

# Sub-Articulatory Interactions in Palatalization Processes

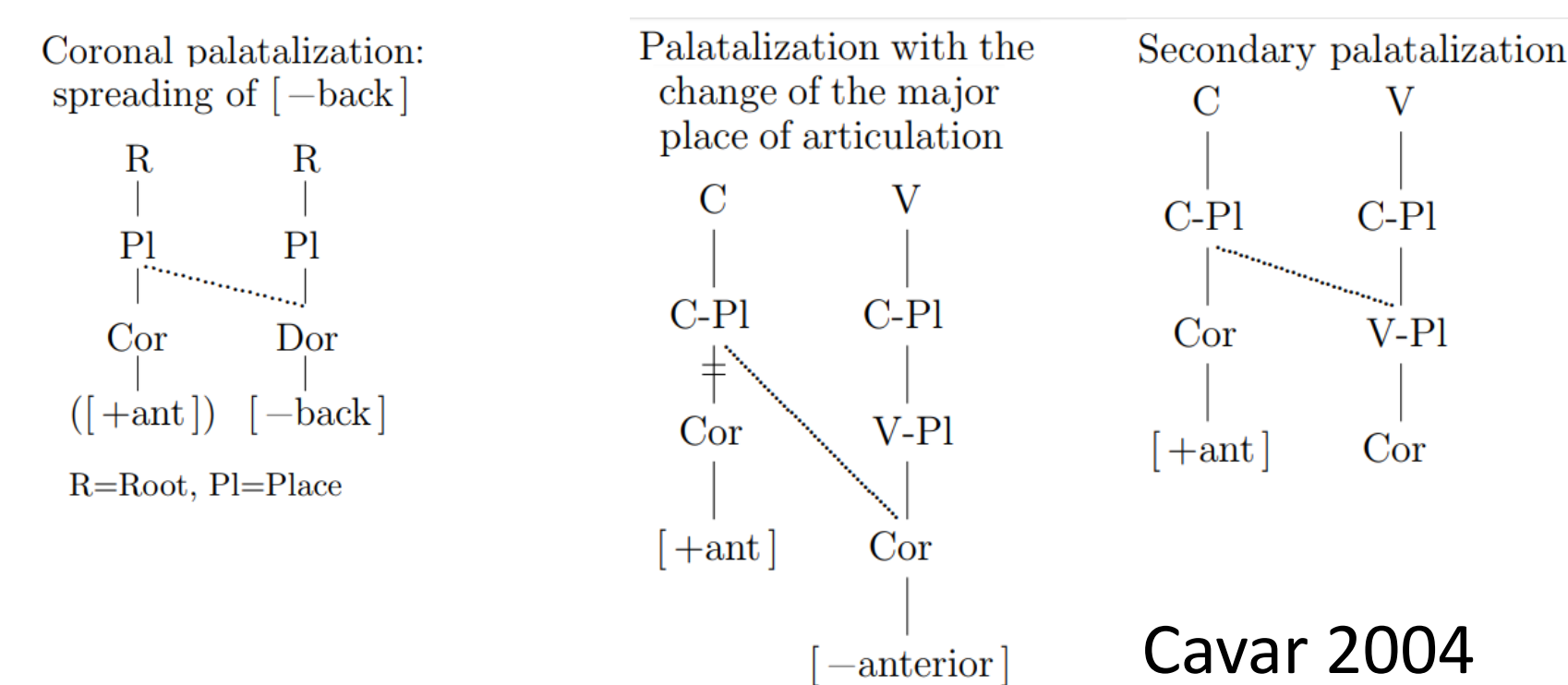


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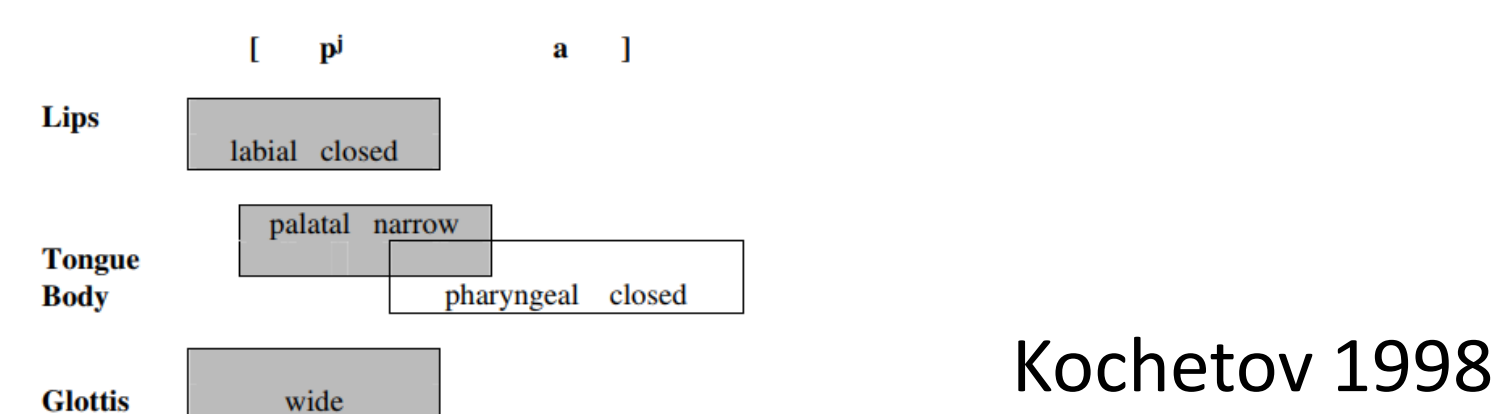
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## Introduction

- Palatalization is a widespread phenomenon across the world's languages, and is typically conceived articulatorily as a tongue body raising and/or fronting gesture that is spread from high and/or front vowels to neighboring consonants.
- Phonological account



Cavar 2004



Kochetov 1998

- We review evidence from instrumental phonetic studies and typological and historical arguments and propose that palatalization processes do not primarily result from gestural overlap, but instead arise from the resolution of incompatible lingual “sub-articulations”.

## Ultrasound Study: Method

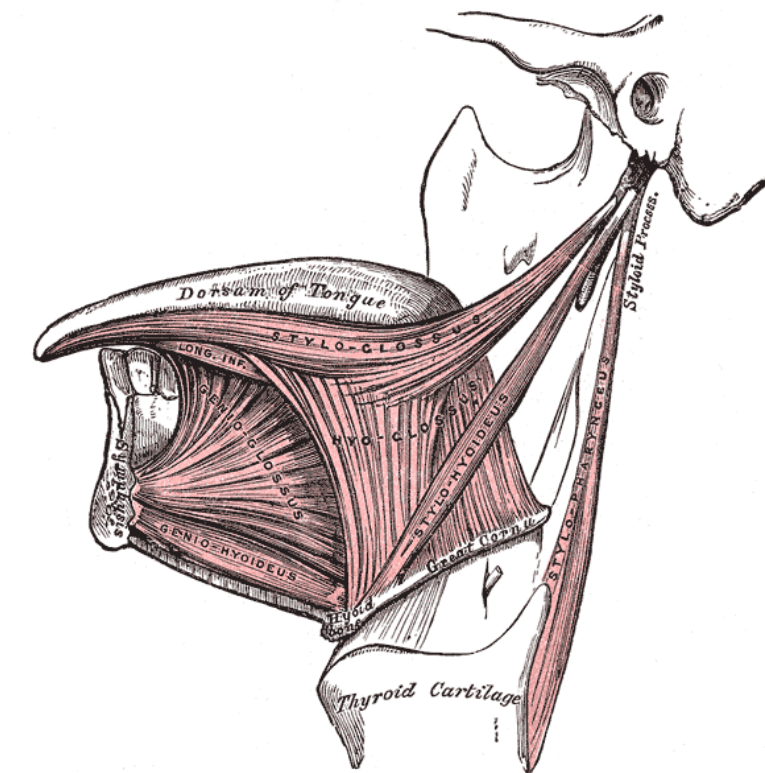
- 5 Polish native speakers (3 women, 2 men) and 9 Russian native speakers (6 women, 3 men) participated in the recordings (some of the Polish speakers in multiple sessions). Participants read word lists.
- Ultrasound images were recorded with a Philips EpiQ7G system using an xMatrixx6-1 digital3D transducer secured under the chin using an Articulate Instruments ultrasound stabilization headset.
- Fully uncompressed DICOM ultrasound files were transferred to a Windows 7 computer.
- Ultrasound/palate files were analyzed w/ a custom MATLAB toolbox, called “WASL”.
- Audio was recorded with a SHURE KSM32 microphone placed approximately 1 meter in front of the participant, at 48kHz sampling rate.

## Acknowledgements

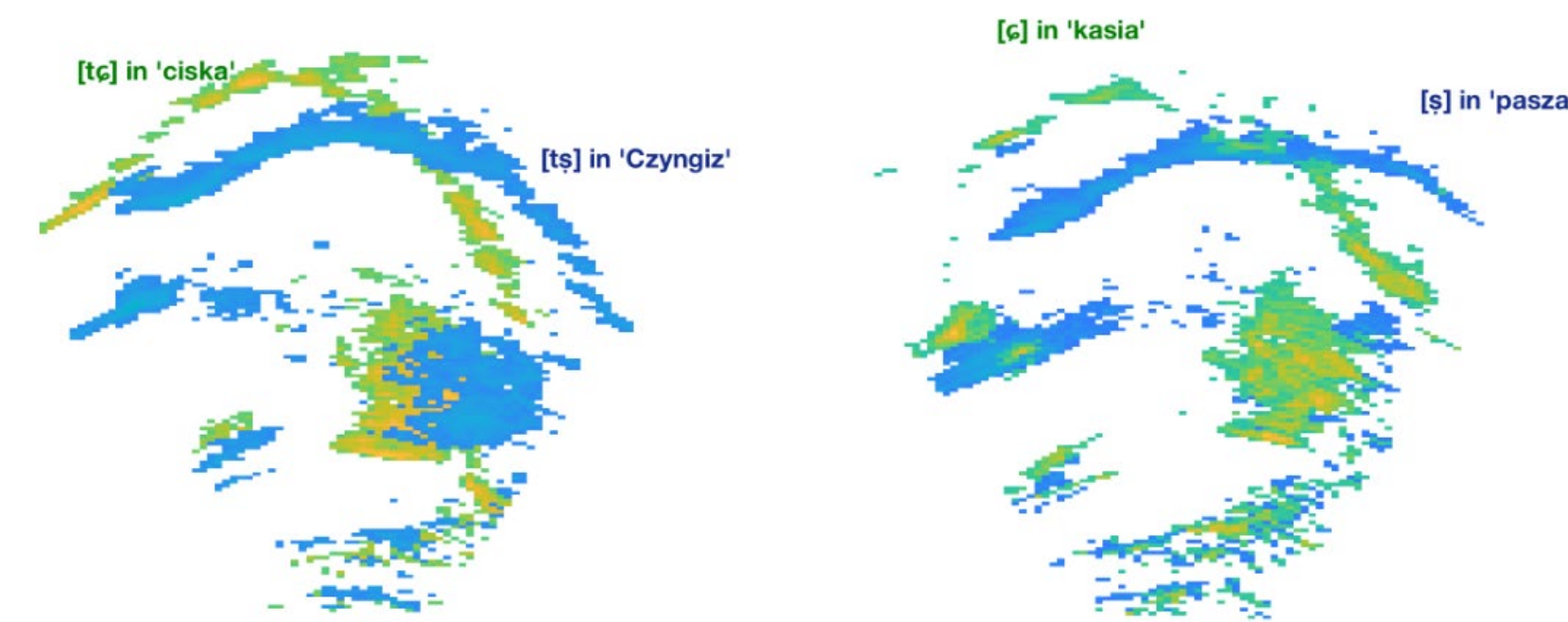
Thanks to Sherman Charles, Olivia Foley, Max Nelson, who participated in the data collection.

## Arguments from anatomy

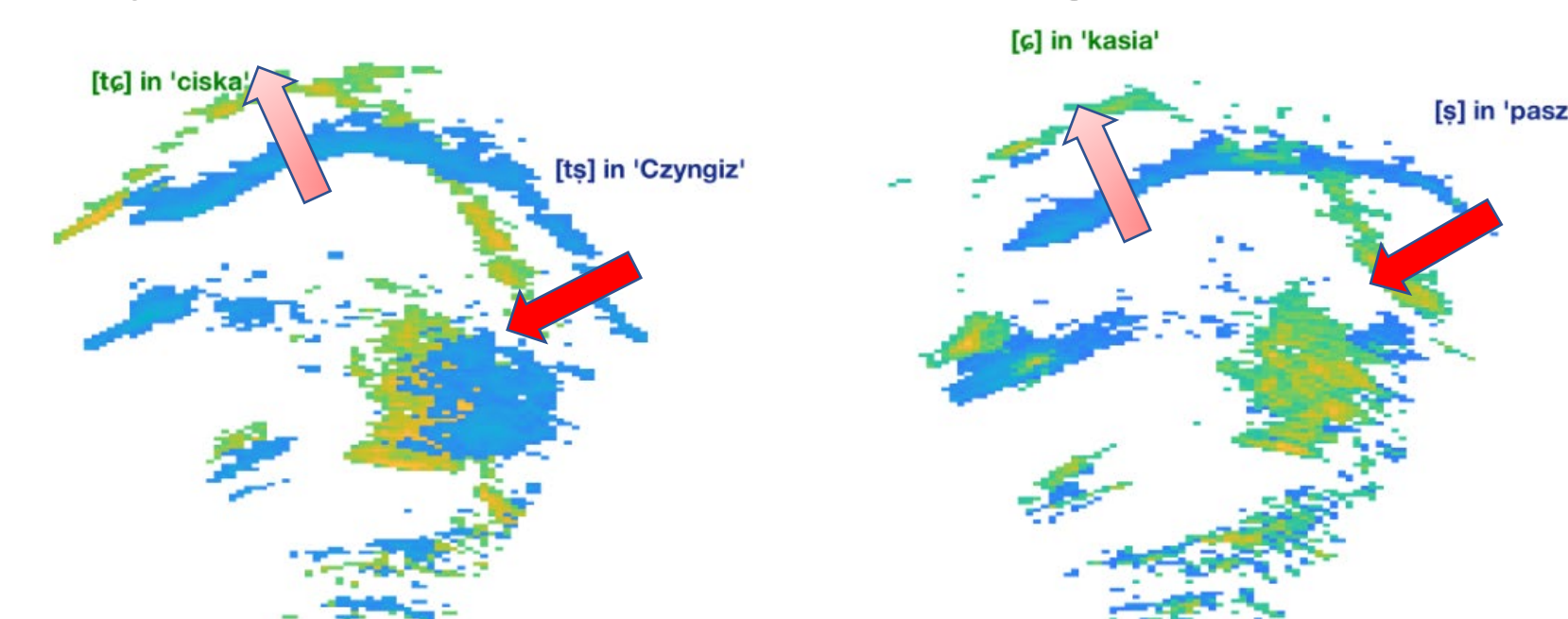
- Articulation is *simply not* mechanically simple. The articulators deform in three dimensions in response to both active and passive forces.
- Active forces include muscle contraction and stiffening.
- Passive forces include volume preservation (muscular hydrostat) and biomechanical stress (energy) minimization.
- **There are no** muscles to move the tongue body directly



Henry Gray, “Anatomy of the Human Body”, 1918

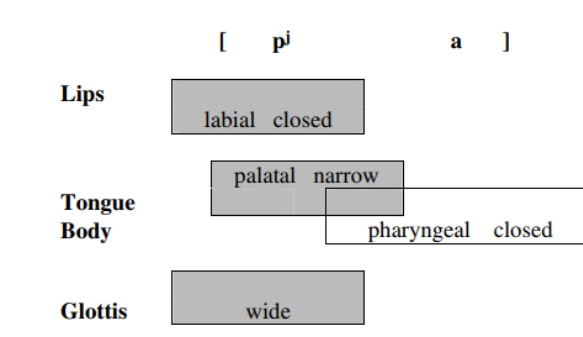


- Palatalization is not primarily a **result of an overlap of tongue body gestures**.
- Instead, the **complex passive effect of advancing the tongue root is to displace tongue volume in the direction of the hard palate**.
- This passive mechanical coupling makes it more difficult to *also* produce a plain coronal or velar stop.
- Palatalization arises from a mechanical compromise rather than from gestural overlap.



## Arguments

### Arguments from typology and phonology



- \* Gestural overlap is a simple way to represent palatalization on labials.
- \* Labials should be the easiest sounds to palatalize because there are no coarticulatory constraints on gestural overlap.
- \* And yet...Labials are the least likely sounds to become palatalized cross-linguistically.

Implicational universal for full palatalization (Bateman 2007: 86)  
labial > coronal and dorsal

Table 1. Full palatalization patterns (from Bateman 2007:44).

Affected POA	Labial	Coronal	Dorsal	Coronal, dorsal	Labial, dorsal	Labial, coronal	Labial, coronal, dorsal
No. of languages	0	27	9	12	0	0	2

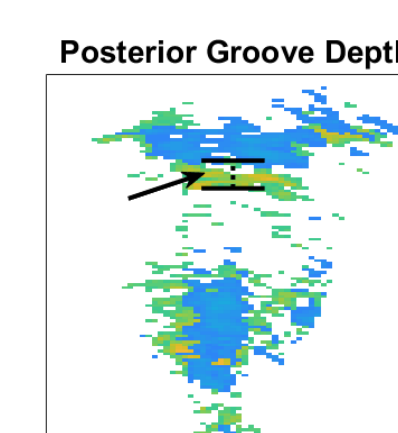
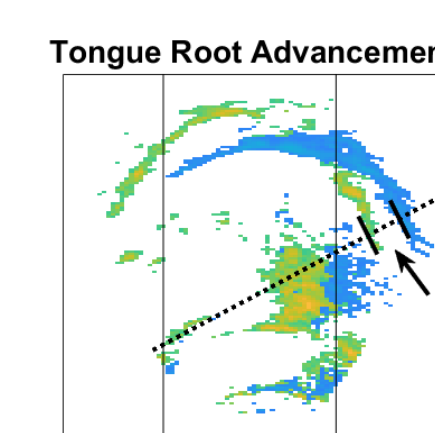
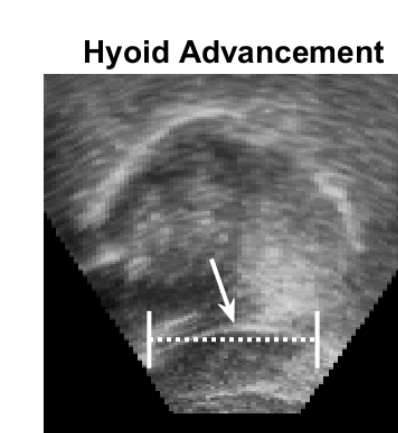
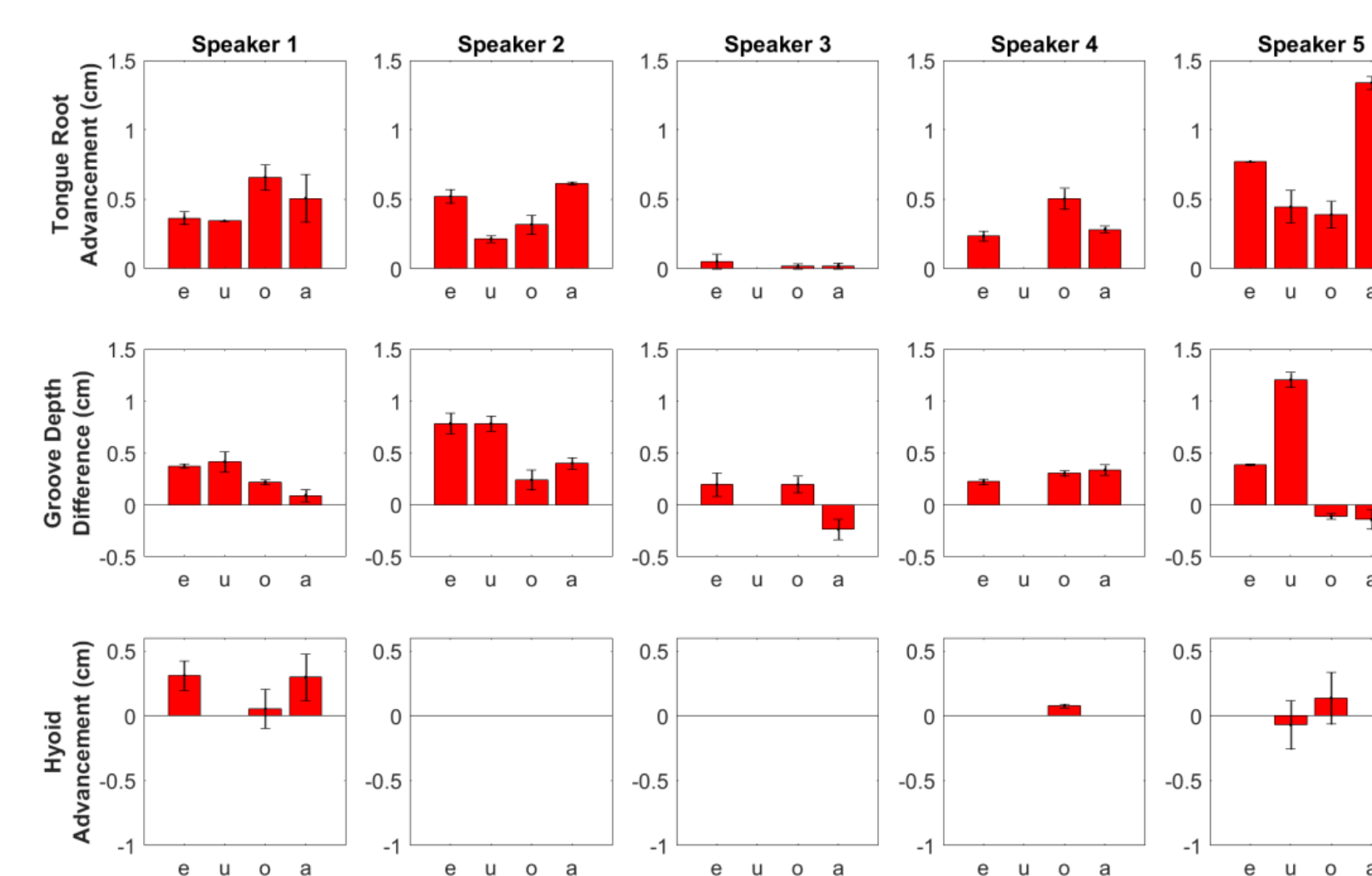
Table 2. Secondary palatalization patterns (from Bateman 2007:50).

Affected POA	Labial	Coronal	Dorsal	Coronal, dorsal	Labial, dorsal*	Labial, coronal*	Labial, coronal, dorsal
No. of languages	0	7	9	3	2*	4*	10

\*For these patterns, the coronal and dorsal places, respectively, show full palatalization.

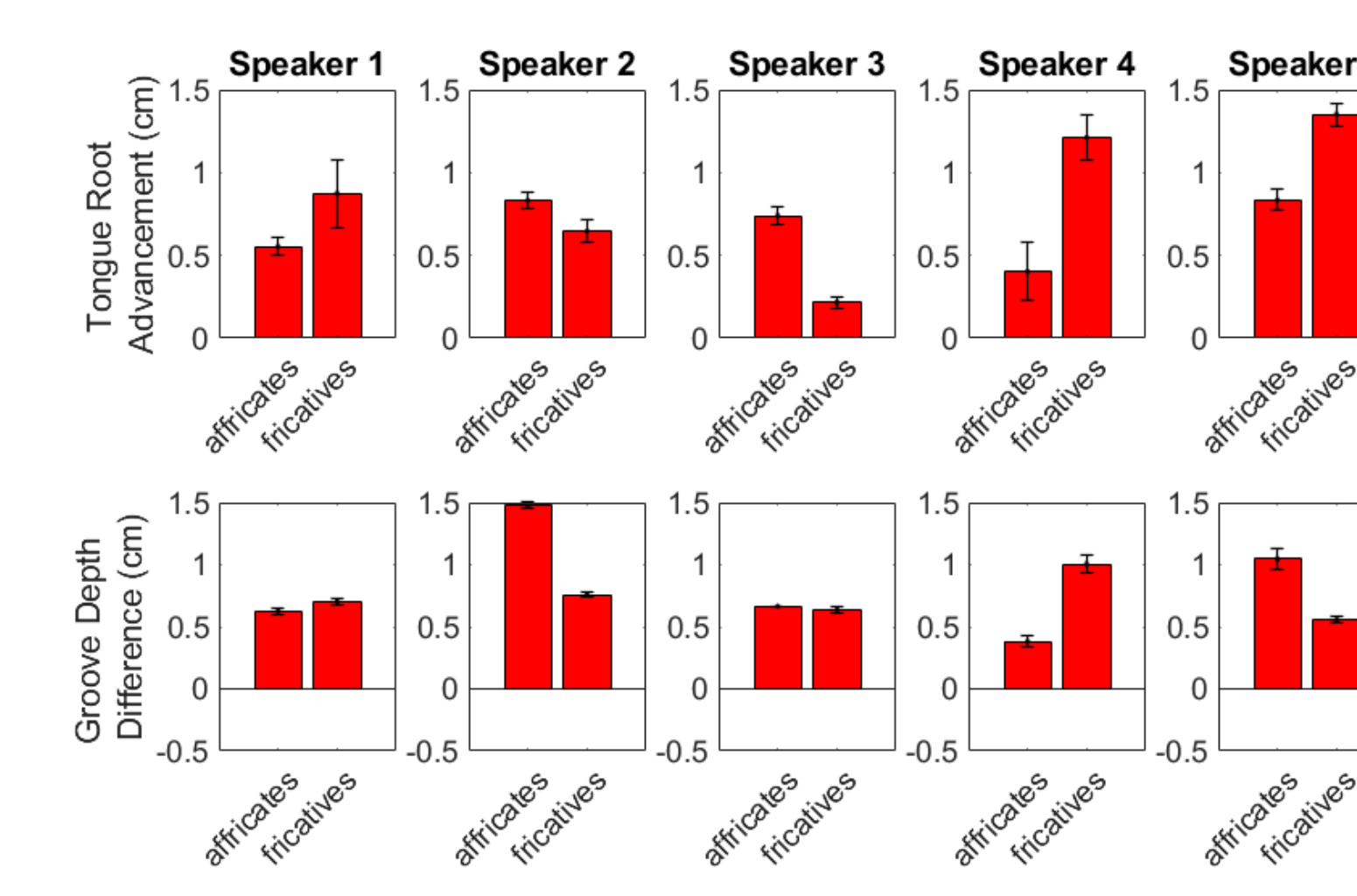
## Evidence from Polish palatalization

The advancement of the tongue root is a consistent, salient feature of Polish **vowels** that trigger phonetic palatalization **and** phonetically **palatalized consonants**. Because the bilateral GGp muscles straddle the midline (and not the lateral margins of the tongue), palatalizing vowels in Polish and palatalized consonants exhibit a **midline groove** in the tongue root. Possible enhancement from geniohyoid muscle contraction is predicted to advance the hyoid bone along with the tongue root.



What was measured....

Functionally soft prepalatals in Polish



## References

- Bateman, N. 2007. A cross-linguistic investigation of palatalization. Doctoral Dissertation. UC, San Diego.  
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Kochetov, A. 1998. Labial Palatalization: A Gestural Account of Phonetic Implementation. The CLA Annual Proceedings.  
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## Scenario for a language change

- ATR is initially the driving force for palatalization of consonants and as such necessarily a palatalization feature.
- Tongue root advancement produces a series of collateral effects: tongue body raising and tongue body advancement, affrication

Tongue body raising  
ATR  
Tongue body fronting  
Affrication

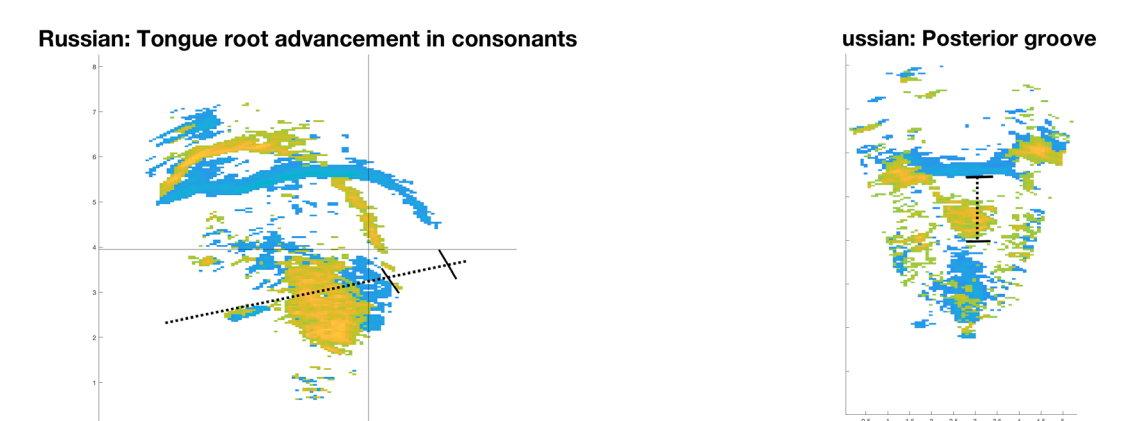
Phonetic palatalization

Language change:  
Potential dissociation  
of feature aggregate

Tongue body raising  
Tongue body fronting  
t → tʃ  
Affrication k → s  
t → ts

Historical/phonological palatalization

## Evidence from Russian



Secondary palatalized /t/ vs non-palatalized /t/ In Russian

## Summary

- Arguments from anatomy, phonological typology and ultrasound studies point to the interpretation of palatalization as driven by the advancement of the tongue root accompanied by compatible gestures and acoustic effects.
- The cross-linguistic variety of palatalization processes results from diachronic dissociation of the feature aggregate and reinterpretation of the contrast.