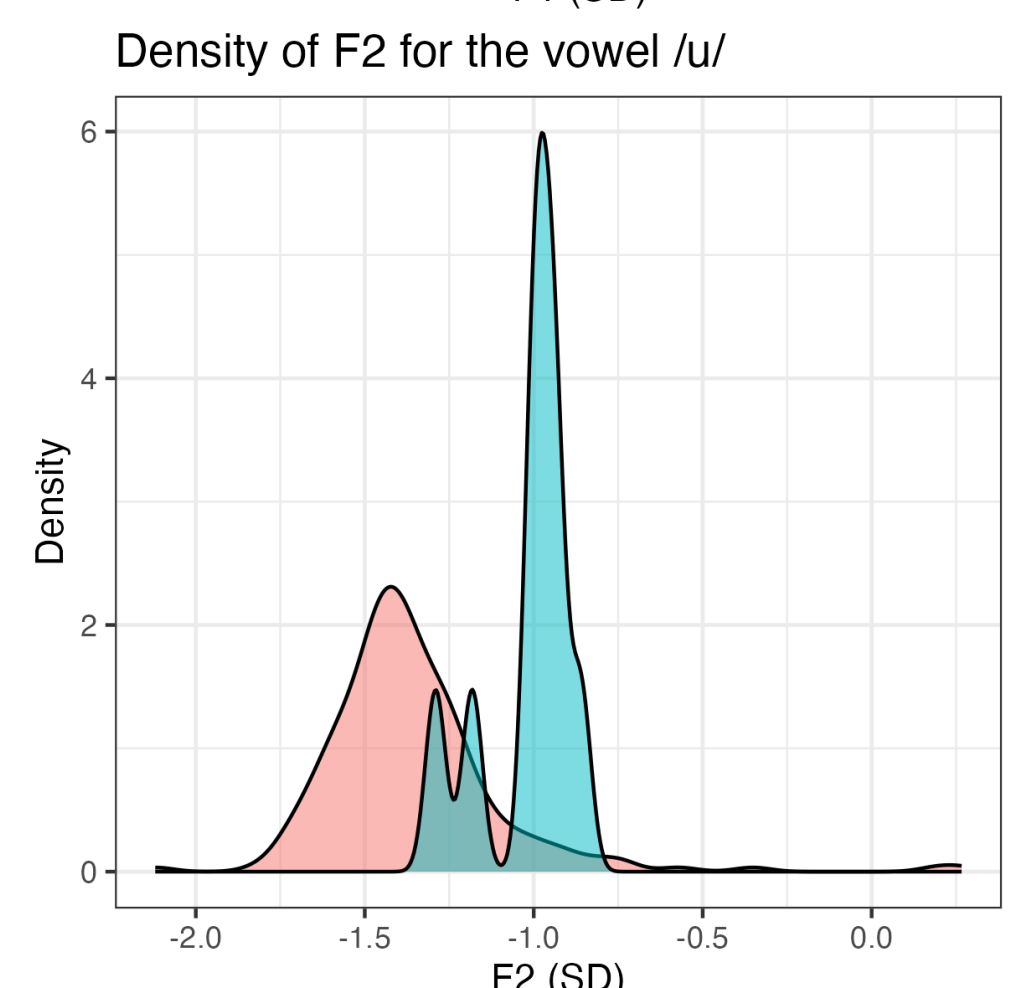
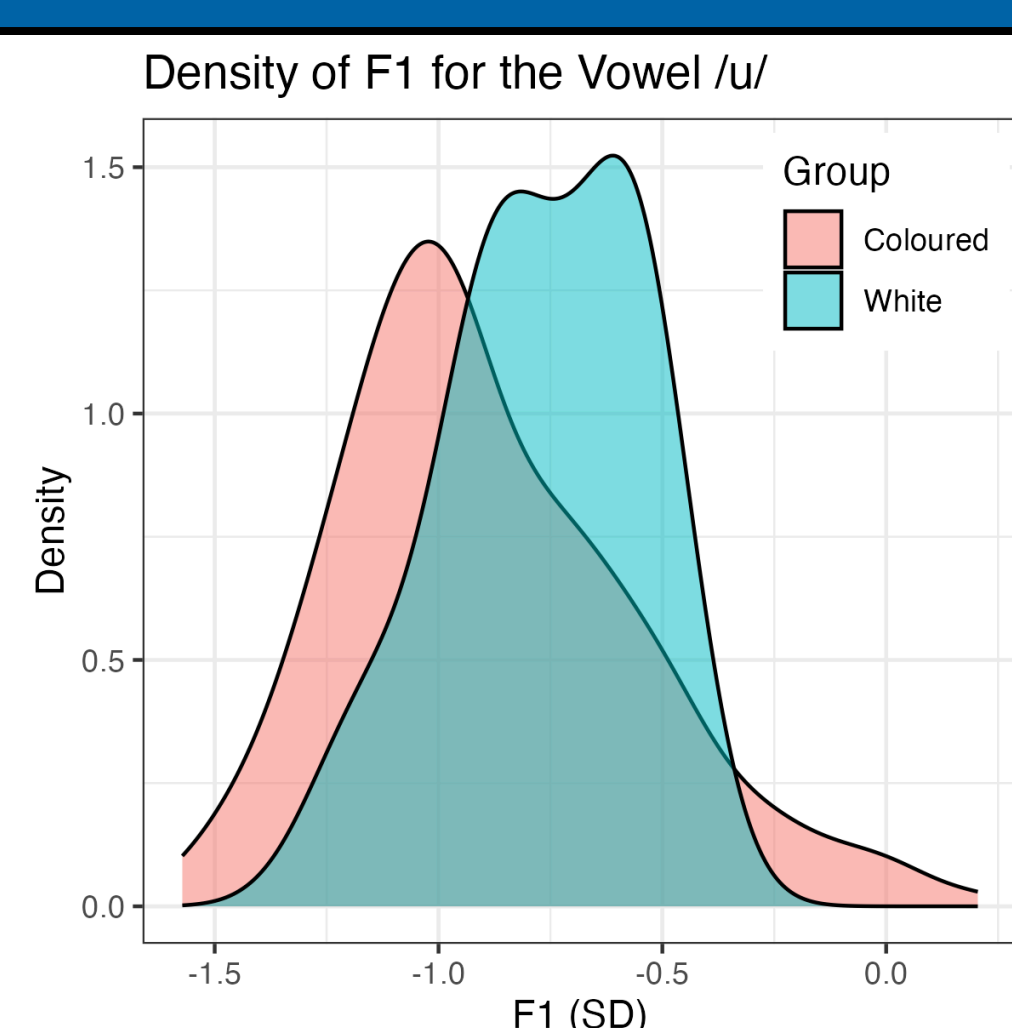
$$\delta(A, B) = 0.5 \int |f_A(x) - f_B(x)| dx$$

Cliff's Delta (1993)

$$\delta(A, B) = \frac{\#(a > b) - \#(a < b)}{|A| \times |B|}$$

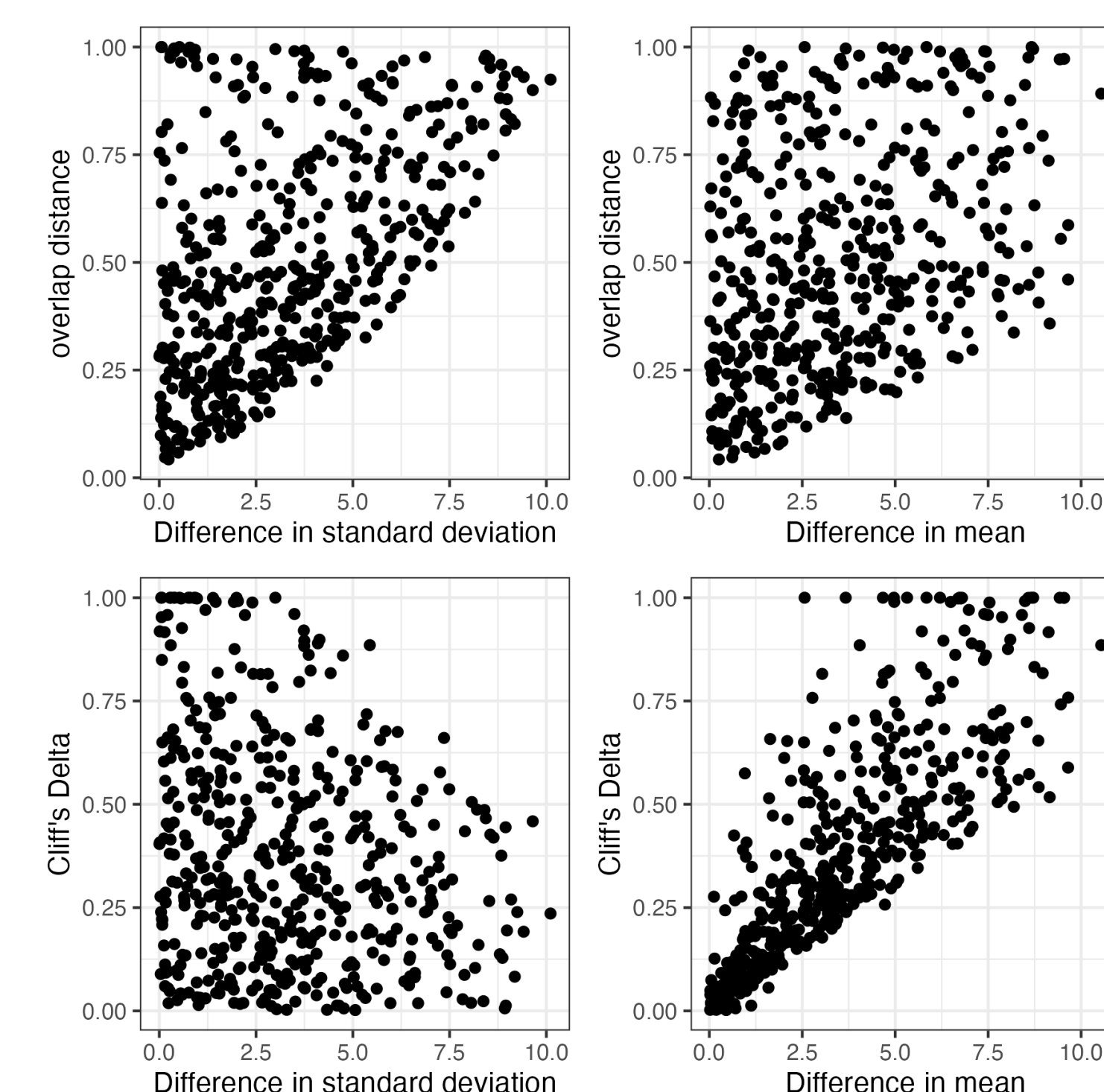
Composite index adapted from Wissing et al. (2023)

$$D(A, B) = \frac{1}{2|V|} \times \sum_{v \in V} (|\delta(F1_{v,A}, F1_{v,B})| + |\delta(F2_{v,A}, F2_{v,B})|)$$



Simulation Study

- Compare the measures across 1000 distributions with random mean and sd.
- Cliff's delta captures difference in mean (rho = 0.86, p < 0.01). Overlap distance captures differences in standard deviation (rho = 0.62, p < 0.01).
- Both measures are correlated (rho = 0.52, p < 0.01).



Conclusions

- Whites and Coloureds realize vowels moderately differently: Cliffs index = 0.44, Overlap index = 0.43. The largest differences are found for the vowels /a/, /ɑ/, /u/ and their diphthongs.
- Cliff's delta is a functioning alternative to overlap distance, capturing differences in central tendency while indicating directionality.
- Both measures should be used to determine if the difference between two vowel spaces mainly concerns variation in realization or a shift in place of articulation.

References

Cliff, N. (1993). Dominance statistics: Ordinal analyses to answer ordinal questions. *Psychological Bulletin*, 114 (3), 494-509.

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Pastore, M., & Calcagni, A. (2019). Measuring distribution similarities between samples: a distribution-free overlapping index. *Frontiers in Psychology*, 10:1089.

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