

Articulatory correlates of morphologically conditioned assimilation:

Evidence from ultrasound imaging

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Introduction

- Impact of morphology on phonology:**
 - casual speech processes (Shockey 2003)
 - allophonic variation of /l/ (Sproat & Fujimura 1993)
 - palatalization (Zsiga 2000)
- Articulatory studies**
 - intergestural timing (Cho 2001, Gafos et al. 2010)
 - coarticulation in coda clusters (Song et al. 2013)
 - l-darkening (Strycharczuk & Scobbie 2016)
- Articulatory correlates of palatalization:**
 - raising and/or fronting of tongue front towards the hard palate (Ladefoged & Maddieson 1996)
 - Tongue root and dorsum advancement (Bennett et al. 2018, Cavar & Lulich 2021)
- Impact of lexical frequency on articulation**
 - more frequent words have more coarticulation/gestural overlap than less frequent words (Bybee 2000, Bush 2001)

Instrumental Study: Method

- Tongue articulatory data was collected via real-time 3D ultrasonography, using the Philips EpiQ-7G machine and a Philips xMatrix x6-1 digital 3D/4D transducer. The ultrasound probe was stabilized under the jaw with an Articulate Instruments Ltd headset (Scobbie et al. 2008).
- Audio signals—recorded at a sampling rate of 48 kHz with a SHURE KSM32 directional dynamic microphone—were captured simultaneously with the ultrasound recordings.
- 8 native speakers of Polish, aged 23–60;
- Ultrasound files were analyzed using custom MATLAB toolbox, called “WASL”.

Assimilation in clusters

fricative + fricative/affricate

dental /s z/ + pre-palatal /c z tʃ dʒ/

- Assimilation possibilities:
 - > two gestures = no assimilation /s z tʃ dʒ/
 - > one gesture = assimilation /tʃ dʒ/
 - > or possibly an intermediate category

References

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Design of the study

Predictions:

- Assimilation depends on the **morphological composition** of the clusters and the **strength/transparency** of the boundary:
- the stronger the boundary, the more assimilated the C1.
- the faster the **tempo**, the more assimilated the C1.
- more **frequent** words – more assimilation than less frequent words

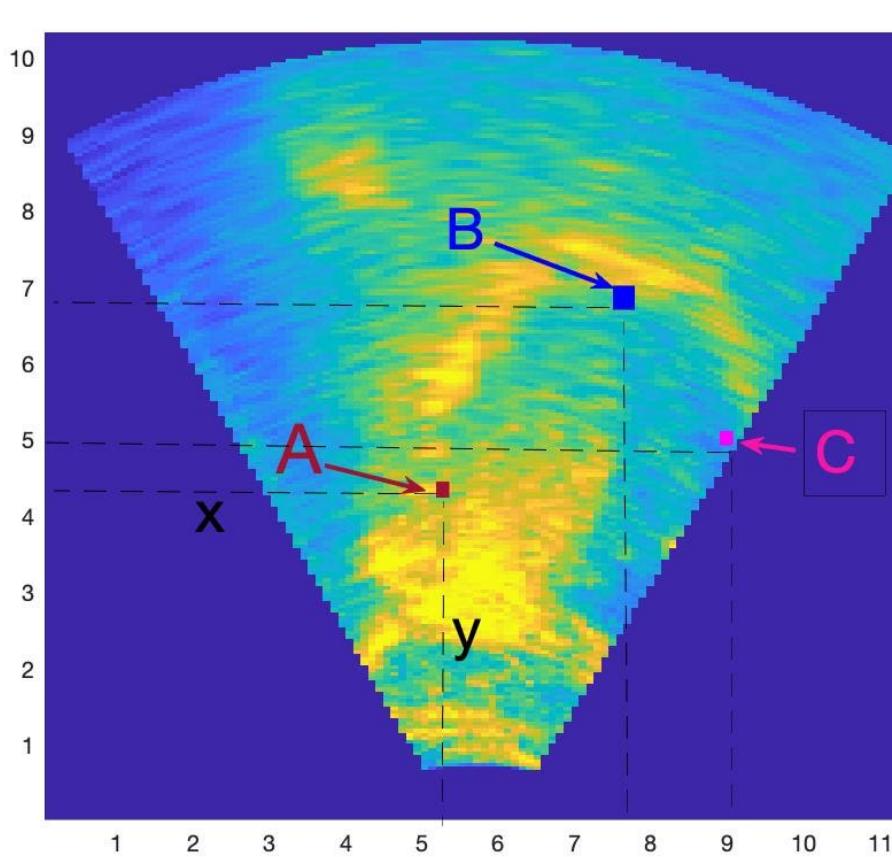
Question:

- What is the best **articulatory correlate** of palatalization for ultrasound studies?
- tongue front, tongue body, tongue root

Stimuli: 75 phrases

Procedure (1) memorize, (2) say it slowly, (3) say it fast

Carrier sentence (They said ...)



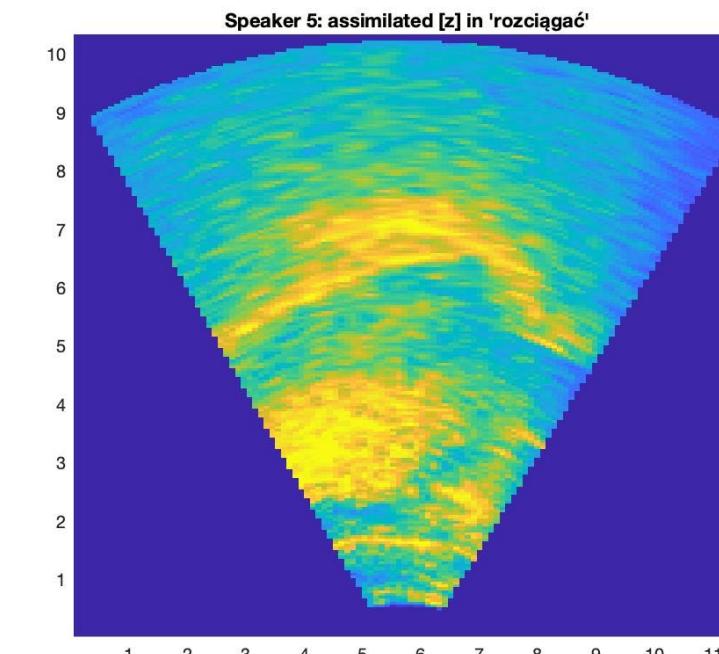
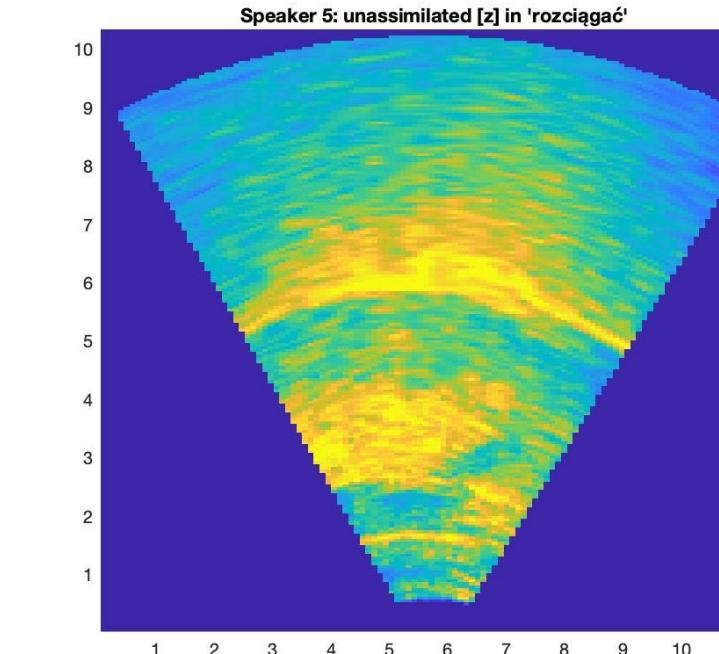
Measured points:

- the point opposite of the tendon of the genioglossus (A)
- the position of the tongue body (B)
- the frontmost position of the tongue front (C).

morphology: Strength of morphological boundaries:

1. intra-morphemic:
w Odessie mieszkać /sç/ 'to live in Odesa'
 2. weak morpheme boundary:
roz+ciągliwa guma /s+tç/ 'stretchy rubber'
 3. strong morpheme boundary:
roz++siadać się wygodnie /s+c/ 'sit comfortably'
 4. clitic boundary:
chleb bez ziaren /s#z/ 'seedless bread'
 5. word boundary:
włos siwy /s#ç/ 'a gray hair'
- word frequency**
tempo of speech

unassimilated vs. assimilated C1



Statistics

Linear mixed-effect regression models

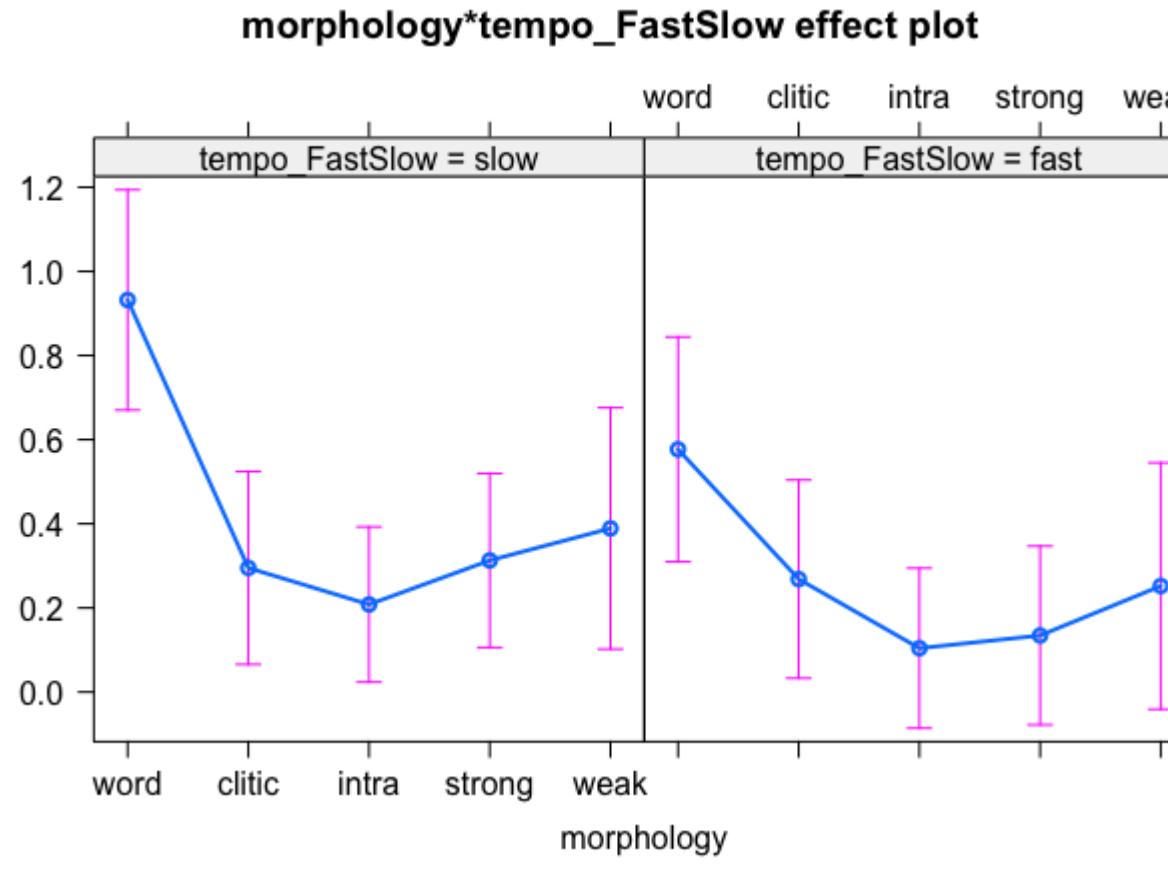
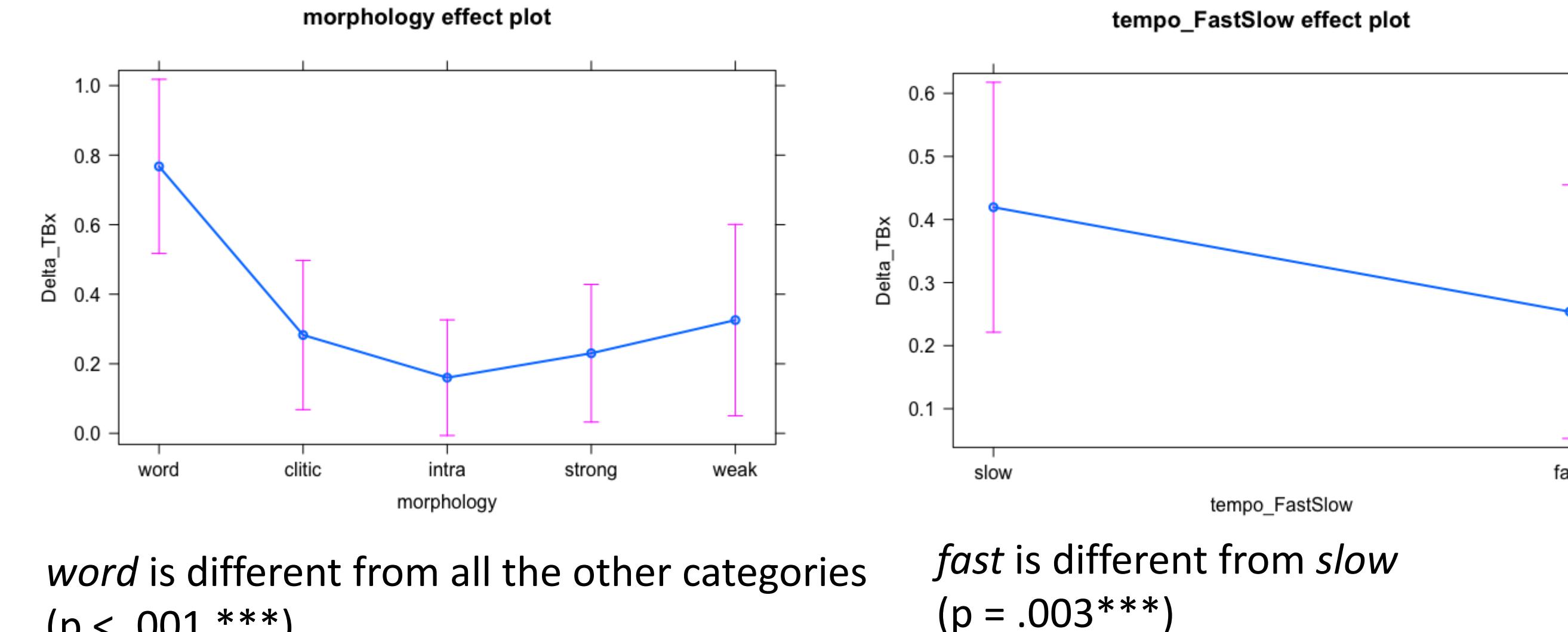
Dependent variables:
DeltaTF, DeltaTB, DeltaTR (x and y)

Predictors:

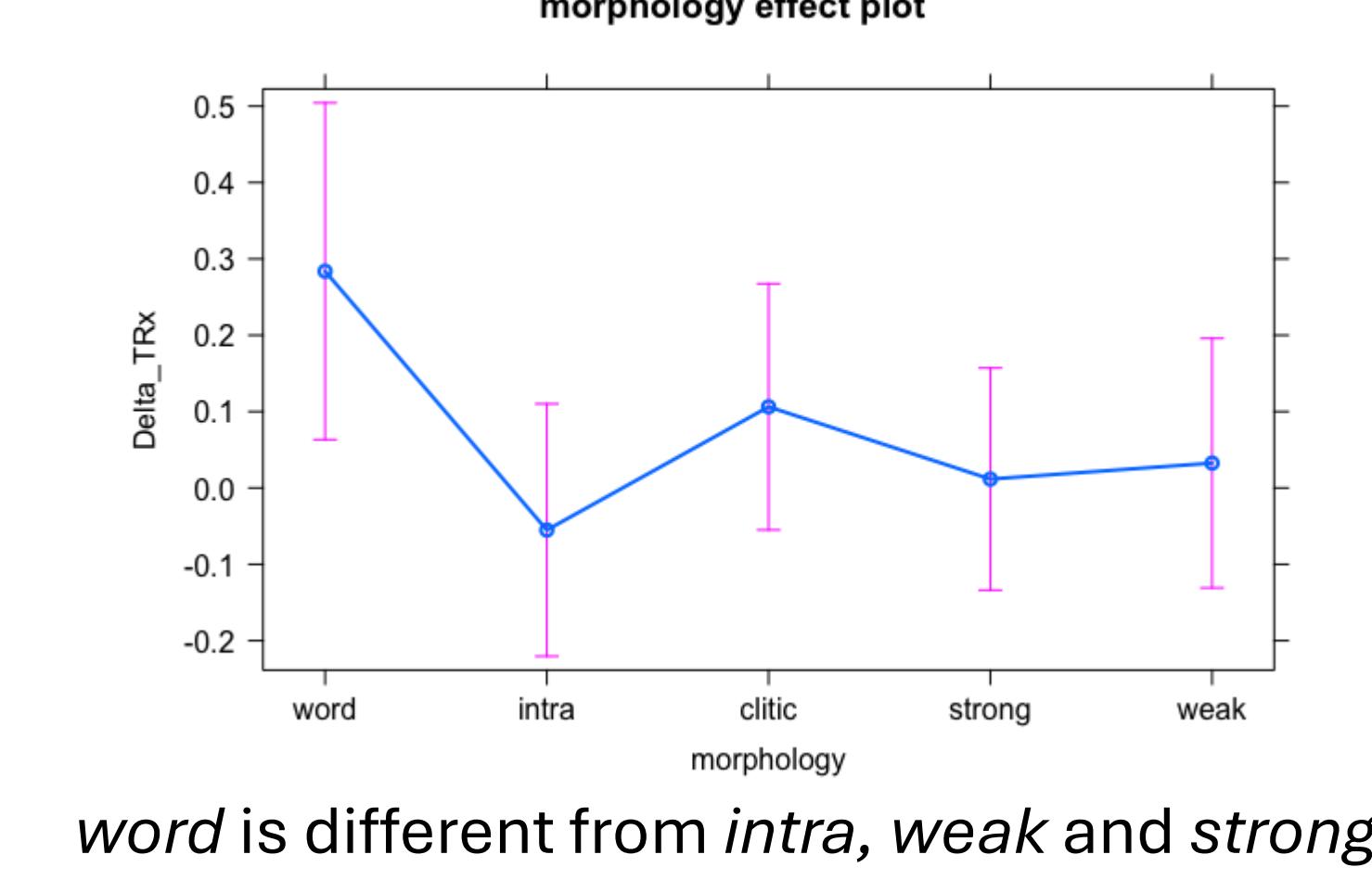
- Morphology:** word, clitic, weak, strong, intra
- Tempo (subjective):** fast/slow
- Tempo (measured):** syllables per second (target phrase)
- Frequency (categorical):** low, medium, high (corpus data)
- Frequency (continuous):** log-scaled (corpus data)
- Manner of C2**
- Voicing of C2**

Results

Tongue Body fronting (Delta TBx)



Tongue Root fronting (Delta TRx)



The least assimilation

Morphology:

- Word boundaries are consistently different from all the other categories.
- Intramorphemic is different from the other categories (for tongue root fronting)

Tempo:

- Effects of subjective tempo (slow vs. fast)
- Effects of measured tempo (syll. per sec.) for clusters across word boundaries.

Lexical frequency:
no significant effects

Conclusions

Articulatory correlates of palatal assimilation:

- Tongue body fronting
- Tongue root fronting

stronger and more consistent effects

The most assimilation