Tsova-Tush "intensive" consonants

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Tsova-Tush

- (a.k.a. Batsbi, Bats)

- Northeast Caucasian
  - ◇ Zemo Alvani, Georgia

- Severely endangered
  - ○ 300-800 speakers
  - ○ also speak Georgian, Russian

- 41 consonant phonemes

Map tiles by Stamen Design, under CC BY 3.0. Data by OpenStreetMap, under ODbL.

Tsova–Tush stop phonemes

	bilabial	dental	velar	uvular	epiglottal	glottal
aspirated	pʰ	tʰ tʰˑ	kʰ	qʰ qʰˑ		
ejective	p'	t' t'ˑ	k'	q' q'ˑ	?	?
voiced	b	d	g			

The claim

- Previous researchers: these are not simply long/geminates.
  - Therefore, the term "intensive" or "strong" is justified.
  - Common to use such terms for languages of the Caucasus

"...the so-called 'strong' consonants *which must be kept distinct from mere geminates* even though they may resemble them at first glance"

(Gippert 2008: 164; emphasis mine)

Research questions

- What are the acoustic properties of the so-called "intensive" stops in Tsova-Tush and their non-intensive counterparts?

- Can this phonemic opposition be adequately characterized by a difference in **duration**?

Methods: Data collection

- A list of 47 target words, compiled from dictionaries
  - Carrier sentence: *as X aɬnas* 'I said X'
  - Roughly 135 observations per measure

- 3 speakers (1 female, 2 male)

- Zoom H2n solid state recorder with external lapel microphone recording at 48kHz / 24 bit
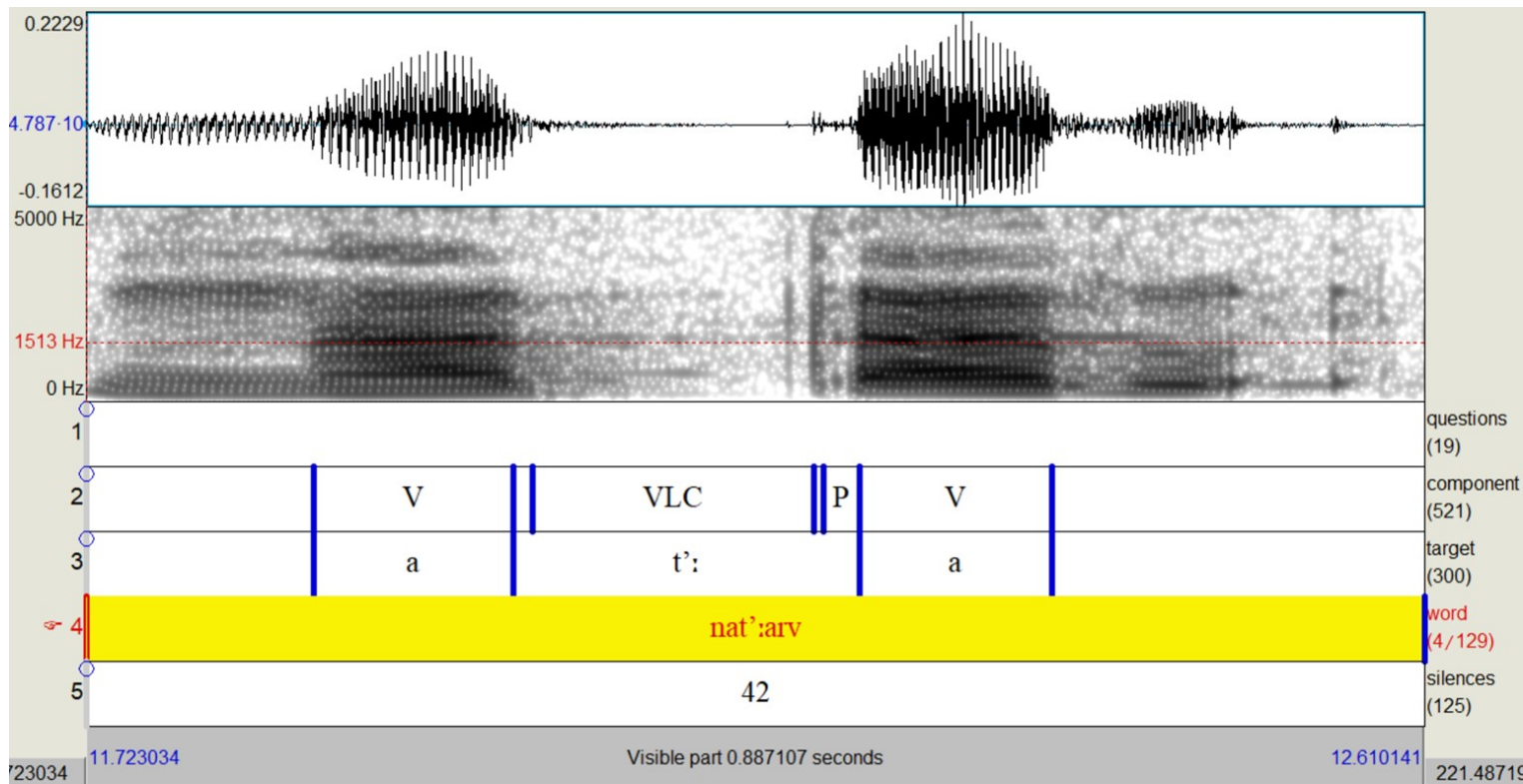
Measures to compare

- Durations of the target stops
  - Total duration
  - Closure duration
  - Voice onset time

- Intensity of the target stops
  - Burst intensity
  - Post-burst intensity

- Duration of the preceding vowel
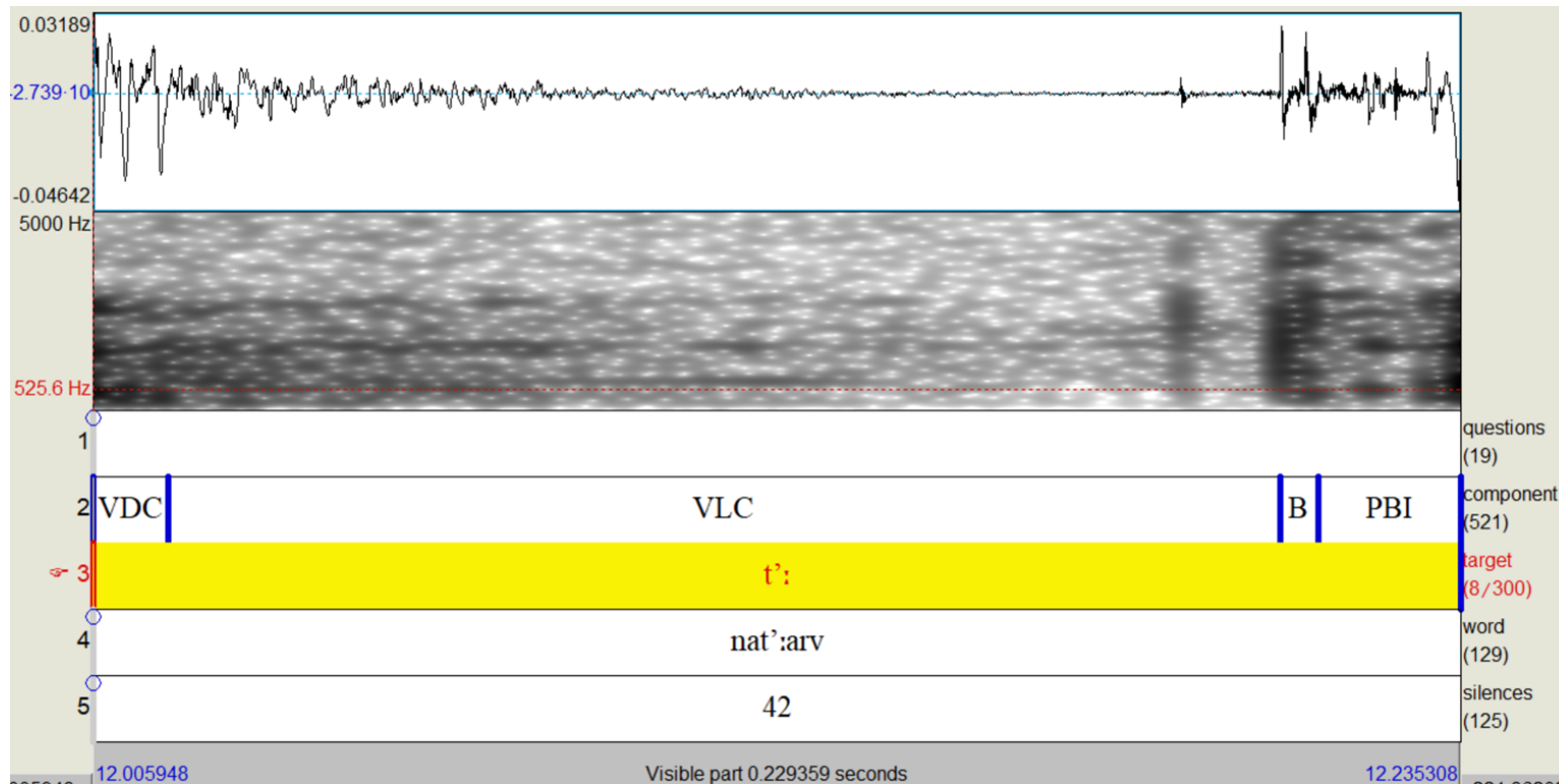
- Quality of the voice source
  - F0
 - H1*-H2*

Data segmentation

# Data segmentation: zoomed in

Methods: Statistical models

- Linear mixed effects regressions
  - Deviation coding (`contr.sum`)

- [relevant measure] ~ intensiveness +

- Fixed effects
  - Position (intervocalic, final, preconsonantal)
  - Airstream mechanism (aspirated, ejective)
  - Place (dental, uvular)

- Random effects
  - Speaker (random intercept by intensiveness)
  - Word

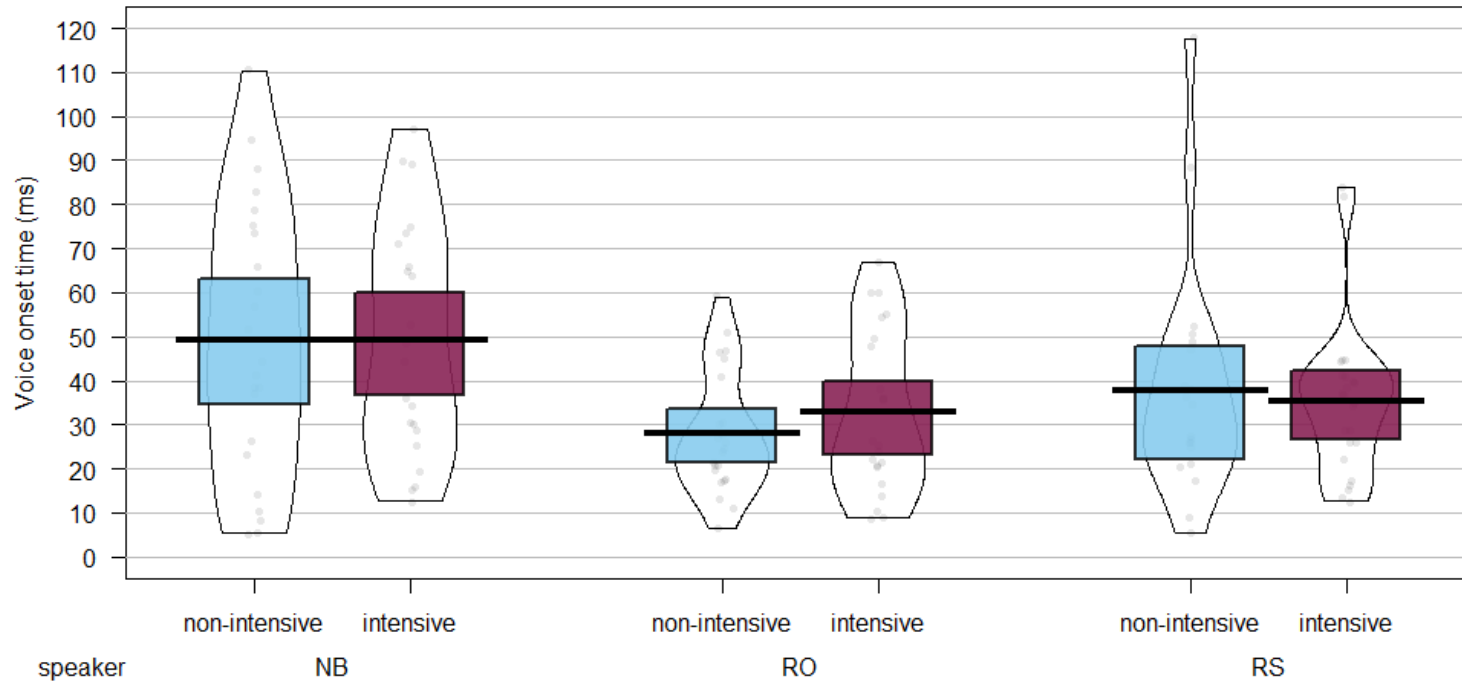**Pirate plot of total duration of stops by intensiveness**
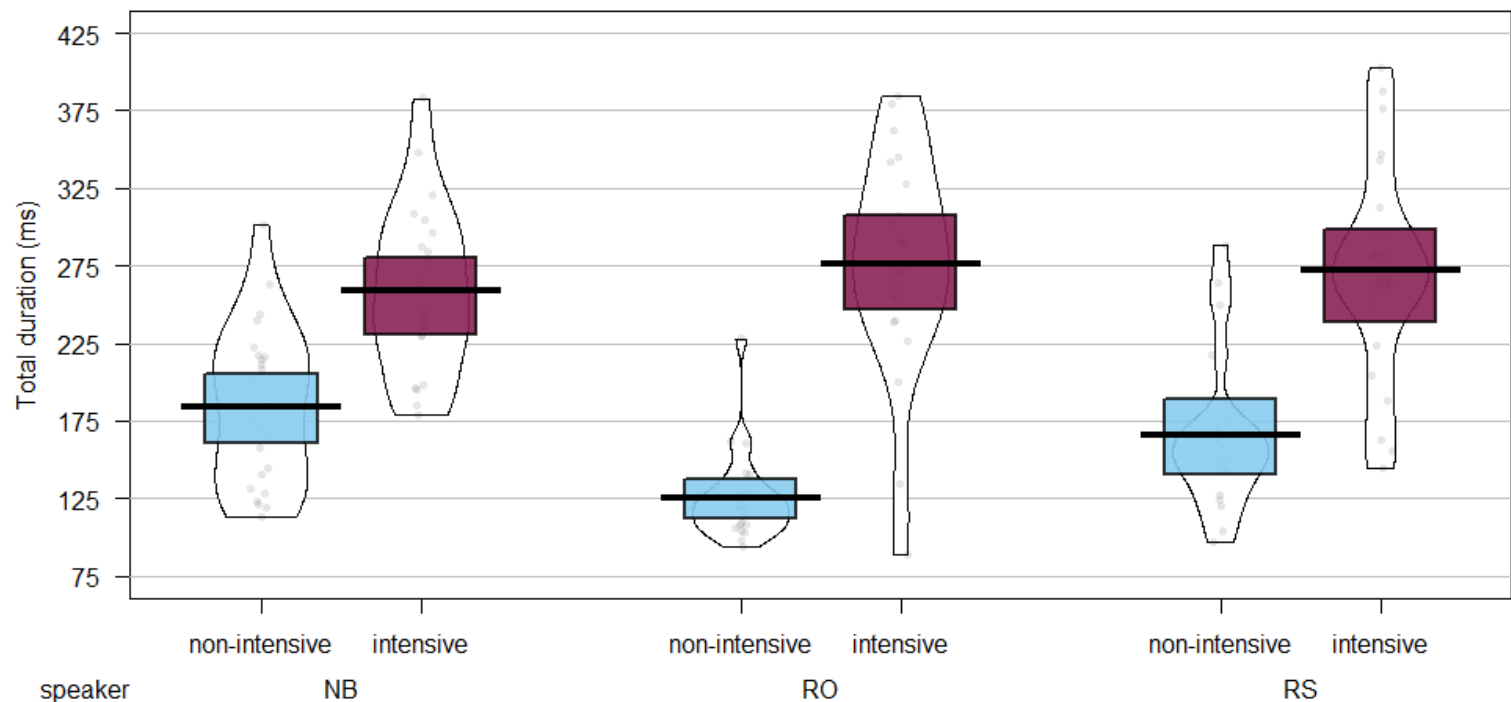
➜ The total duration of intensive stops differed from the grand mean (β = 44 ms, p = .01).

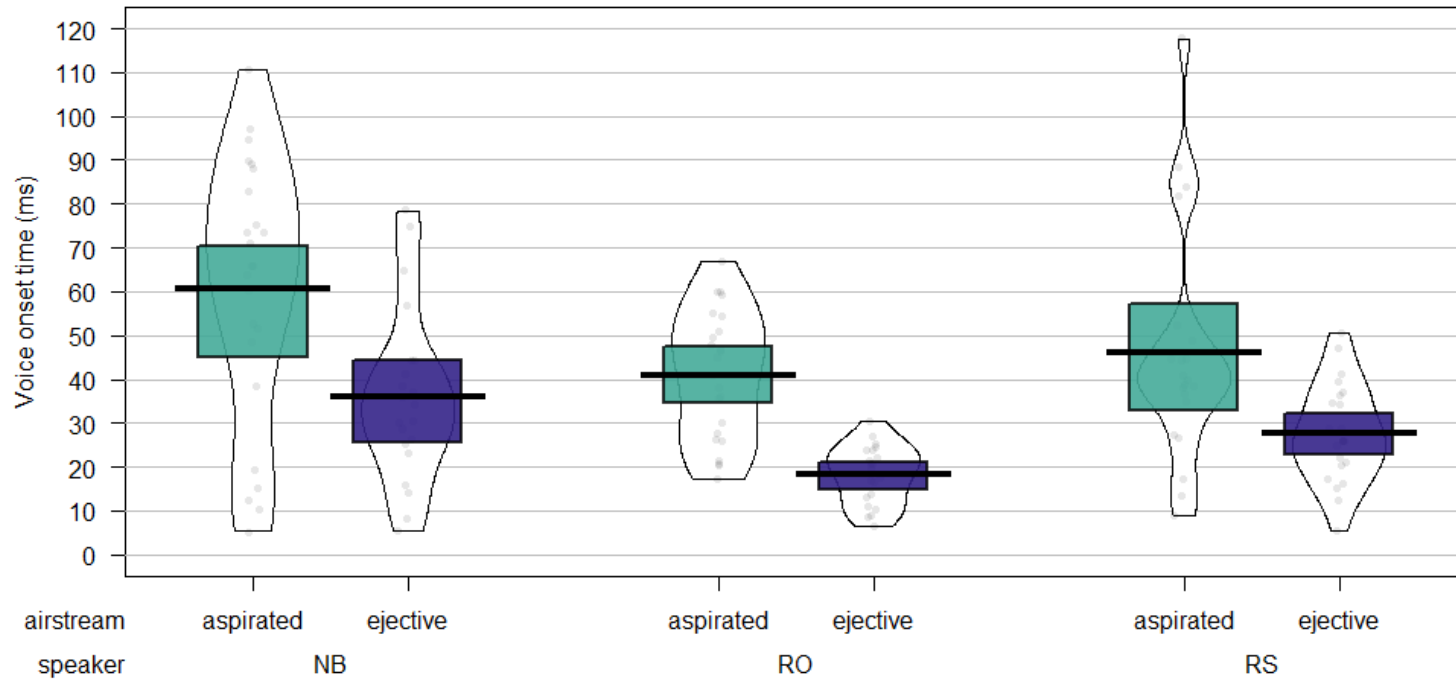**Pirate plot of closure duration of stops by intensiveness**
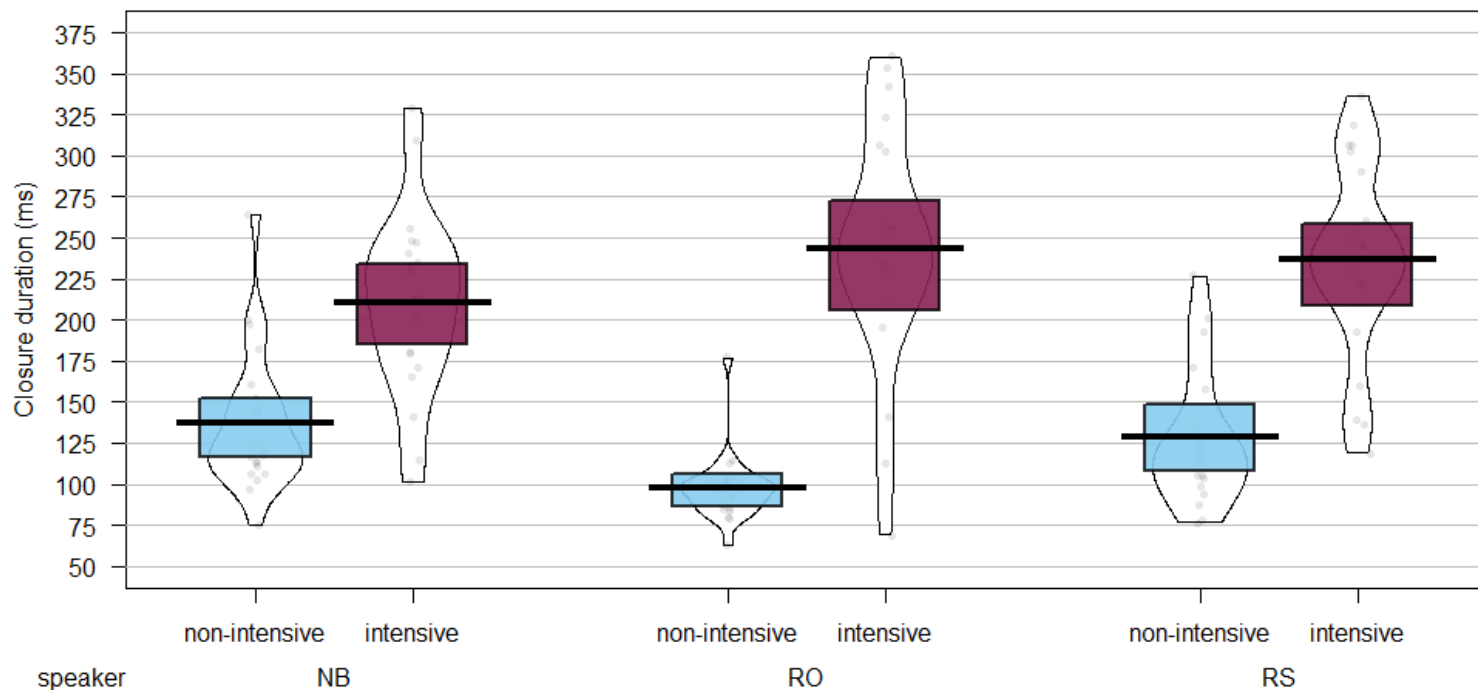
➔ The closure duration of intensive stops differed from the grand mean (β = 47 ms, p < .01).

Pirate plot of VOT of stops by intensiveness

➔ The VOT of intensive stops **did not differ** from the grand mean (β = -3 ms, p = .49).
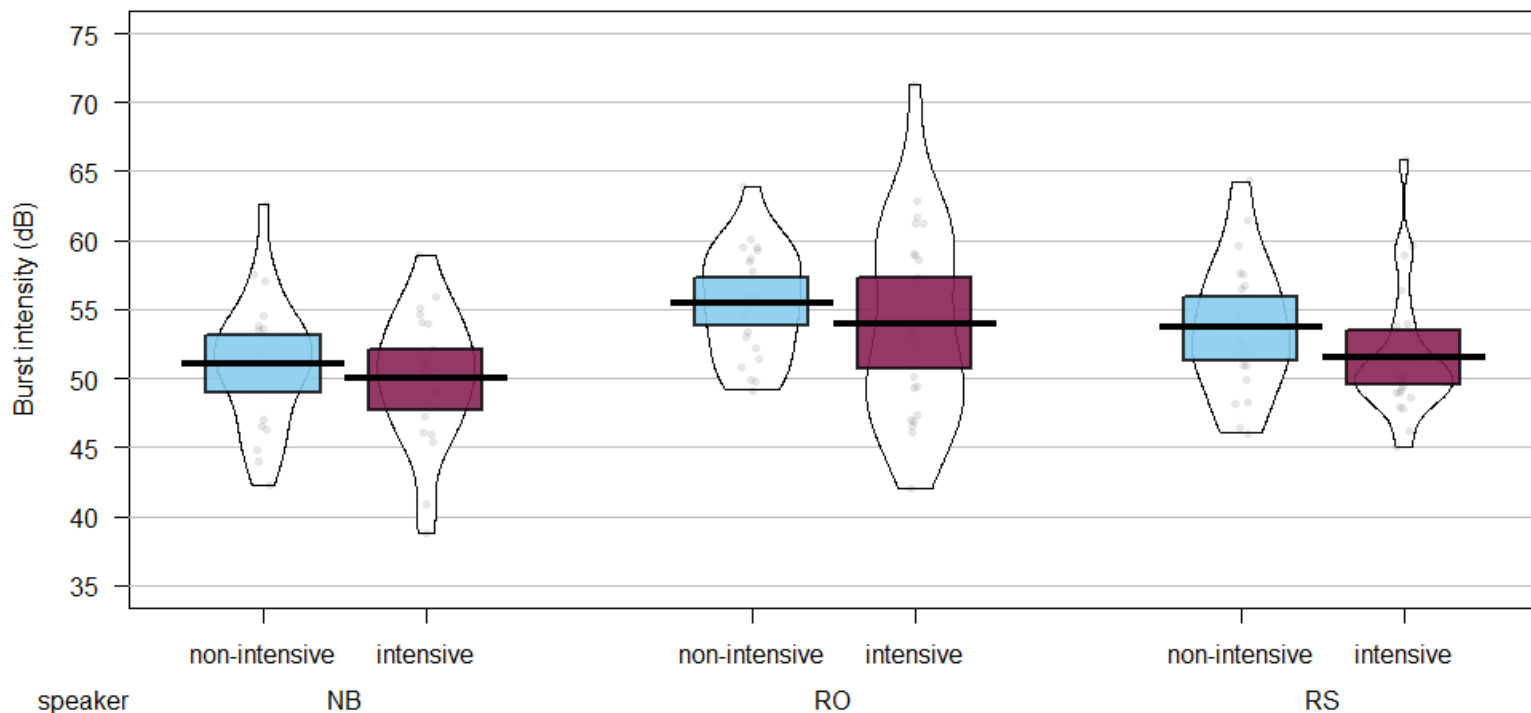
Pirate plot of VOT of stops by airstream

➔ The VOT of **ejective** stops differed from the grand mean (β = -11 ms, *p* = .01).

Conclusions by hypothesis for intensiveness

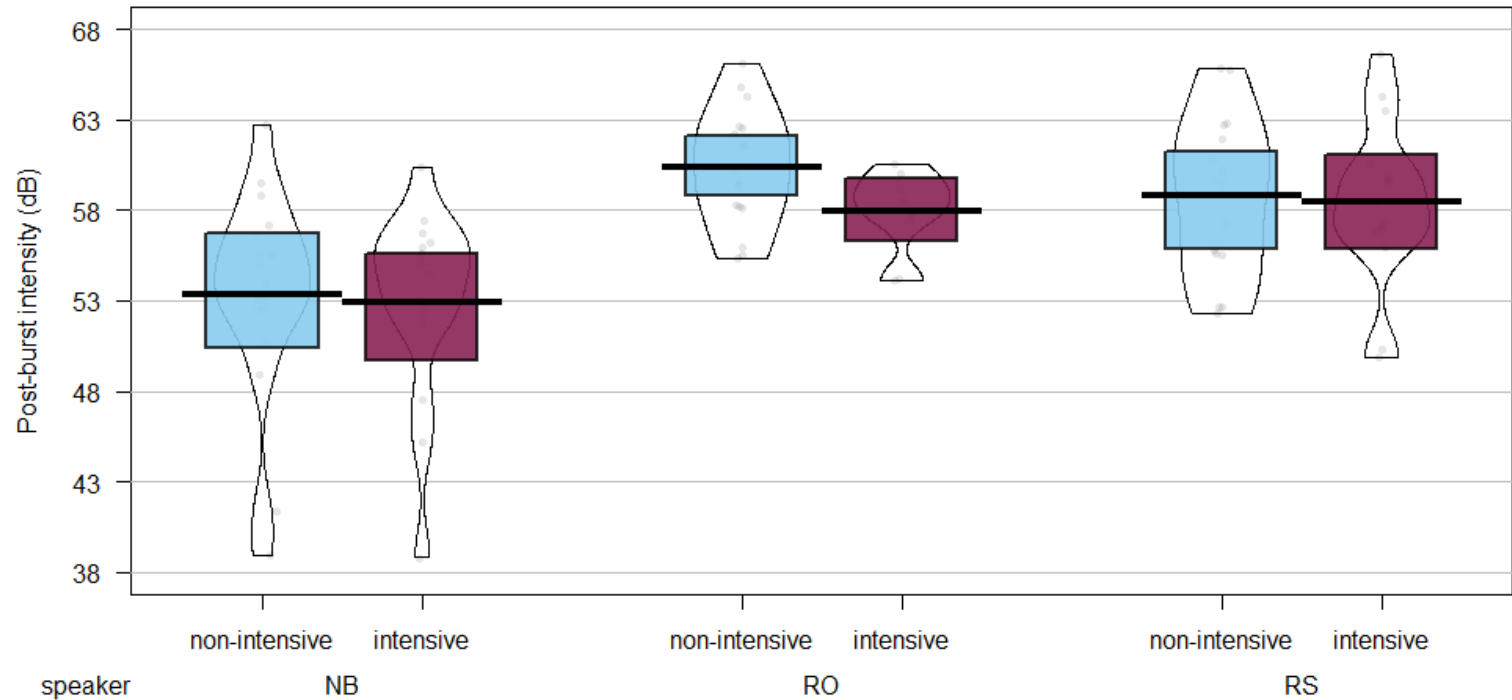| There is a difference in…	Conclusion
Total duration	reject null
Closure duration	reject null
Voice onset time	fail to reject
Burst intensity	…
Intensity of post-burst interval	…
Preceding vowel	…
F0 at voice onset	…
H1*-H2*	…

Pirate plot of burst intensity by intensiveness

➜ The burst intensity of intensive stops **did not differ** from the grand mean (β = 0.3 dB, p = .71).
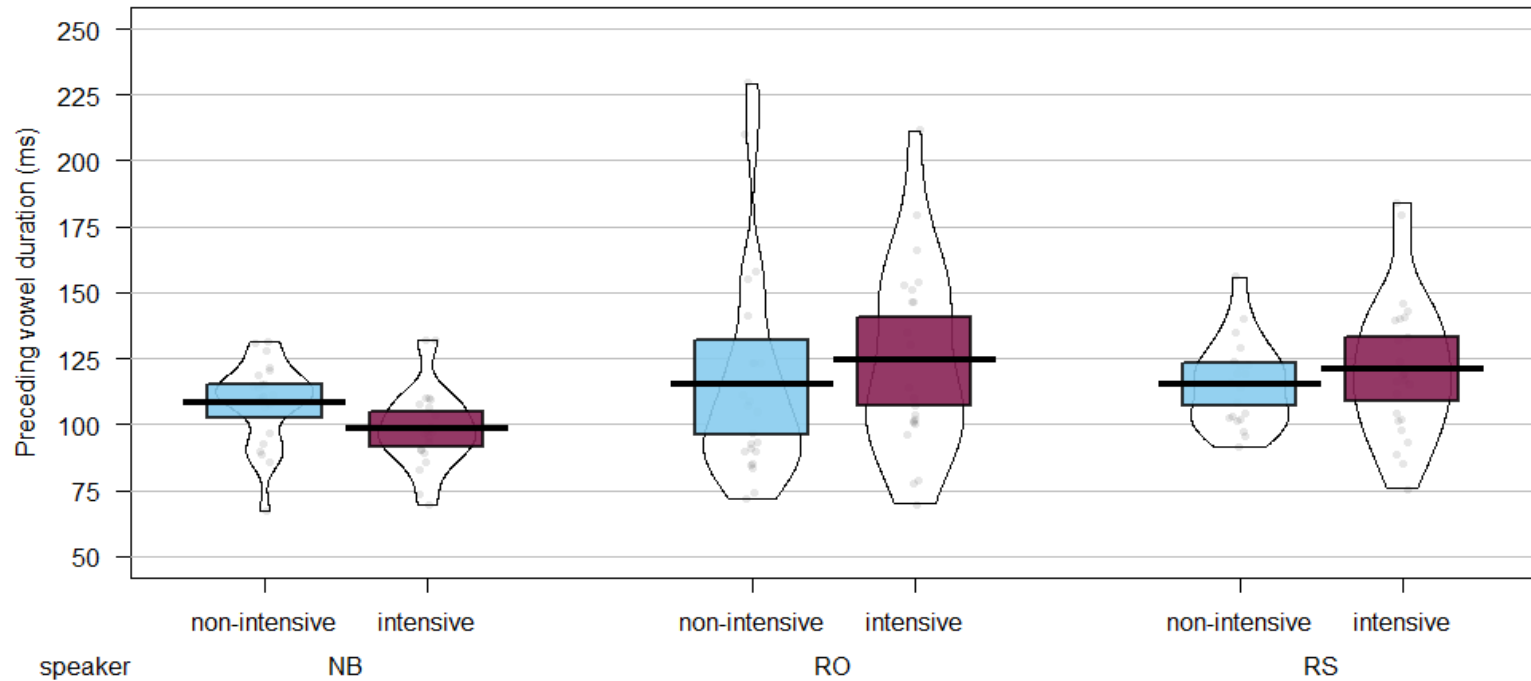
Pirate plot of post-burst intensity by intensiveness

➤ The post-burst intensity of intensive stops **did not differ** from the grand mean (β = 0.4 dB, p = .61).

Pirate plot of preceding vowel duration by intensiveness

➔ The duration of vowels preceding intensive stops **did not differ** from the grand mean (β = 1 ms, *p* = .81).

Conclusions by hypothesis for intensiveness

There is a difference in...	Conclusion
Total duration	reject null
Closure duration	reject null
Voice onset time	fail to reject
Burst intensity	fail to reject
Intensity of post-burst interval	fail to reject
Preceding vowel	fail to reject
F0 at voice onset	...
H1*-H2*	...

Pirate plot of f0 in first chunk of following vowel by intensiveness
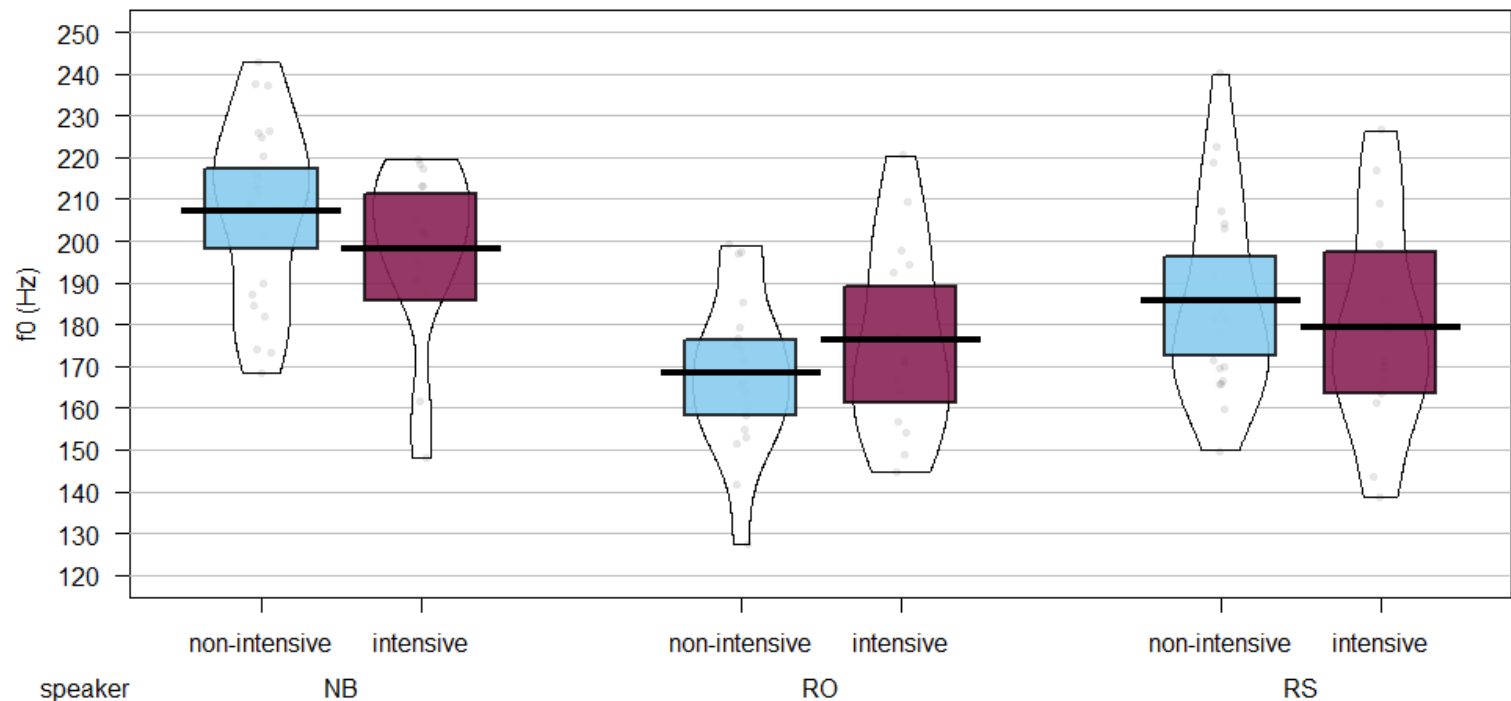
➔ The f0 of vowels following intensive stops **did not differ** from the grand mean (β = -2.3 Hz, p = .52).

Pirate plot of H1*-H2* in first chunk of following vowel by intensiveness
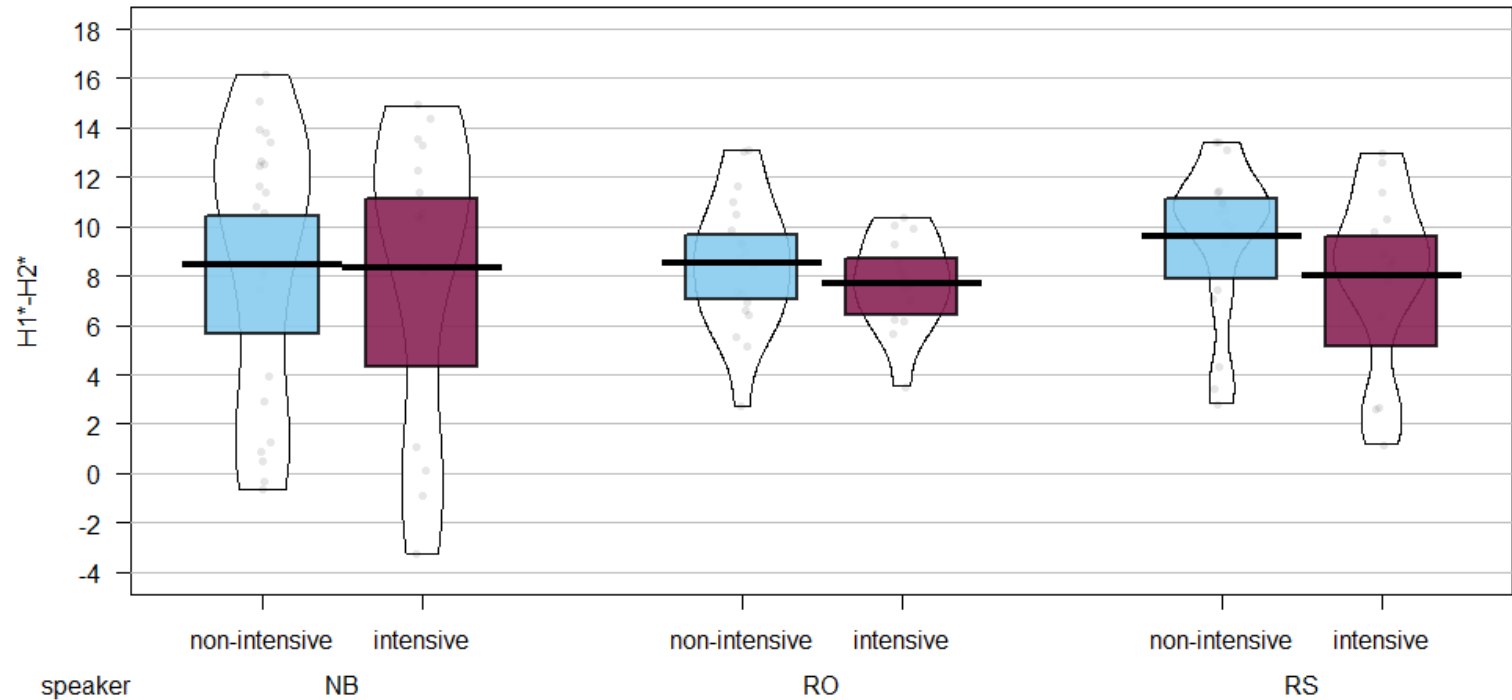
➔ The spectral tilt of vowels following intensive stops **did not differ** from the grand mean (β = -0.2 Hz, p = .68).

Pirate plot of H1*-H2* in first chunk of following vowel by airstream

➔ The spectral tilt of vowels following **ejective** stops differed from the grand mean (β = -2.3 Hz, p = .01).
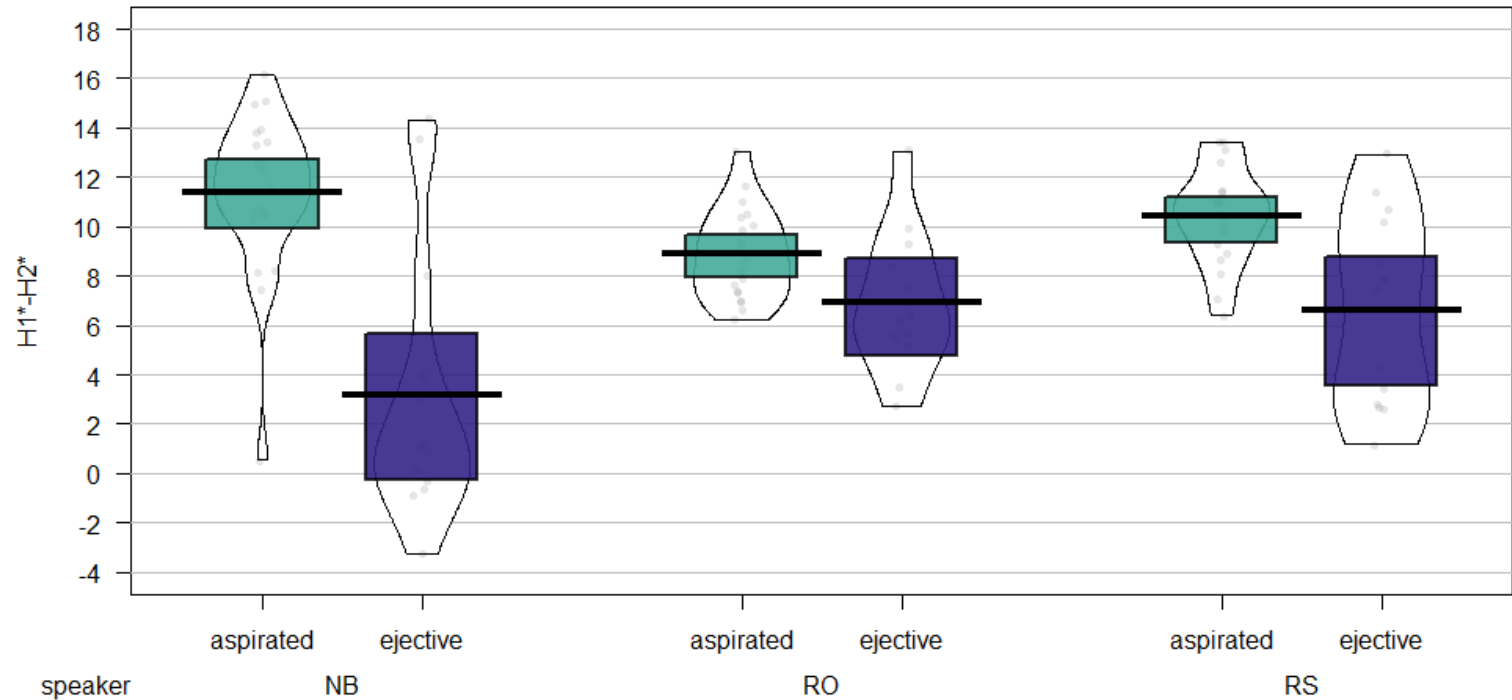
Summary: Conclusions by hypothesis

There is a difference in...	Conclusion
Total duration	reject null
Closure duration	reject null
Voice onset time	fail to reject
Burst intensity	fail to reject
Intensity of post-burst interval	fail to reject
Preceding vowel	fail to reject
F0 at voice onset	fail to reject
H1*-H2*	fail to reject

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Conclusions

- The chief difference between non-intensive and intensive stops lies in duration (specifically in the closure)
  - Better terminology: singleton vs. geminate (short vs. long)

- Ratio of closure duration, singleton to geminate = 1 : 1.9
  - Aspirated singleton to geminate   1 : 2.0
  - Ejective singleton to geminate   1 : 1.8

- /t'ː/ and /q'ː/ are geminate ejectives (cross-linguistically rare)

Future directions

- Expanded study to include "intensive" fricatives and lateral
  - /s sː ʃ [ʃː] x xː l lː/

- Companion study of ejectives (including /p'/ and /k'/) to provide a more detailed description of geminate ejectives

- Informed recommendations for community orthography development
  - represent geminates by doubling grapheme: တတ, �, etc.

Selected references & acknowledgements

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Data access

File name	Speaker initials	Details
BH2-051	RO	male
BH2-052	RS	male
BH2-055	NB	female

- Recordings (audio, video) available via *Kaipuleohone*
  - https://scholarspace.manoa.hawaii.edu/handle/10125/42581

- Other project files available via GitHub
  - https://github.com/brynhauk/tsova-tush-intensives
  - Praat scripts and TextGrids
  - R scripts