Subsegmental interactions between affrication and devoicing in Québec French

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Introduction

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- **Affrication** in Québec French (QF): Canonically, /t, d/ ⟶ [ts, dz] before /i, j, y, ɥ/
- Previously noted complications:
  - Independent site for high vowel deletion, devoicing & other lenition processes (e.g., Gendron 1966; Cedergren and Simoneau 1985)
  - /d/-devoicing (partial or total), with sociolinguistic factors (Bento, 1998)
- We add here evidence for **fricative-vowel coarticulation** (FVC), manifesting as partial vowel 'fricativization'

Consequences

- Affrication is maximally 4-phased (Burst friction, aspiration, FVC, 'pure' vowel), e.g., [ts$\underset{\circ}{\text{ii}}$]
- Complex/contour segments potentially created from both input segments (e.g., /t/ $\longrightarrow$ [ts], /i/ $\longrightarrow$ [$\underset{\circ}{\text{ii}}$])
- Q Theory (e.g., Inkelas and Shih 2016) offers attractive insights into these sequences' representations and realizations

Main questions (for today)

Q. How does FVC manifest itself phonetically in QF affrication?

A. Tentatively, early dip in centre of gravity and/or gradual rise in voicing.

Q. How common is it?

A. Quite, though seemingly not a target.

Q. What could Q Theory have to say?

A. Processes can target and affect subsegments, motivated by phonetic affinities. Overlap of consonantal subsegments into vocalic segments and/or underrepresentation of subsegments may offer an explanation.

Outline

Background: Affrication

Affrication in Canadian French

- Categorical within words, variable between words (e.g., Dumas 1987)
- Present & non-stigmatized in QF except for Gaspésie & Côte-Nord
- Less common in Acadian French except in PEI (King and Ryan, 1989) and Northwest New Brunswick (Cichocki and Perreault, 2018)
- Acadian variants include palatalized [dʒ] and aspirated [t^h]

Articulation

- Contact between tongue predorsum and postalveolar/prepalatal region and lowering of tongue tip towards lower teeth (Charbonneau and Jacques, 1972)

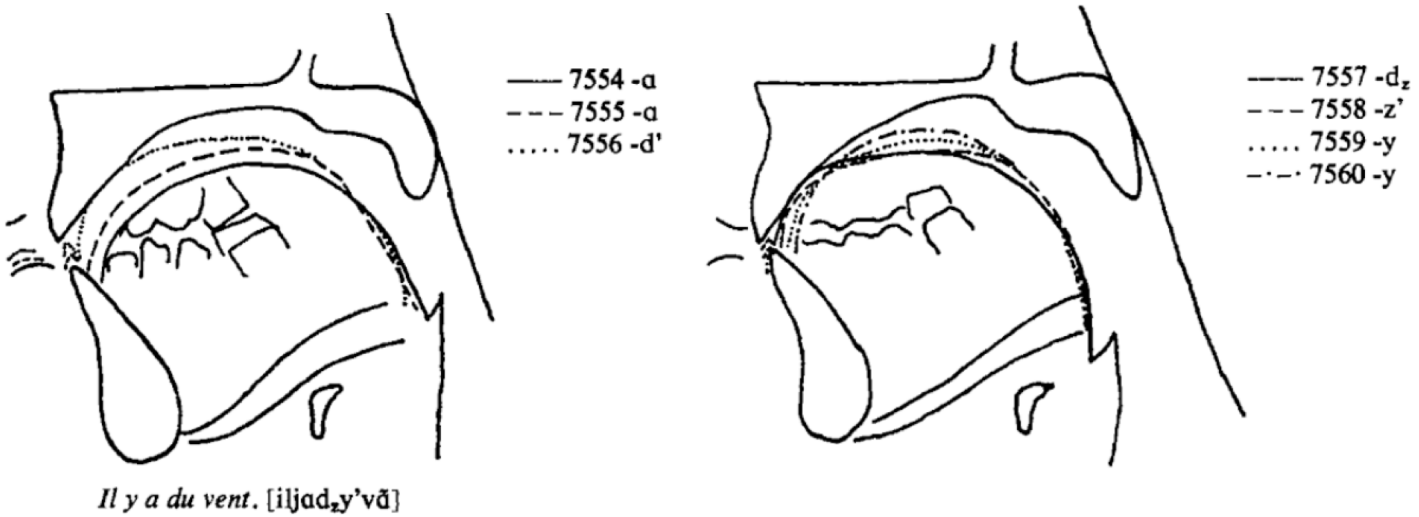


Fig. 1: X-ray tracings of /ady/, *(il y) a du (vent)* (Charbonneau and Jacques 1972: 87)

Typology

- Assibilation more generally (/t/ $\longrightarrow$ [s], [t^{s}], [t$\int$]) most frequently targets coronal stops before high front vocoids (Hall et al., 2006)
- Trigger is always to the right of the target for aerodynamic reasons (Clements, 1999; Kim, 2001)
- Motivated by the degree of closure of high vowels creating the conditions for turbulance (Jaeger, 1978)

Phases, I

- Hall et al. (2006) distinguish 'burst friction' (BF) and 'aspiration' (A) as parts of larger 'friction phase' in assibilation, as in Fig. 2

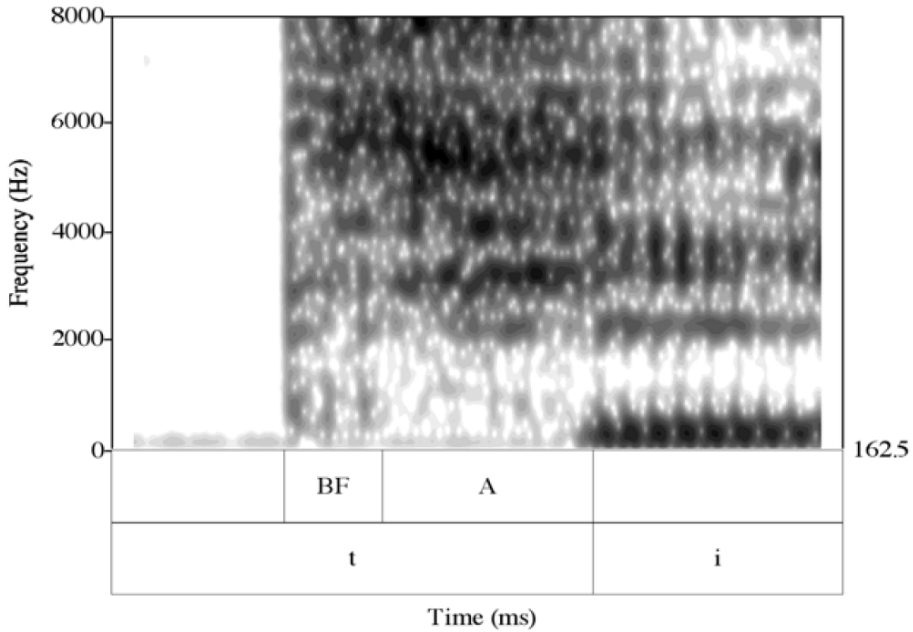


Fig. 2: An example from German (Hall et al. 2006: 64)

Phases, II

- Burst friction necessarily precedes and is shorter than aspiration; generated at stop PoA and having relatively lower energy than aspiration, from 3500 to 7000 Hz (Hall et al. 2006: 64)
- Aspiration "generated at the glottis and shows a stronger concentration of energy in the higher frequency region but also formant like peaks in lower frequency regions" and "overlaps with friction generated at the constriction of this vocoid".
- We distinguish aspiration from an additional phase with lower energy and more prominent formant peaks...

Compare with. . .

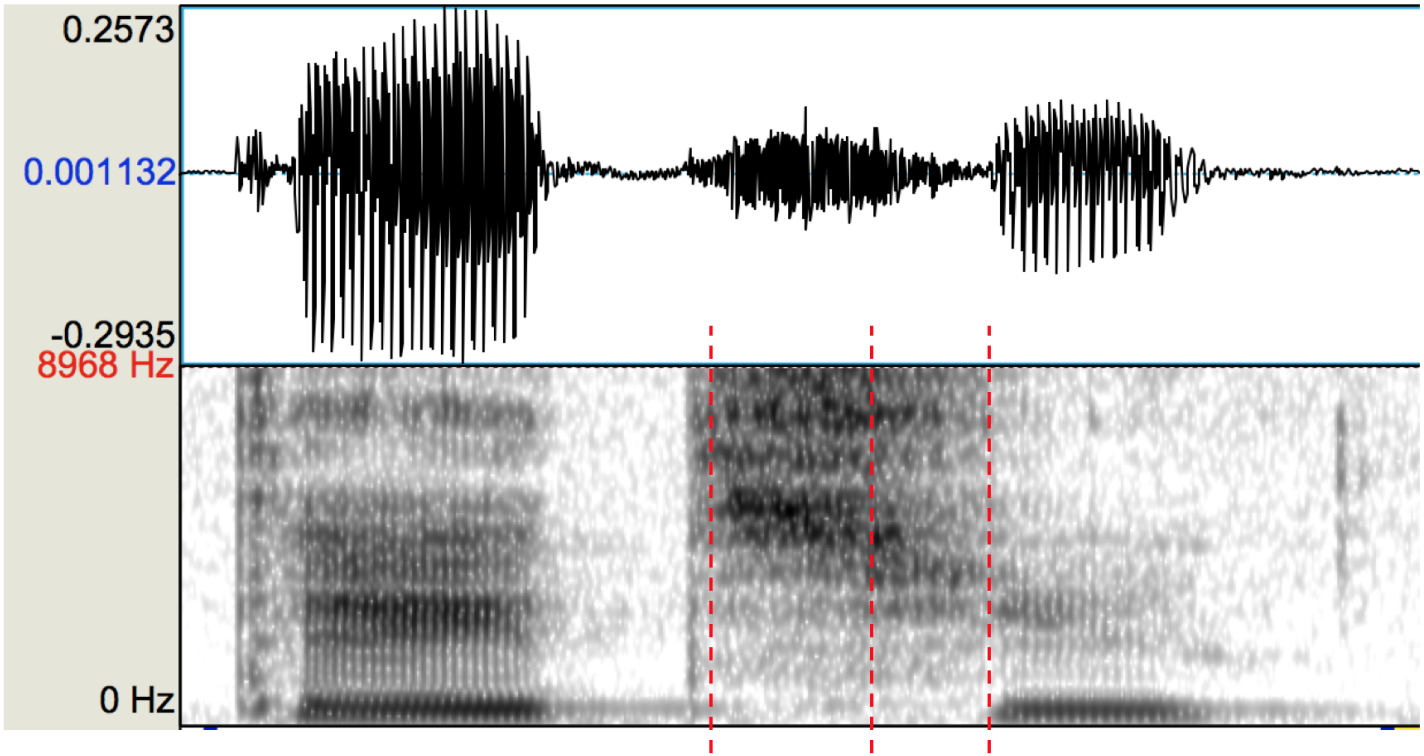


Fig. 3: Phases in /ty/, *têtu* (speaker 1)

Compare with. . .

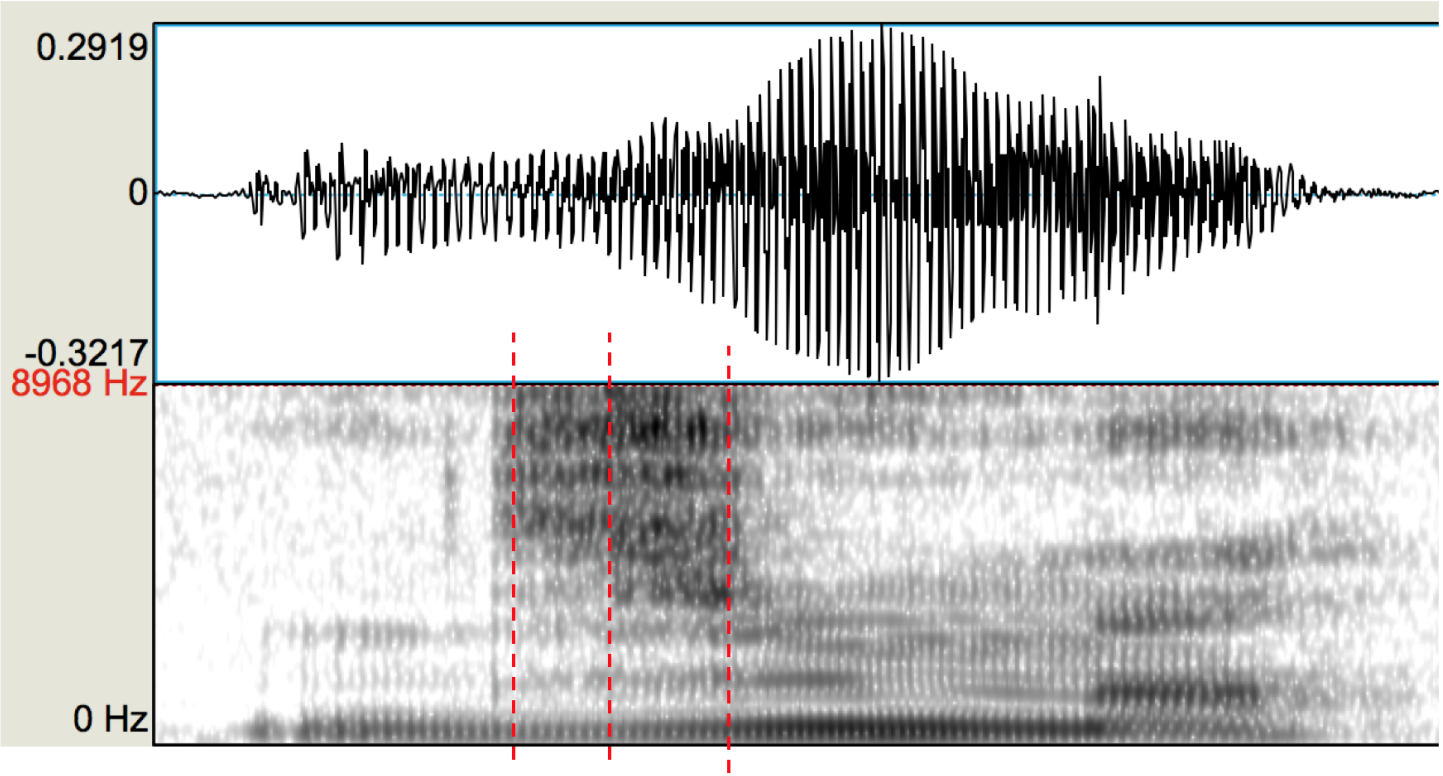


Fig. 4: Phases in /dy/, *dûment* (speaker 1)

Fricativized high vowels

- Simultaneous tongue tip and tongue body constriction (Zhou and Wu, 1963), with strident frication and high vowel-like formant structure (Connell, 2007)

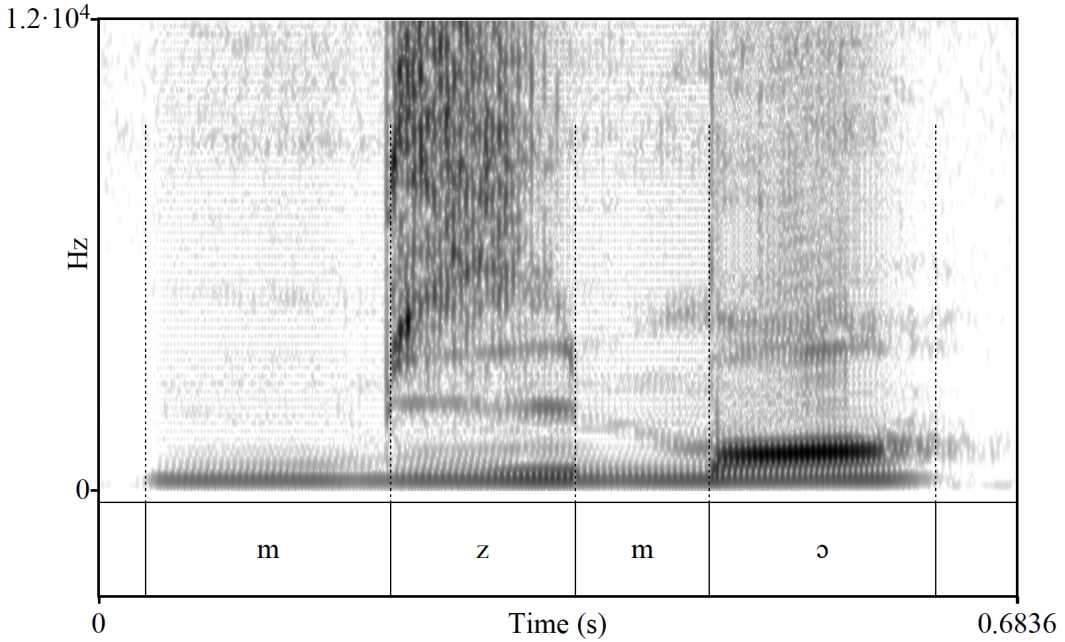


Fig. 5: Fricativized vowel in Wanghao Wu Chinese, [mz̩mɔ] (Faytak, 2014)

Methodology

Experiment

- Stimuli:
  - Reading task, real words of French containing /ti, ty, di, dy/ sequences in open initial and closed final syllables
  - 1 word per sequence, per following consonant type: voiceless stop, voiced stop, voiceless fricative, voiced fricative, sonorant
  - Additional 3 words per sequence in final open syllable
  - 49 tokens (some lexical gaps) + 50 distractors
- 4 randomized orders presented per speaker in slideshow, self-directed pace
- 5 native QF speakers, all around age of 25 and female
- Recorded with Samson Meteor microphone in Praat (mono, 44.1 kHz sampling frequency)

Data processing

- Controls: intervocalic /s, z/
- /t, d/ + /i, y/ sequences subjectively divided into aspiration, FVC and/or vowel phases based on energy concentration and formants in spectrogram
- 2 repetitions excluded for speaker 2 (microphone error)
- 877 sequences in total (not including controls)

Measurements

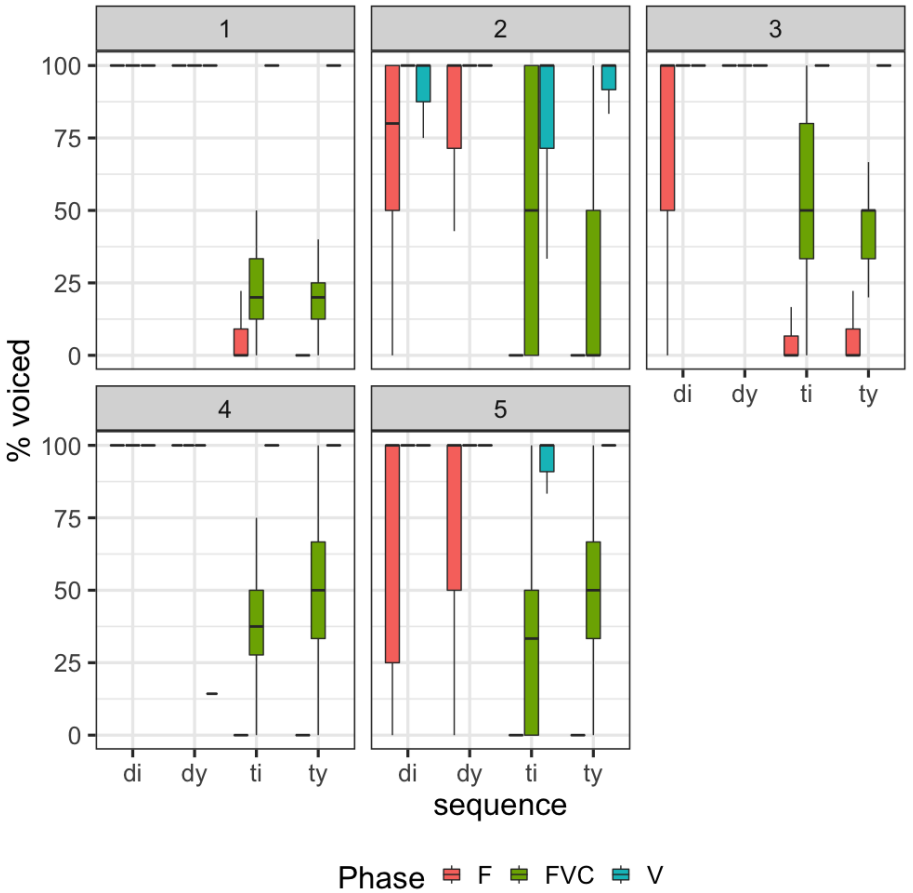
- Voicing automatically extracted for (sub)segments of interest from voice report (pitch range: 75-500 Hz, otherwise standard settings)
- Centre of gravity (COG):
  - 500 Hz high pass filter applied (e.g., Hamann and Sennema (2005))
  - Spectrogram (max frequency 11 kHz, otherwise standard settings) $\longrightarrow$ COG extracted from spectral slices at 5 ms intervals
  - Standard deviation provided dispersion
- Timestamps scaled for word, speaker and reading

Results & Discussion

Impressionistic notes

- Full vowel frequently reduced or missing before oral & nasal stops (e.g., *dimanche, typique*)
- Otherwise, several generic types evidenced:
  - /tV/: F+FVC+V (where FVC looks like voiceless vowel)
  - /tV/: F+V with short gap between the two (some speakers seem to prefer this)
  - /dV/: F+FVC+V (where FVC looks like fricativized vowel)
- Where present, F and FVC appear to have similar length, and F+FVC appear to have similar duration as V (influence of following segment aside)

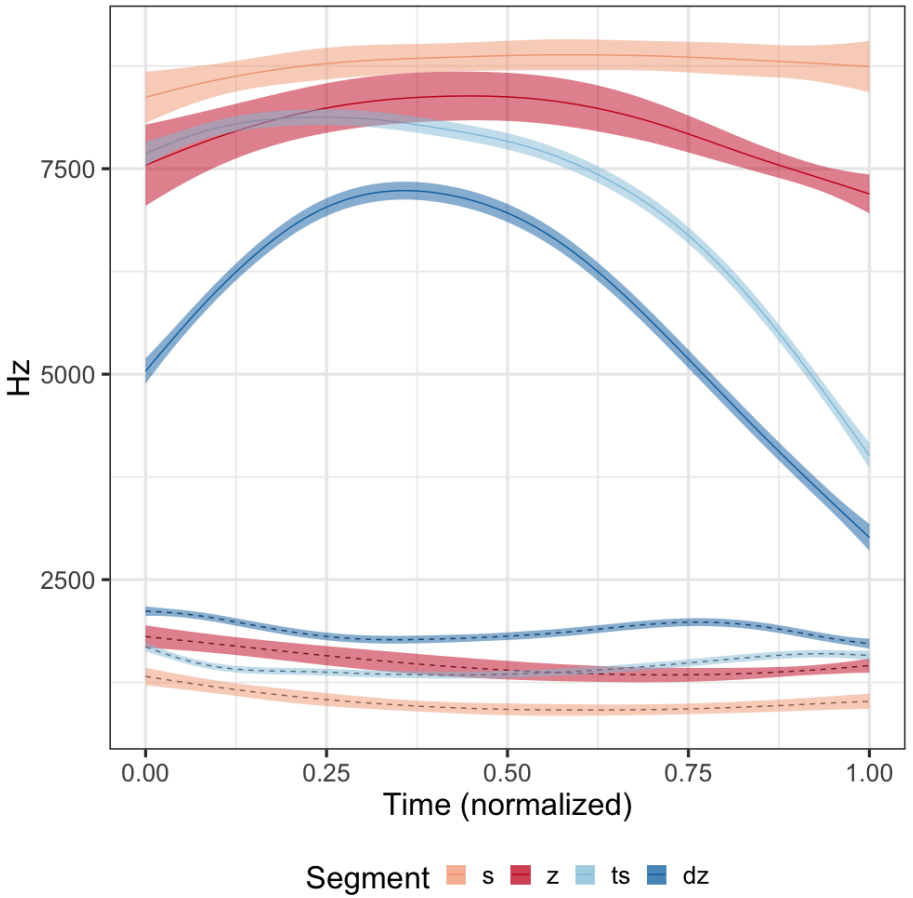
Voicing



- Speakers 1, 3 & 4 barely devoice /dV/ (save for S4 /di/ variation)
- Aspiration voicing in /tV/ sequences near 0%
- FVC voicing in /tV/ sequences intermediate
- Vowel voicing maintained

Fig. 6:
Mean voicing by phase, sequence & participant
F = friction (aspiration), FVC = fricative-vowel coarticulation, V = vowel

Centre of gravity & dispersion



- Voicing effect in both cases (voiced < voiceless)
- Affricates characterized by spike in frequency (voiced) and gradual decline around 33-50% (both)
- Fricatives remain fairly stable, as does dispersion
- Same trends hold in individual results, save for variation in /z/ (declines more sharply for some)

Fig. 7:
SSANOVAs with 95% confidence intervals, fricatives & affricate non-V phases
COG = solid lines, dispersion = dashed lines

Discussion

- Low initial COG of affricates indicative of burst friction, with rise towards fricative(-like) target
- Early COG decline doesn't seem to imply rise in dispersion
- Could suggest addition of lower-energy vowel structure is proportionate to lowering of higher-energy associated with friction/aspiration
- Tongue tip lowering and vocalic gestures may thus be fairly well coordinated (see also rise of voicing in this phase)
- 'Fricativized vowel' phase present but not a target, rather a result of looser interpolation
- F2, intensity and skewness need to be looked at in future

Q Theory

- Divides the classic segment [Q] into subsegments [q]
- Example: post-oralized vs. pre-nasalized stops in Panará, $C(m^1m^2p^3)$ vs. $C(m^1p^2p^3)$ (Garvin et al., 2018)
- FVC may be represented as surface emergence of consonantal [q] in vocalic [Q] or vice-versa
- For instance: $C(t^1t^2t^3)V(i^1i^2i^3) \longrightarrow C(t^1s^2s^3)V(s^1i^2i^3)$
- Underrepresentation is also a tempting avenue, but requires more work on the actual substance of [q]'s

Conclusion

Summary

- QF affrication shows evidence for fricative-vowel mixing between aspiration and vocalic phases, though it may not be a planned property of pronunciation
- Q Theory well-advantaged to capture internal complexity of these sequences
- May also provide interesting insights into underlying structure of these segments (esp. of high vowels)

Acknowledgments

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