An articulatory perspective on the secondary palatalization contrast in Romanian postalveolar fricatives

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In brief

The contrast	Plain and secondarily palatalized postalveolar fricatives
The language	This contrast occurs in Romanian, but is very restricted cross-linguistically
Example	[koʃ] 'basket' [koʃʲ] 'you sew'
The question	How is this contrast implemented in articulation?

SP overview

Production of secondary palatal gesture in addition to a C's primary place gesture.

- Found in 27% of random sample of 117 lgs (Bateman 2007)
- Present in Polish, Russian, Irish, Isthmus Mixe, etc.
- **Phonological status:**

  Contrastive Russian: Cs with SP articulations part of the phonemic inventory, in contrast with plain Cs
  e.g. [krov] *shelter* vs. [krov^{j}] *blood*

  Not contrastive Korean: /put-i/ –> [put^{j}i] *please* (Hong 1997)

SP: Romanian

- Found in Romanian, but not elsewhere in Romance
- ONLY in word-final position
- Commonly associated with (but not restricted to) presence of 2 affixes (**plural** for nouns/adj and **2nd p.** pres. ind. of verbs)
- Widespread view (Chitoran 2002): **C+/i/** → **[C^{j}]** ⇒ surface contrast between plain and pal. Cs word-finally

Plural	a.	*pom* [pom] /pom/ 'tree'
	b.	*pomi* [pom^{j}] /pom-i/ ''trees'
2nd p.	a.	*sar* [sar] /sar/ 'I jump'
	b.	*sari* [sar^{j}] /sar-i/ 'you jump'

- Schane 1971: Depalatalization applies to palatal Cs (ʃ, ʒ, ʧ)

UR: /moʃ-i/ → moʃ^{j} → depalatalization → SR: [moʃ] 'old men'

SP in postalveolars

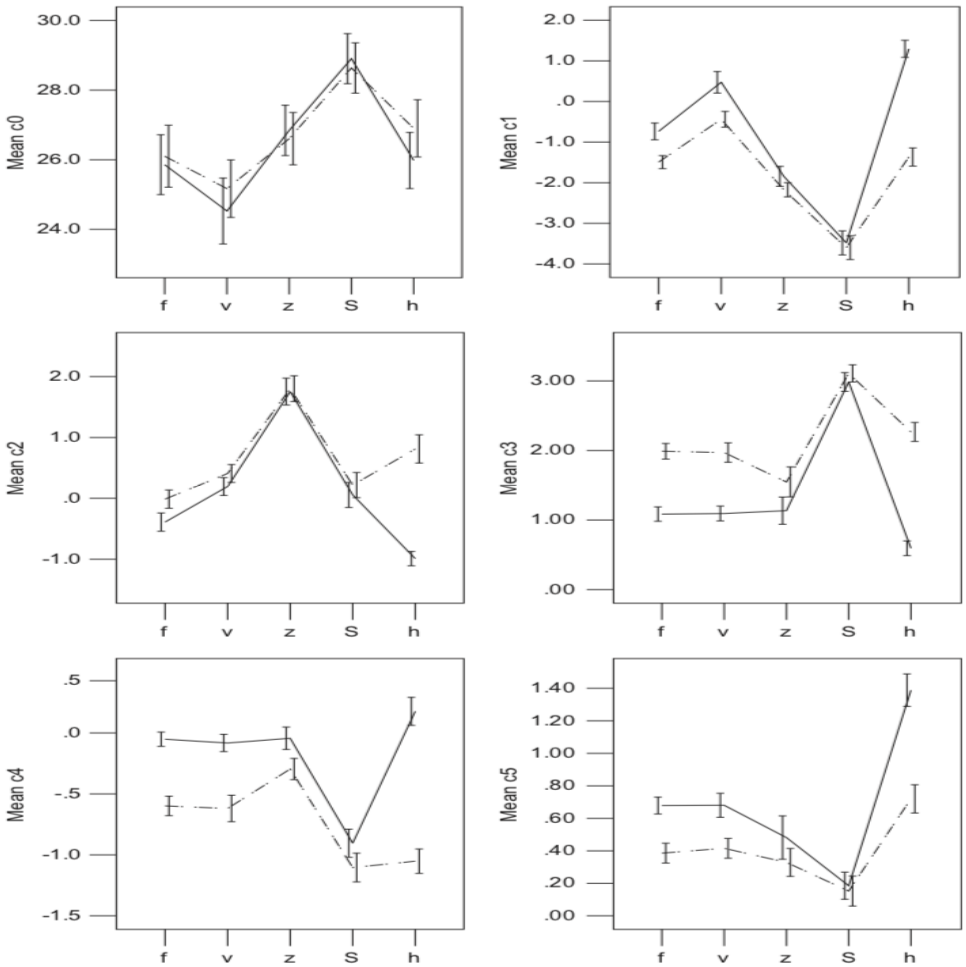
- Postalveolar segments usually pattern with either plain or palatalized Cs
- Livonian contrasts /ʃ/ and /ʃʲ/ (Campbell 1974)
- Morphological palatalization affects all Cs in Isthmus Mixe, including postalveolar fricative (Dieterman 2002)

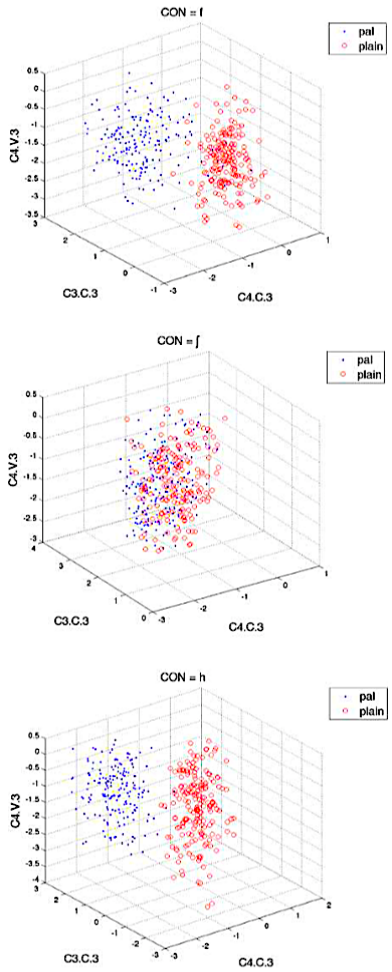
Romanian: SP in postalveolars

Șuteu 1961: mail survey

- pronunciation study in Bucharest, Romania
- 94.4% of 309 respondents reported a distinction between sg. and pl. form of word ending in a [ʃ]
- 'short' or 'weak' i-sound at the end of the plural item

Acoustic studies: SP contrast in Romanian postalveolars





(Spinu et al. 2012, Spinu & Lilley 2016, Spinu 2018)

Perception studies: SP contrast in Romanian postalveolars

Spinu et al. (2012)

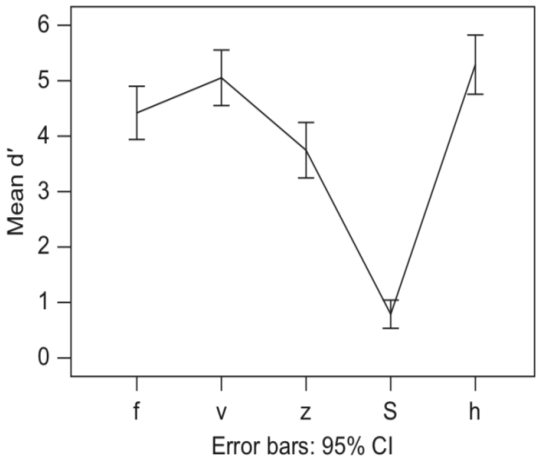
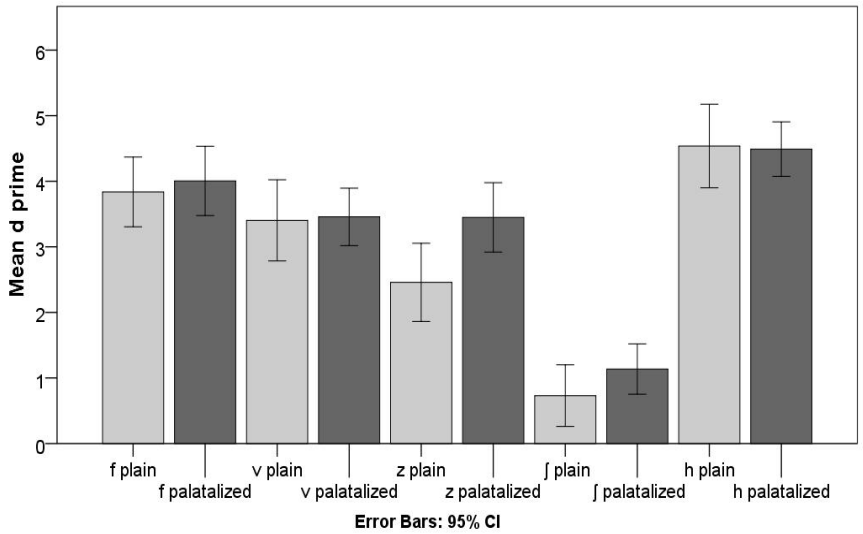


Fig. 5. Mean sensitivity by consonant.

Spinu (2018)



Romanian: SP in postalveolars

Spinu (2018)

- Plain vs palatalized form can be distinguished reliably (74% correct classification rate) based on cepstral measurements, though less than at other PoAs
- SP contrast acoustically realized by 27 out of 31 speakers
- Contrast perceptually salient, but listeners only display moderate sensitivity to it

Romanian: SP contrast in postalveolars

Possibilities:

- phonetically-driven neutralization in progress (Hayes & Steriade 2004)
- morphologically-driven maintenance (Pierrehumbert 2001)
- stable variation arising from opposing forces, driven by articulatory uniformity (cf. Faytak 2018)

THIS BRINGS US BACK TO OUR MAIN QUESTION
Is SP in Romanian postalveolars robustly implemented in articulation, but obscured acoustically by presence of primary PoA, or is it an articulatorily weak contrast and/or variable across speakers?

Production Experiment

Based on previous acoustic and perceptual results with Romanian SP and on cross-linguistic patterns:

Hypothesis 1: Differences between plain and palatalized fricatives in tongue raising and fronting depend on primary PoA (more subtle gestures in vicinity of palatal area).

Hypothesis 2: More individual variation in the realization of SP in postalveolars.

Production Experiment

Ultrasound imaging (Bennett et al. 2018):

- relatively non-invasive
- practical (reduced prep time)
- real-time visualization
- direct information about tongue body shape and movement, crucial to an understanding of palatalization

Stimuli

Three POAs, each represented by a plain and a palatalized form:

Labial	[f] - [fʲ] (e.g. zuluf-zulufʲ *curl-curls*)
Dental	[z] - [zʲ] (e.g. mofluz-mofluzʲ *morose-sg.-morose-pl.*)
Postalveolar	[ʃ] - [ʃʲ] (e.g. giduʃ-giduʃʲ *playful-sg.- playful-pl.*)

- Real words, bisyllabic
- Stress on final syllable
- Presented in carrier sentence: [zik ... kɨnd pot] *I say ... when I can.*
- Total: 3 Cs × 4 words × 2 forms × 6 reps × 10 speakers = 1,440

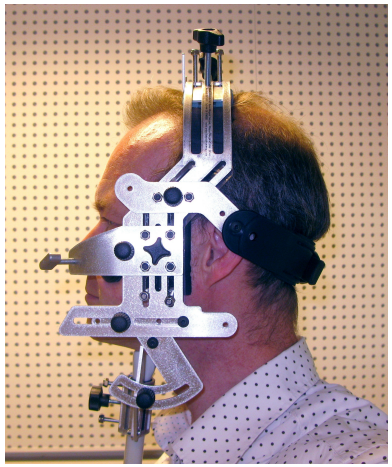
Participants and Procedure

Participants

- 10 native speakers (5 F)
- 29-51 y. o. (mean 42)
- In Canada for 0-16 years

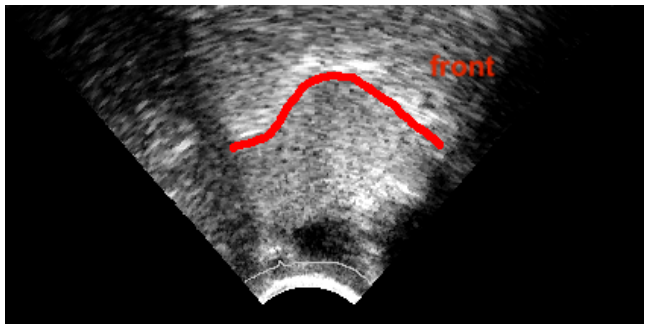
Instrumentation

- Midsagittal ultrasound data
- Telemed Echo Blaster 128 CEXT-1Z
- Articulate Instruments pulse-stretch
- Head stabilization headset
- `http://www.articulateinstruments.com/`

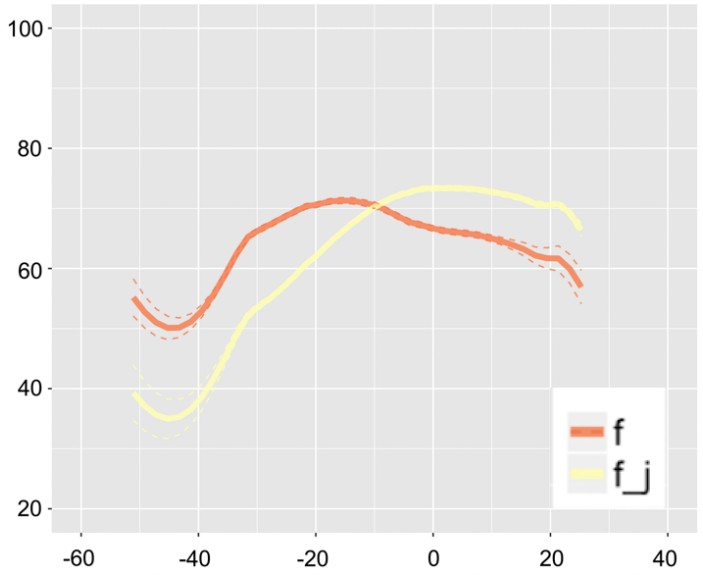


Analysis

- Tongue tracings using AAA at frame of max displacement
- Contours extracted as series of *x* and *y* coordinates and rotated wrt occlusal plane
- Smoothing Spline ANOVAs (SS-ANOVAs, Davidson 2006), *gss* package (Gu 2014)
- Radius values averaged across FRONT and BACK of tongue. Boundary determined as point of intersection for plain and pal [f]
- LME models in R: **dep. variable**: radius R, **fixed effects**: Consonant (f, z, ʃ) and Palatalization (plain, palatalized), **random effects**: Speaker (R01-R10) and Utterance (3 per target).

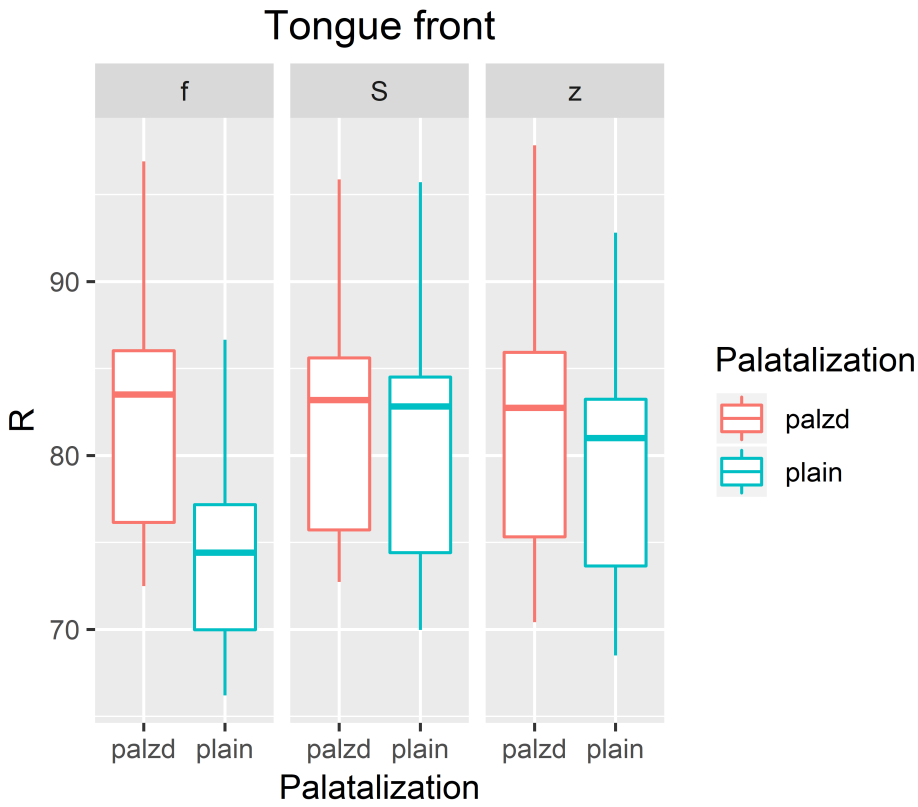


Sample SS-ANOVA for [f] vs. [fʲ] targets (R06).



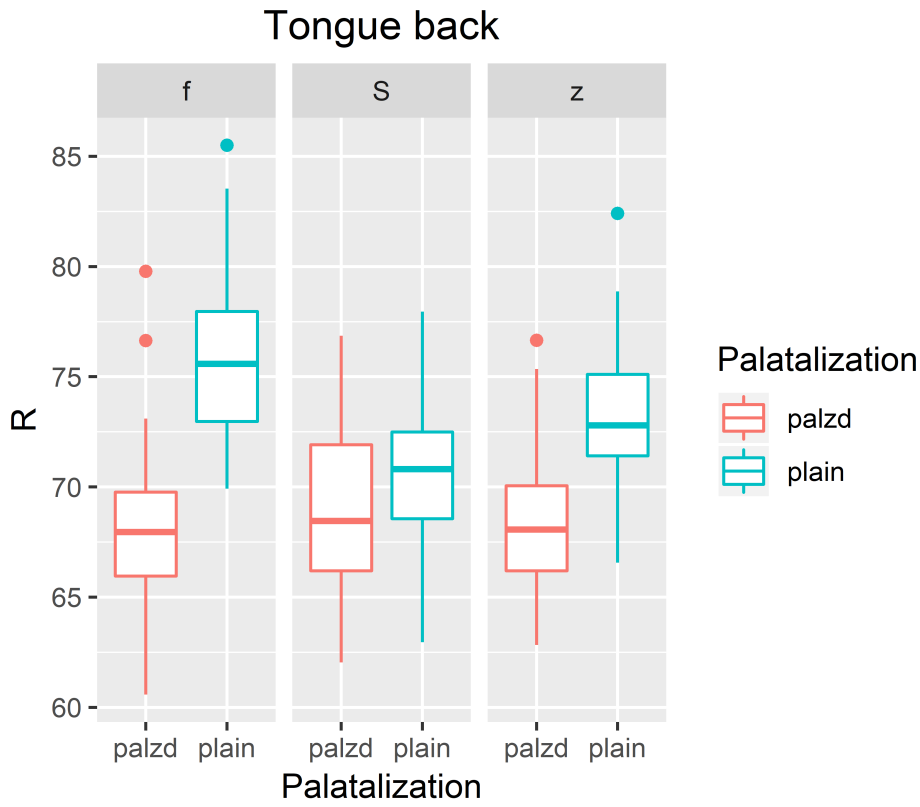
Results: tongue front

- Cons, Pal, Cons × Pal: all significant ($p<0.001$)
- Effect of Pal sig. for each C; pal Cs greater tongue body/blade raising than plain.
- Different magnitude of effect: [f] highest palatalization difference, [ʃ] lowest.



Results: tongue back

- Pal, Pal × Cons: significant ($p<0.001$) (not Cons)
- Effect of Pal sig. for each C; pal Cs greater tongue root/body fronting than plain.
- Different magnitude of effect: [f] highest palatalization difference, [ʃ] lowest.

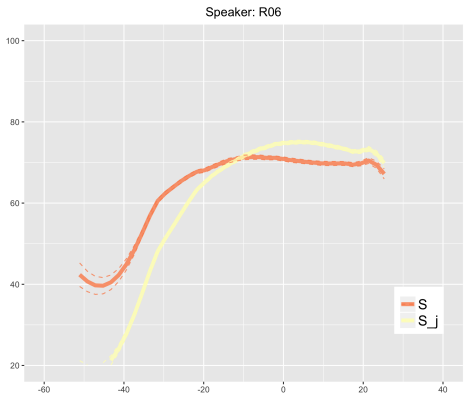


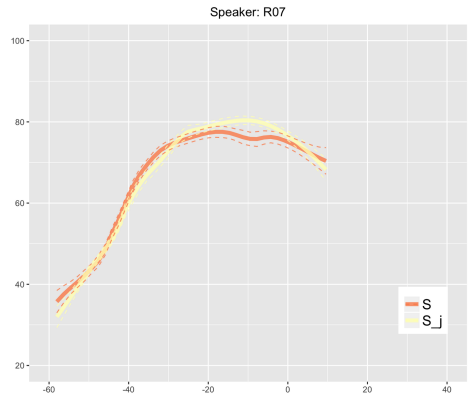
Results: Individual behavior

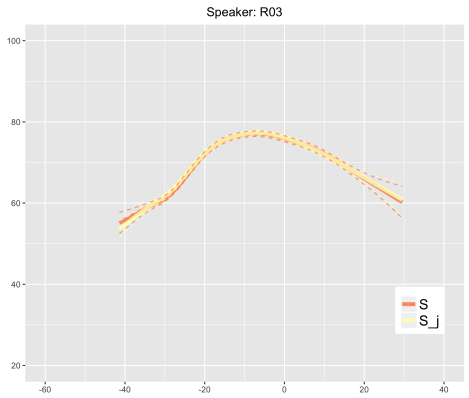
Postalveolars only 3 speakers clearly distinguished palatalization; the others either showed relatively small differences (5 speakers) or no differences (2 speakers).

Dentals 8 out of 10 speakers showed clear palatalization differences, with only one speaker apparently neutralizing the contrast.

Labials All speakers produced clear differences between plain and palatalized forms.







Main findings

Both hypotheses supported

Hypothesis 1 plain and palatalized targets differ significantly in both tongue regions (front and back), but magnitude of this difference not the same: [f]-[f^{j}] > [z]-[z^{j}] > [ʃ]-[ʃ^{j}].

Hypothesis 2 SP contrast in postalveolars shows more variation and appears to have been completely neutralized by 2 of the 10 speakers

SP gesture (articulatory uniformity across PoAs)

- potential invariance in feature realization may be more robustly manifested at production level compared to acoustic level (Liberman & Mattingly 1985, Browman & Goldstein 1995)
- Connemara Irish (Bennett et al. 2018) – high consistency in realization of SP across place, manner, and vowel contexts
- BUT our ultrasound analysis based on a single frame and did not include other potentially relevant aspects (e.g. tongue tip)

Predictions for sound change

Licensing by Cue (Steriade 1997):

- If environment A provides more acoustic information to a contrast between two segments /x/ and /y/, the identification of the contrast by listeners is likely to be high, and, as a result, the contrast would be *preserved*.
- If environment B provides less acoustic information to the contrast, the identification rate of /x/ vs. /y/ would tend to be lower and the contrast is more likely to be *neutralized*.

Phonetic knowledge hypothesis (Hayes and Steriade 2004): perceptually fragile contrasts tend to undergo one of two changes – enhancement or neutralization.

Enhancement

Examples (in general):

- Plain Cs → velarized in languages with SP
- Contrast [s]-[ʃʲ] in Romanian
- Also Romanian: SP contrast in dorsal fricatives [x]-[ç] ([çʲ]?)

Possible enhancement strategies for postalveolar fricatives:

- retroflexion/apicality: Polish (Hamann 2003, Zygis & Hamann 2003)
- strengthening to affricate: Catalan - natural tendency due to large area of contact btw tongue and roof (Flemming 2002, Lavoie 2014)
- fortition to full-fledged stop (Lavoie 2001)

No evidence of enhancement with SP contrast in Romanian postalveolar fricatives.

Neutralization

Examples:

- voiced vs. voiceless distinction neutralized in Russian obstruents
- SP contrast with labials in coda position cross-linguistically

Romanian SP contrast in postalveolars: not realized in 20% of speakers vs. 13% (2009) vs. 6% (Șuteu 1961 - speculative as findings not supported by acoustic/articulatory measurements).

Perhaps this is a case of partial/incipient neutralization?

Grammatical restructuring

No enhancement and limited neutralization: contrast maintained?

- Deviations from cross-linguistic patterns may be due to properties of lexicon & grammar – contrast maintained in a less favorable environment if pressure from additional factors sufficiently strong (Kochetov 2002)
- Strength of pressure depends on productivity and relative salience of morphological categories (Pierrehumbert 2001): stronger effects for highly productive, morphologically transparent alternations

Romanian postalveolar SP may be a case of relatively **stable variation** resulting from 2 conflicting demands (phonetically-driven neutralization and morphologically-driven maintenance). Speakers may vary in how they balance these pressures (within-speaker uniformity, Faytak 2018).

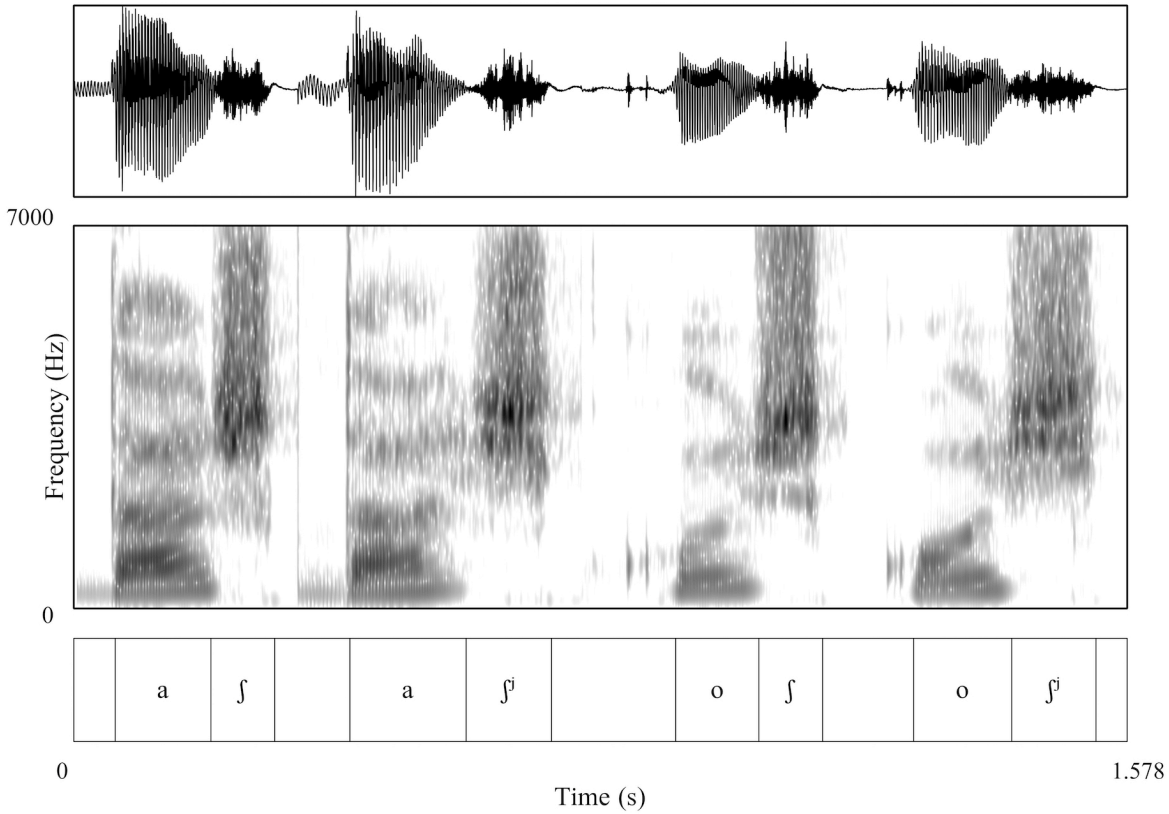
Conclusions

- First account of articulatory properties of SP in Romanian
- Rare cross-linguistic contrast conforms to typological predictions – acoustically, perceptually, and articulatorily weak
- We have found some neutralization and individual variation, but the contrast appears to have persisted over time (stable variation resulting from 2 conflicting demands?)
- Lack of 1-to-1 correspondence between phonetic factors triggering neutralization and attested neutralization patterns.

Caution/Future Direction

SP inherently dynamic - may not be synchronously timed with the primary gesture. There are likely other differences (including during preceding V) that our analysis is missing, being limited to a single frame.

Thank you



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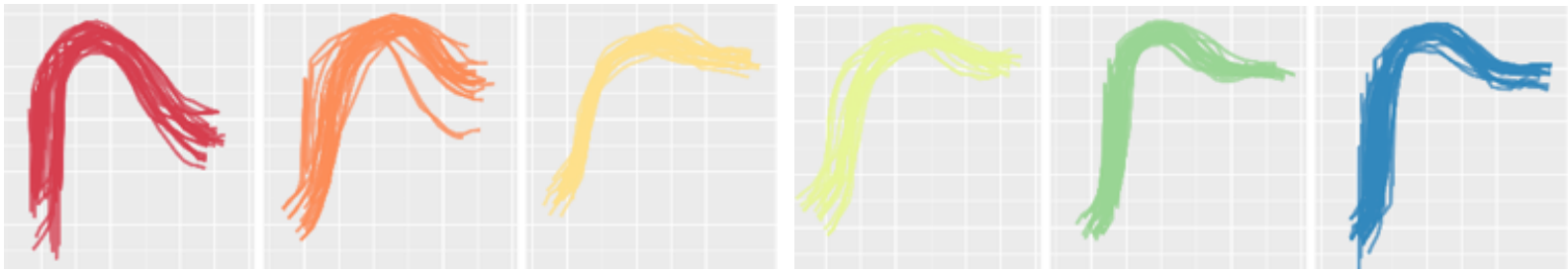
Tongue tracings

[f] [fʲ] [ʃ] [ʃʲ] [z] [zʲ]



Speaker R04