Oral–velum actions in the articulation of nasal juncture geminates and singletons

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INTRODUCTION

Articulatory studies on geminate and singleton consonants largely focus on **oral** gestures, without further attention to **non-oral** gestural actions (e.g., velum or larynx gesture).

We investigate spatiotemporal properties of both oral and velum gestures in nasal **singletons** and **geminates** to understand the dynamical mechanisms underlying these multi-gestural structures.

Q1. Oral & Velum gestures

Given that under focus, articulation of consonants with a single **oral** gesture are generally ***larger and longer*** (e.g., [1]) ...

Would focal prominence similarly ***enlarge and lengthen*** the component **velum gesture** in nasals?

Q2. Singletons vs. Geminates

Do (non-lexical/juncture) geminates exhibit similar focus effects as singletons, or does focus gesture modulates different articulatory aspects in geminates from singletons?

METHOD

Stimuli: Korean nasal singletons and geminates elicited by producing a noun + number classifier sequence in a sentence (7-8 repetitions)

[hatp*a] 'fishcake bar' [ɕʰilpʰan] 'chalkboard' [nɛkɛ] 'four'+classifier

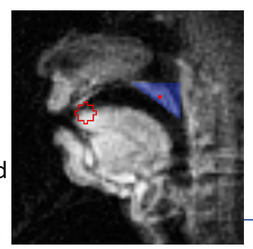
	Accentual Phrase (AP)	AP w/ focus (AP+focus)
Singletons	hatp*a] **n**ɛkɛ 'four fishcake bars'	'**four** fishcake bars'
Juncture geminates	ɕʰilpʰa**n**] **n**ɛkɛ 'four chalkboards'	'**four** chalkboards'

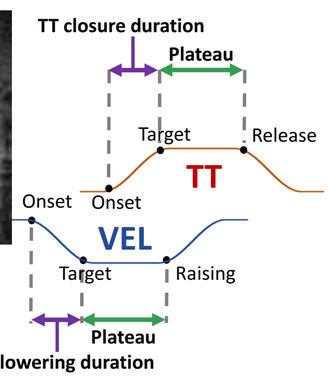
Data acquisition

- Real-time MRI data of the midsagittal vocal tract from two native Korean speakers
- Kinematic trajectories of **Tongue Tip (TT)** gestures & **Velum (VEL)** lowering gestures

Measurements

- TT magnitude: pixel intensity (red ● ROI, [2])
- VEL magnitude: Vertical centroid displacement (blue ◥ ROI, [3])





- TT closure duration
- VEL lowering duration
- Plateau durations

SPATIAL RESULT

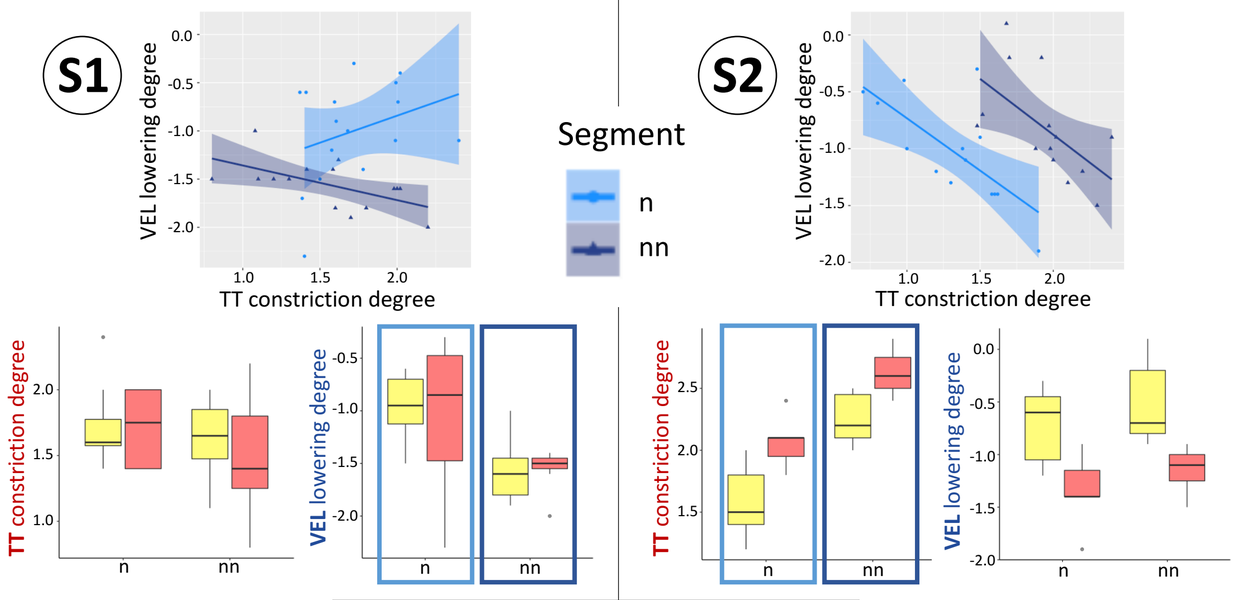
n vs. nn

Geminates either have
- greater VEL lowering (S1)
  or
- more TT constriction (S2)

than singletons.

But, the pattern is not consistent across two speakers.

For S2, there is a strong **negative correlation** between TT and VEL magnitudes.



TEMPORAL RESULT

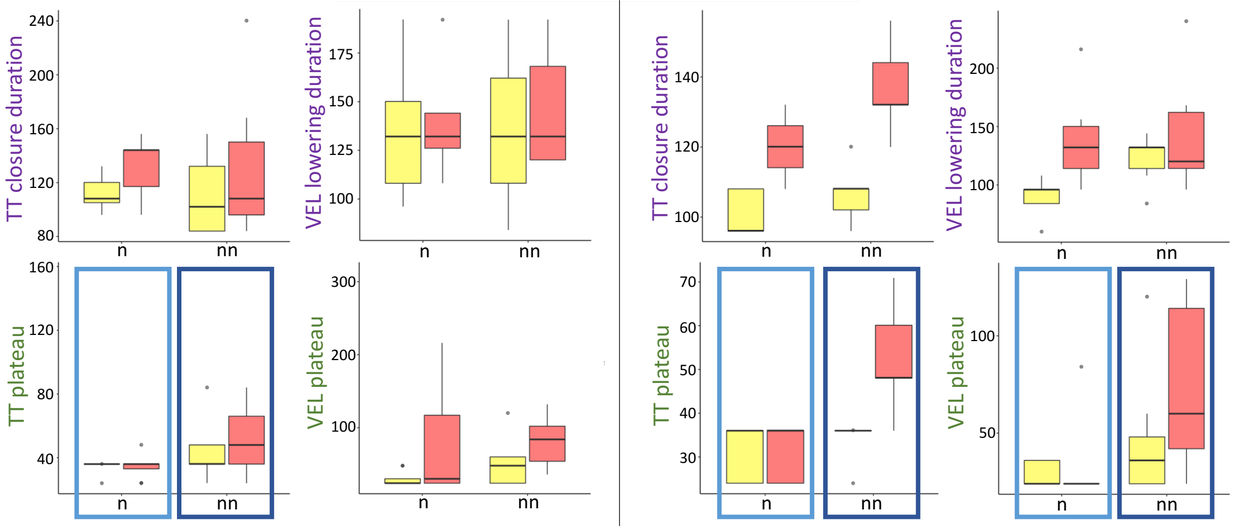
n vs. nn

Geminates, under focus, have
- longer TT plateau (S1 & S2)
  and/or
- longer VEL plateau (S2)

than singletons.

But, no noticeable difference in TT and VEL duration.

For S2, focus modulates TT & VEL durations and geminate plateau (but not singleton plateau).



DISCUSSION & CONCLUSION

- Velum and oral components of nasal consonants may pattern distinctly in their spatial actions.
  - Individuals may use different gestural components to distinguish nasal singletons from geminates.
- Subset of data shows negative correlations between TT and VEL magnitudes, suggesting that the two gestures are tightly linked to each other.
- Plateau, but not closure/lowering duration, distinguishes singletons from geminates.
- Focus—a prosodic modulation (μ-) gesture—does not uniformly enlarge and lengthen both TT and VEL gestural component actions across nasal geminates & singletons, though in many instances it does.
  - Under focus, for S2, plateau lengthening is only seen for geminates.
  - And for S1, VEL lowering is not lengthened, nor is TT plateau.
- Uniform prosodic transgestural action is not observed for multi-gestural segments.

➤ ***Do prosodic gestures apply at a more abstract level??***

REFERENCES

[1] Cho, T., & Keating, P. 2009. Effects of initial position versus prominence in English. *Journal of Phonetics*, *37*(4), 466- 485. **[2] Lammert, A., Ramanarayanan, V., Proctor, M., & Narayanan, S. 2013.** Vocal tract cross-distance estimation from real-time MRI using region-of-interest analysis. In *INTERSPEECH* (Lyon, France), 959–962. **[3] Oh, M., & Lee, Y. 2018.** ACT: An Automatic Centroid Tracking tool for analyzing vocal tract actions in real-time magnetic resonance imaging speech production data, *Journal of the Acoustical Society of America,* 114(4), EL290–EL296.