

Acoustic and articulatory vowel variation as quality shift and increased variance in anticipatory and carryover vowel-to-vowel coarticulation

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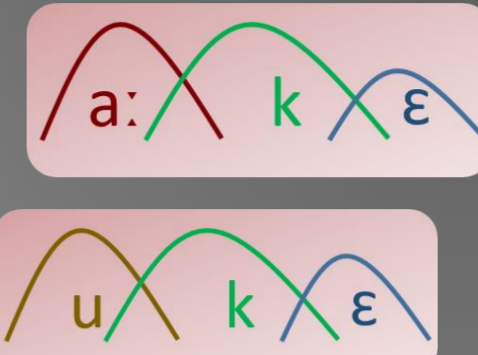
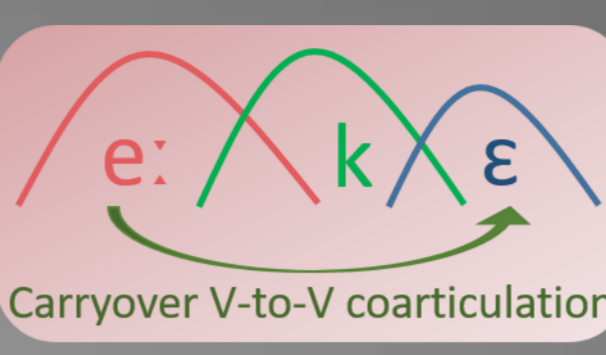
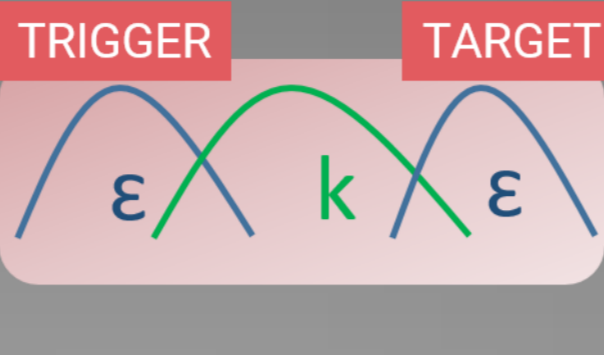
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Introduction

V-TO-V COARTICULATION: Vs in VCV sequences are produced with one single **underlying diphthongal gesture** to which the **C's gesture is superimposed** (Öhman 1966).



V-to-V coarticulation induced contextual variation of vowels is hypothesized to be dependent on several factors.

Accent related effects on V-to-V induced vocalic variation

Prosodically strong locations (lexical stress, pitch-accent, edge of prosodic domain) condition articulatory "strengthening" (increased spatio-temporal magnitude of gestures) → **H:** increased coarticulatory **resistance**...

...and **aggression**.

aggression hypo

- Fowler (1984): **acoustic distances across contexts** are smaller if stressed (nonwords),
- Cho (2004): **articulatory distances of coart'd and non-coart'd tokens** is smaller if accented ('plausible' words)
- Deme et al. (2019): **distances and across context dispersion** (see below) showed divergent results, esp. for the two domains of production (real words)

While several studies demonstrated c. aggression and resistance are the "two sides of the same coin" in C-V coarticulation (e.g., Recasens & Rodríguez, 2016),

- no increased aggression was found in articulation in V-to-V (Cho, 2004).

Direction effects on V-to-V V-to-V induced vocalic variation

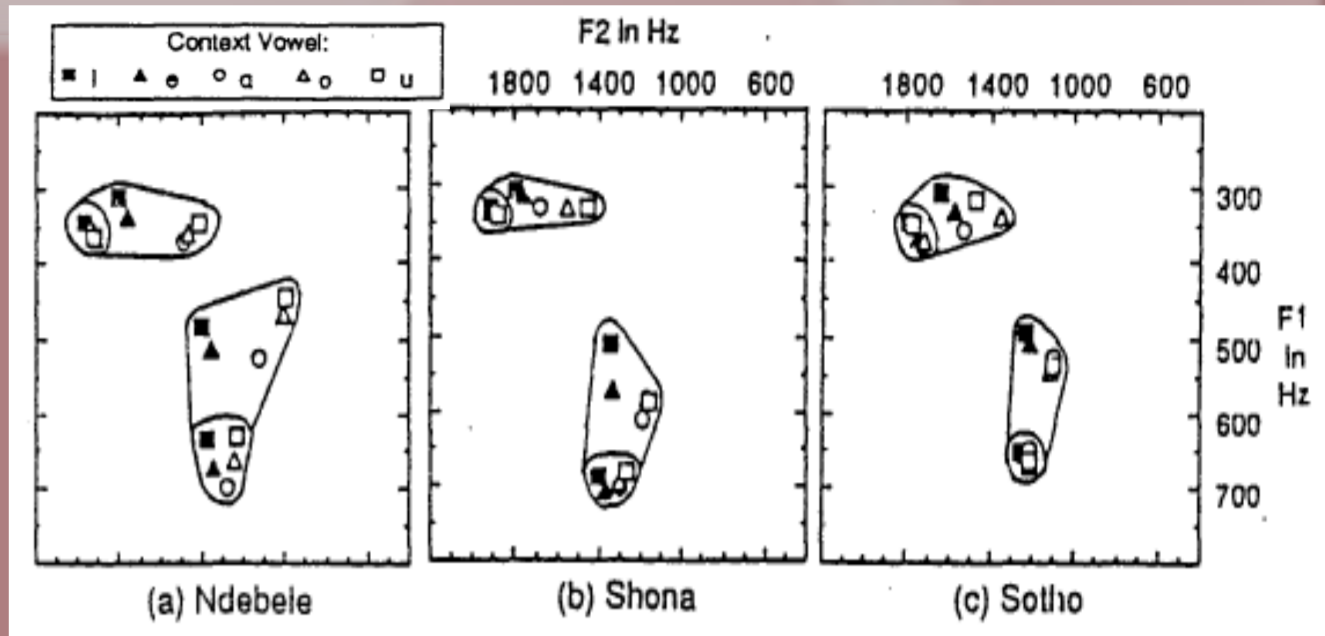
V-to-V effects differ as a function of direction of coarticulation.

- **Carryover effects exceed that of anticipatory**
- in /i/ and /a/ in articulation (Cho, 2004).
- in open /æ/ (Mok 2011) and /i u a/ (Mok 2012) in acoustics.

direction hypo

How do we determine coarticulatory effects and coarticulatory variability?

- Previous studies: in quality shift, as determined by **distances of tokens**.
- However, contextual variability is very often represented visually by dispersion ellipses, i.e., **across context variability or dispersion, SD**.



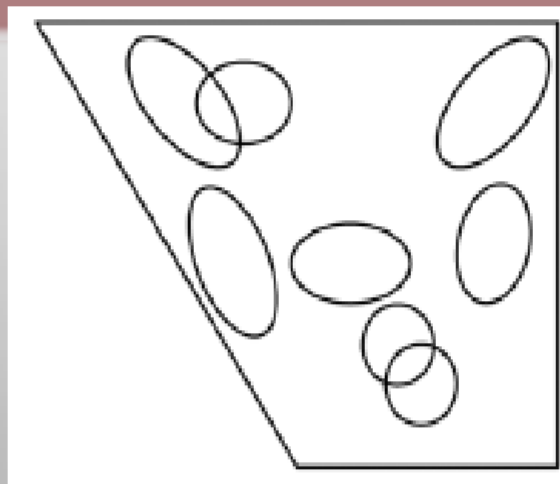
Manuel (1990: 8): across context "scatter" of vowels

Questions

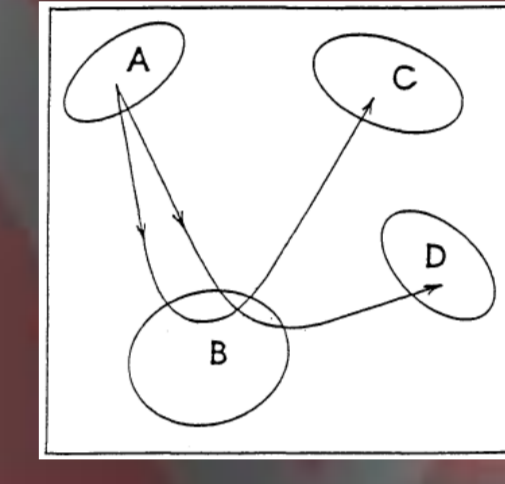
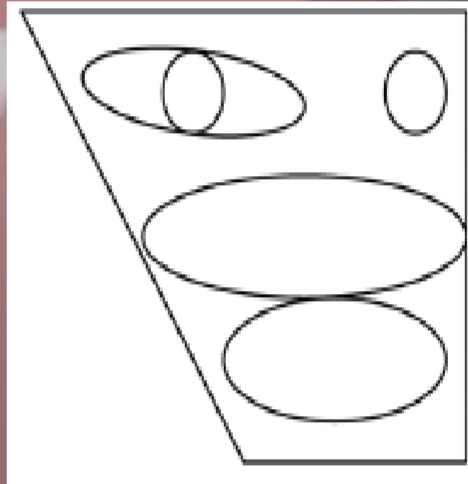
Q1: Does V-to-V induced variation in vowels depend on the **direction of coarticulation** (carryover vs. anticipatory)? (coart. **direction** hypo.)

Q2: Are V-to-V effects influenced by **prosodic position of the target vowel** (i.e., sentence level accent / pitch-accent)? (coart. **resistance** hypo.)

Q3: Does **prosodic strengthening of the trigger vowel** have an effect on variation in the target vowel, i.e. does pitch-accent induce greater coarticulatory aggression? (coart. **aggression** hypo.)



Mok (2012:194): "phoneme size"



Manuel (1990: 17): "target spaces"

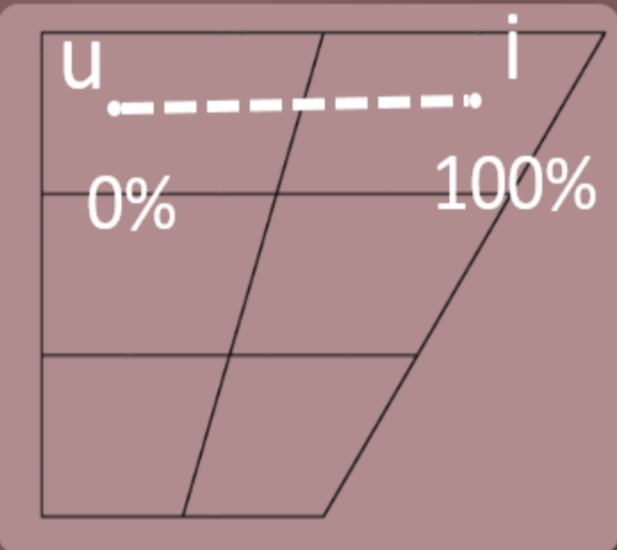
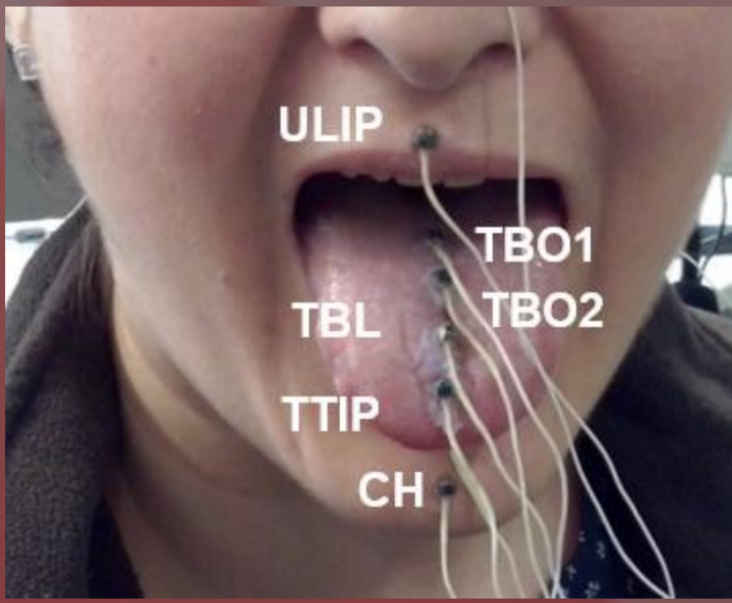
... if measured

- both in **dispersion** (across-context variance), and **quality shift** (distances),
- in both domains of production, and
- in Hungarian.

Methods

Recordings, measures, analyses

Audio + EMA (AG 501).



Parameters:

- F_{2onset} , $F_{2offset}$ and F_{2mid} (acoustics),
 - Horiz. dorsum pos. as a mean of tbo1 and tbo2 (articulation).
- Speaker diff.s normalized using rel. position to their max. and min.
- x-displacement (Cho, 2004).

Statistics

Linear mixed effects models (random intercept & slopes for speakers); post hoc (Tukey). (R: lmerTest, lsmeans)

Derived measures of V variation:

1. Distances: of coart'd and neutrally pos'd tokens:

- $F_{2\text{ edge, asym}} - F_{2\text{ edge, sym}}$
- $\text{Dorsum}_{\text{edge, asym}} - \text{Dorsum}_{\text{edge, sym}}$ (after Cho, 2004).

2. Dispersion:
RSD of F_{2mid} &
RSD of Dorsum_{mid}

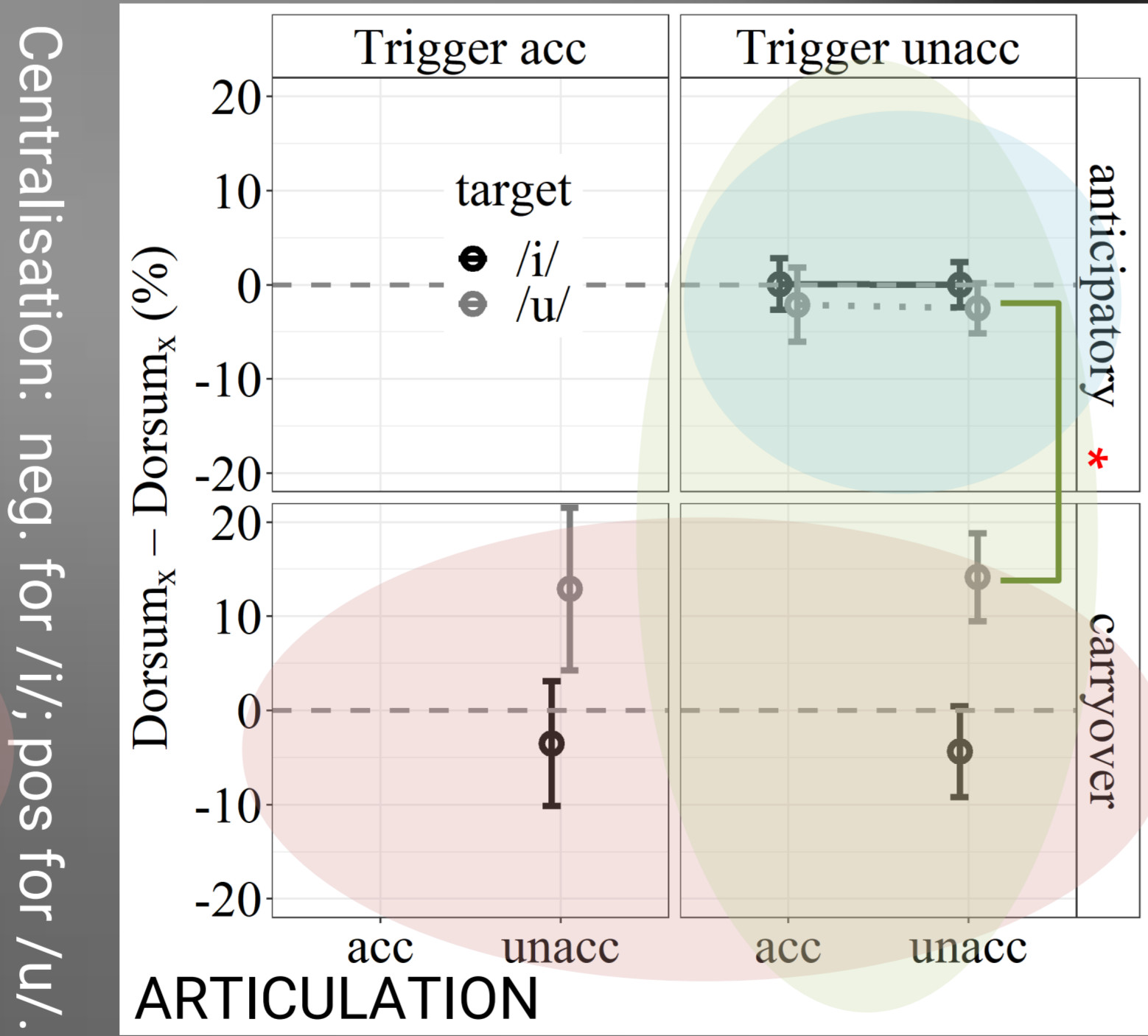
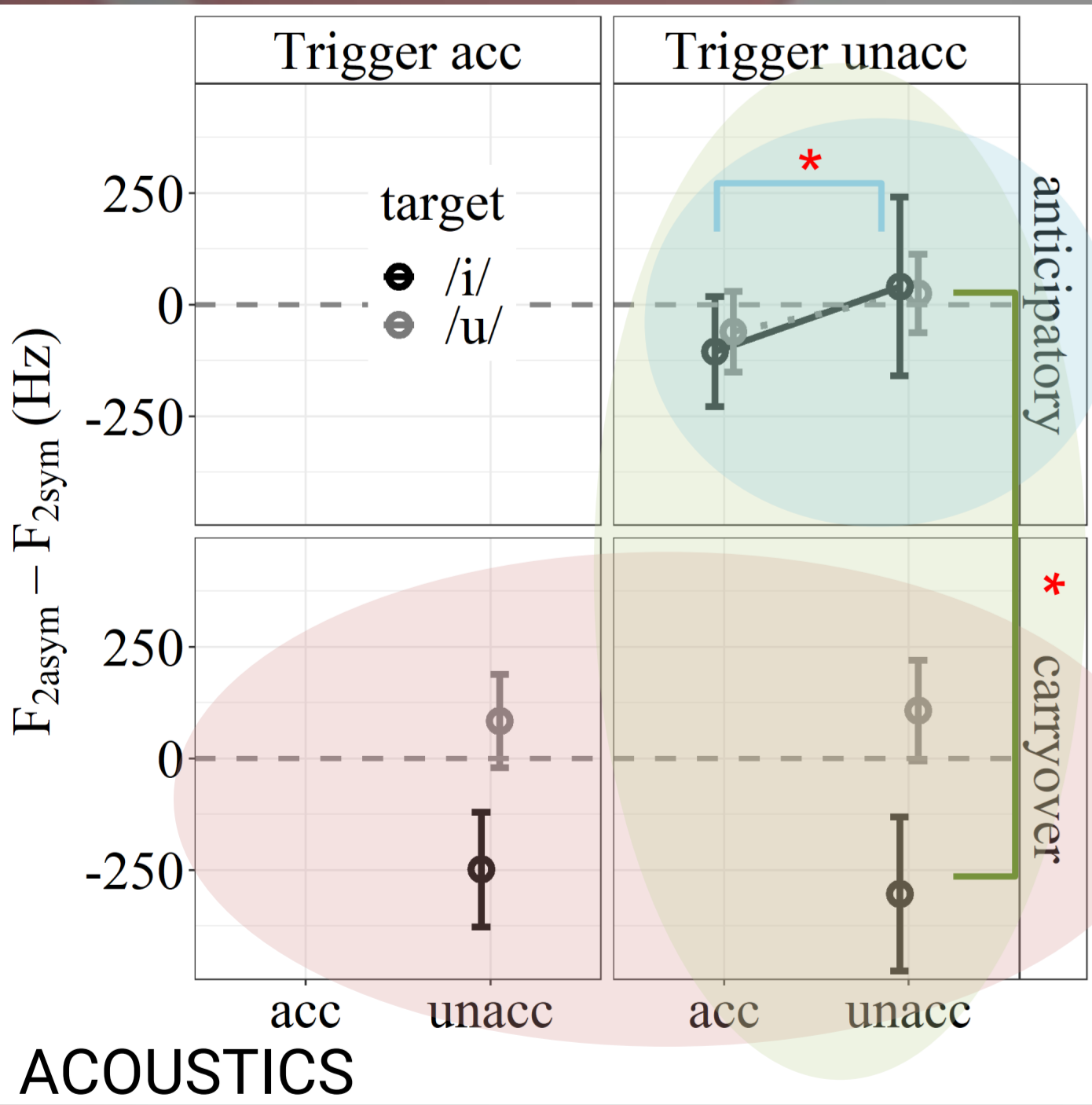
Participants and material

- 9 female speakers of Hungarian.
- Target and trigger (i.e. context) Vs: /i u/ (in /p/-context) (nonsense words after Cho, 2004 and Mok, 2011; 2012)
- Actually, 6 different words per speaker read in min. 6 rep.

(IPA)			Context /i/		Context /u/	
	Targ acc	Coart. dir.	acc	unacc	acc	unacc
target /i/	unacc	Anticipatory	—	'pipipipi	—	'pipipupu
		Carryover	'pipipipi	'pipipipi	'pupipipi	'pupipipi
	acc	Anticipatory	—	'pipipipi	—	'pipupupu
		Carryover	—	—	—	—
target /u/	unacc	Anticipatory	—	'pupupipi	—	'pupupupu
		Carryover	'pipupupu	'pipipupu	'pupupupu	'pupupupu
	acc	Anticipatory	—	'pupipipi	—	'pupupupu
		Carryover	—	—	—	—

Results

Distances



Direction: in /i/ (carryover > anticipatory)

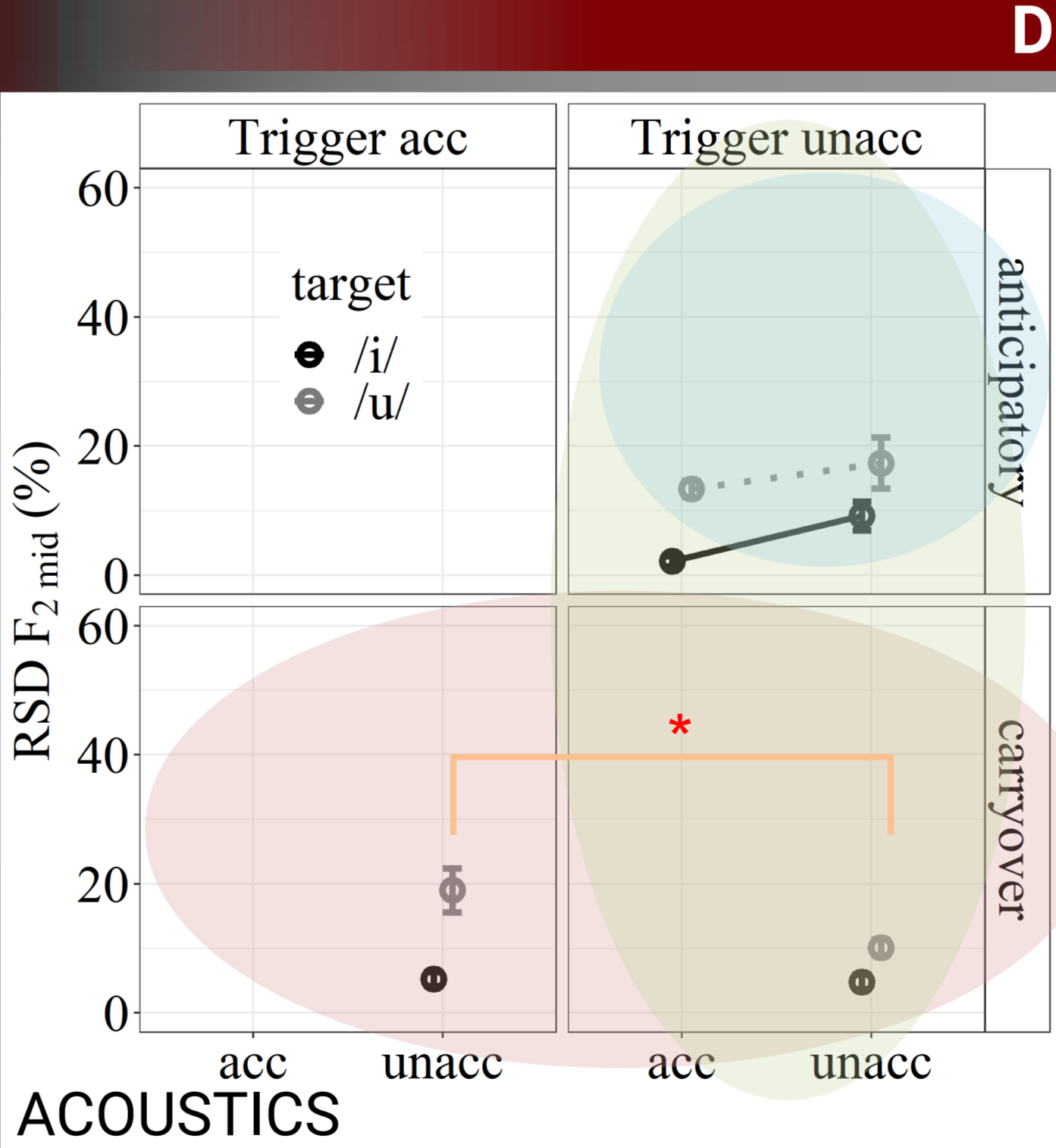
Resistance: /i/ is more centralised(!) if accented; /u/ is more peripheral.

Direction: in /u/ (carryover > anticipatory)

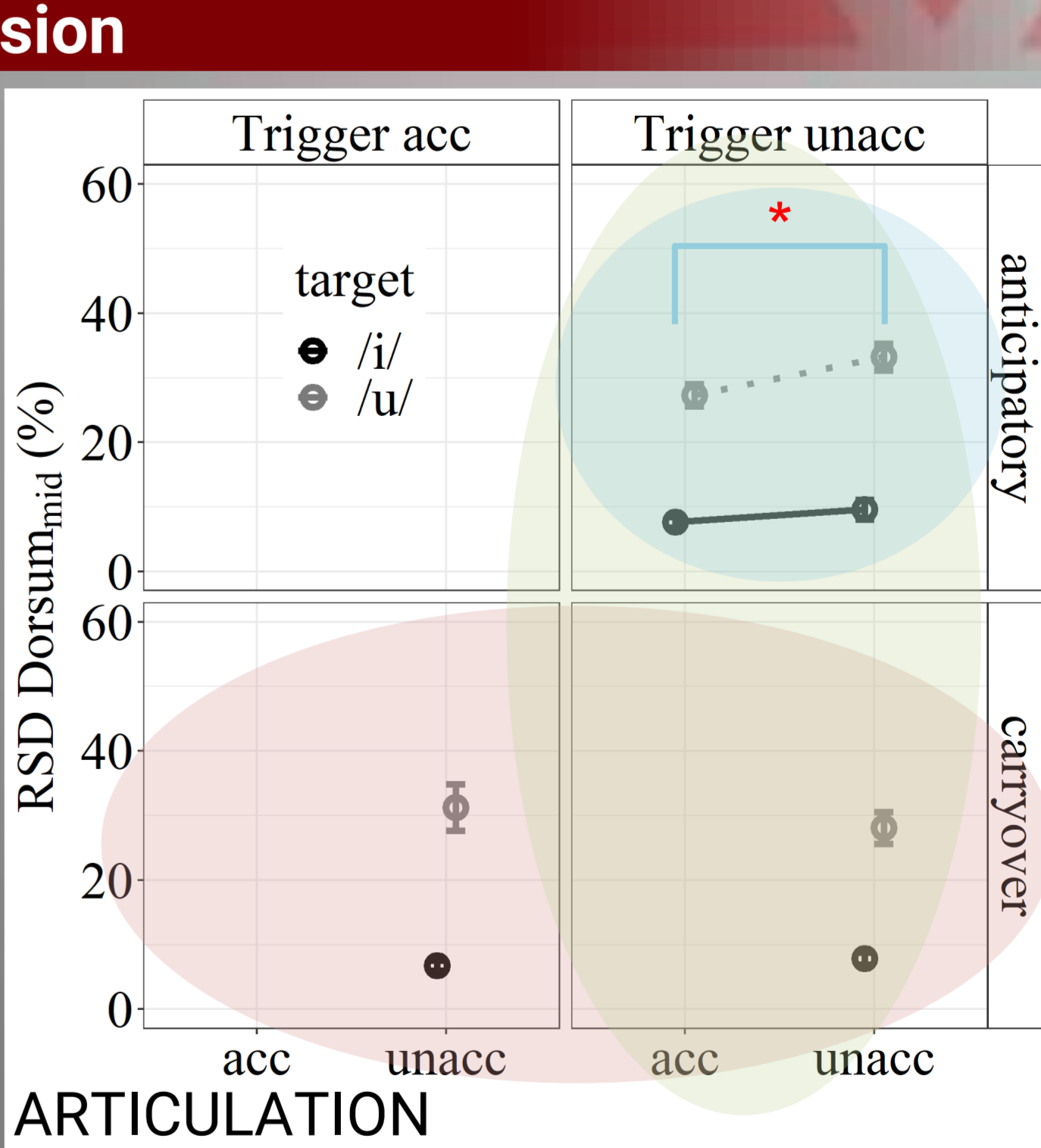
		Direction	Resistance	Aggression
DISTANCES	Acoust.	✓/i/	→← /i/ ✓/u/	✗
	Artic.	✓/u/	✗	✗
DISPERSION	Acoust.	✗	✗	✓/i/
	Artic.	✗	✓/u/	✗

But note that

- **dispersion** (uniformity of targets) seem to show **accent** effects, as it revealed increased **resistance** and **aggression** not seen in distances data, while
- **distances** (magnitude and character of quality-shift) revealed **direction** effects not seen in dispersion data.



Aggression: in /u/ (carryover > anticipatory)

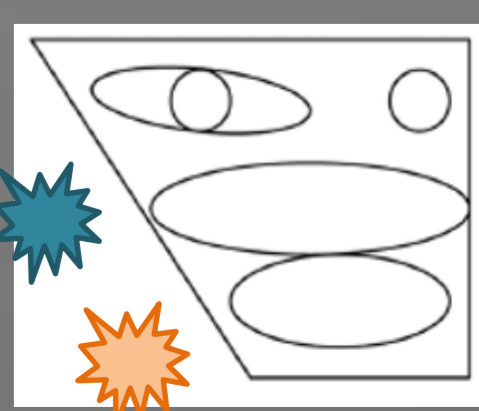
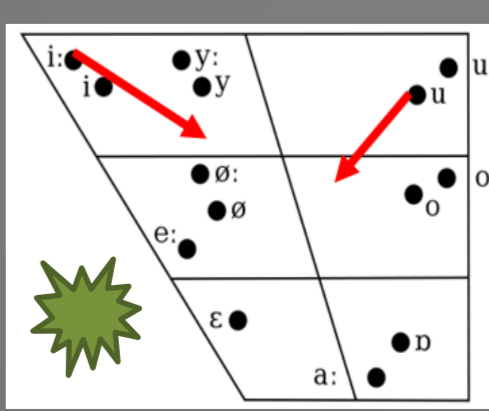


Resistance: in /u/.

Conclusions

Accent related effects are less clear than suggested previously. May be due to...

- Hungarian being an obligatory syntactic focus marking language
- Coarticulatory effects of /i/ and /u/ interactions being smaller than that of /i/ and /a/ (Cho 2004)...



What is resistance, and how should we measure it?

Contextual (in)variance, or shift in acoustic / articulatory quality of vowels (centralisation)?

The authors acknowledge the kind help of Zsófia Weidl, Zsófia Puzder, Valéria Krepsz, Ákos Búza, Anne Hermes, Doris Mücke, Theo Klinker., The research was funded by the Bolyai János Research Scholarship of the Hungarian Academy of Sciences, the ÚNKP-20-5 New National Excellence Program of the Ministry for Innovation and Technology from the source of the National Research, Development and Innovation Fund, and the Thematic Excellence Program of the Ministry for Innovation and Technology.