Variability of articulatory dimensions relates to their role in distinguishing phonological categories for individual speakers

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1. VARIABILITY AND CONTRAST

How do individual differences in articulatory variability relate to the production of segmental contrasts?

Previous research → a relationship exists between variability in speech production and phonological contrast ([1],[2])

= articulatory dimensions crucial for differentiating contrastive segments are less variable than non-contrastive dimensions

Individual differences between speakers in

a) Use of articulatory and acoustic dimensions to produce segmental contrasts ([3-5])

b) Effect of contextual factors on the realization of articulatory and acoustic dimensions in a segment ([6-10])

→ *Potentially related to individual differences in stochastic variability ([11])*

Hypothesis:

Interspeaker differences in the **use of articulatory dimensions** to differentiate pairs of contrasting segments in production are related to interspeaker differences in **articulatory variability**.

Predictions:

Prediction 1: Speakers who **differentiate** segments along an articulatory dimension in production will be **less variable** than speakers who don't

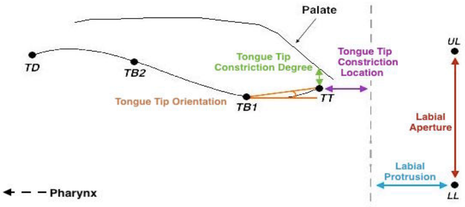
Prediction 2: Speakers who use an articulatory dimension to a **greater extent** in segment differentiation will be **less variable** in their production

2. METHODS

Articulatory Analysis

Kinematic articulatory data collected from 40 speakers in the Wisconsin XRMB corpus ([12])

- Word-initial and –final tokens of /s/, /ʃ/, /l/, and /ɹ/ from sentence and passage reading tasks automatically analyze using modified version of findgest algorithm (MVIEW, Tiede) (7,298 total)



Measured articulatory dimensions: **CL**, **CD**, **CO**, **LA**, and **LP**

Statistical Analysis

All statistical analyses conducted separately for each speaker

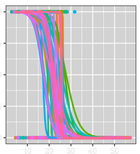
Multiple logistic regression = measure of segment differentiation

(a) **significance** and

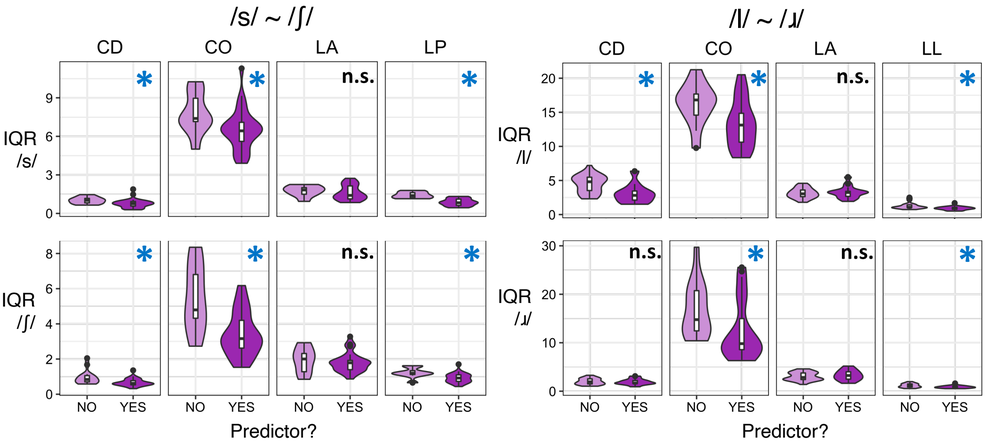
(b) **extent** of dimensions' contribution to distinguishing /s/ vs. /ʃ/ and /l/ vs. /ɹ/

Interquartile Range (IQR) = measure of variability

→ calculated for each articulatory dimension in each segment AND for both segments in a contrast combined



3. RESULTS: PREDICTOR SIGNIFICANCE



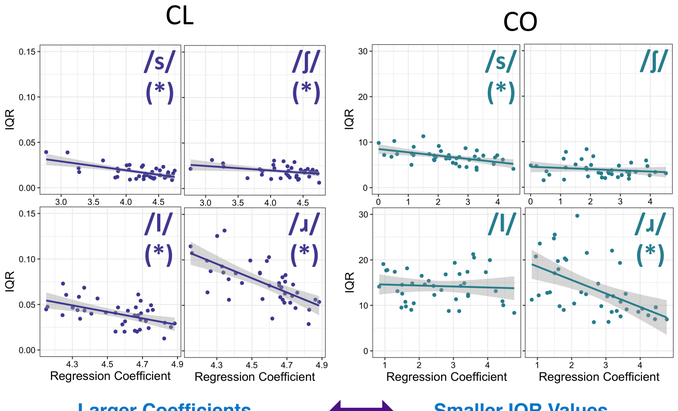
Count of "predictor" speakers

	/s/ ~ /ʃ/	/l/ ~ /ɹ/
CL	39	40
CD	26	29
CO	27	27
LA	26	14
LP	26	17

Speakers who **distinguish segments** along an articulatory dimension are **less variable** in their production of that dimension (**Prediction 1**)

4. RESULTS: EXTENT OF CONTRIBUTION

Speakers who use an articulatory dimension **to a greater extent** in segment differentiation are **less variable** in their production of that dimension (**Prediction 2**)



Larger Coefficients *(greater use in classification)* ⟷ **Smaller IQR Values** *(less variability)*

	IQR	/s/ ~ /ʃ/	/l/ ~ /ɹ/
CL	C1		
	C2		
	Pooled		
CD	C1	COR	COR
	C2		
	Pooled		COR
CO	C1		
	C2		
	Pooled		
LA	C1	COR	
	C2	COR	
	Pooled	COR	
LP	C1		
	C2		
	Pooled		

Results of multiple regression analyses with IQR and Mean Difference as predictors of logistic regression coefficients (green = significant; red = not significant: COR = Mean Difference and IQR correlated)

Relationship still observed when accounting for effect of distance between category means

5. CONCLUSION

Interspeaker differences in articulatory variability and in the use of dimensions to differentiate contrasting segment pairs are generally **related**

Speakers who exhibit less variability along an articulatory dimension

a) Are **more likely** to differentiate segments using that dimension

b) Use it to **a greater extent** in distinguishing segment pairs

The relationship observed between variability and segment differentiation is not a side effect of the relationship between variability measurements and the difference between category means for most dimensions

→ Suggests independent role of variability in the differentiation of these segment pairs

References, additional graphs, and further information on analyses available at sarahkharper.github.io/ISSP2020