The source and significance of consonant-intrinsic pitch
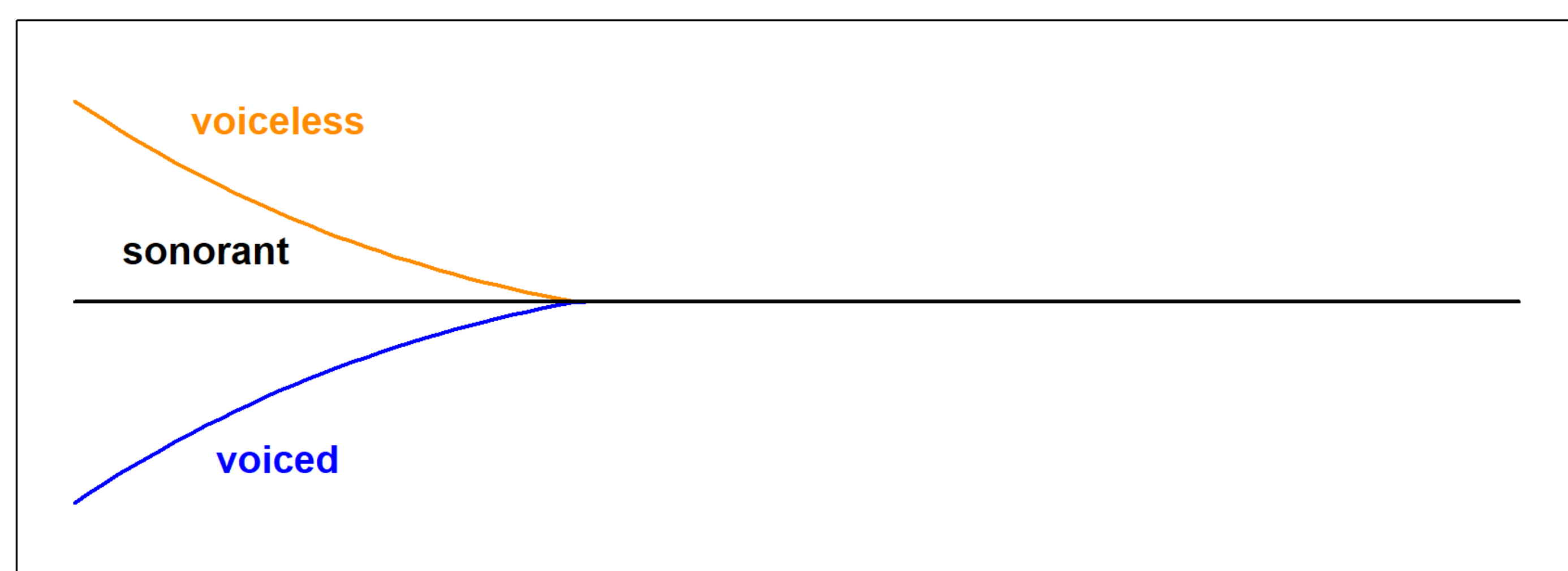# New evidence from Danish

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Consonant (co-)intrinsic pitch

Laryngeal contrasts in obstruents sometimes exert a localized influence on pitch, often referred to as **CF0**

Open questions

What is the source of CF0?

- **F0 lowering after underlyingly voiced obstruents** enhances [voice] feature (Kingston & Diehl 1994)
- **F0 raising after voiceless obstruents** is a biomechanical side effect of gestures that inhibit phonation
  - Generalized or specifically cricothyroid tensing (Goldstein & Browman 1986; Löfqvist et al. 1989)
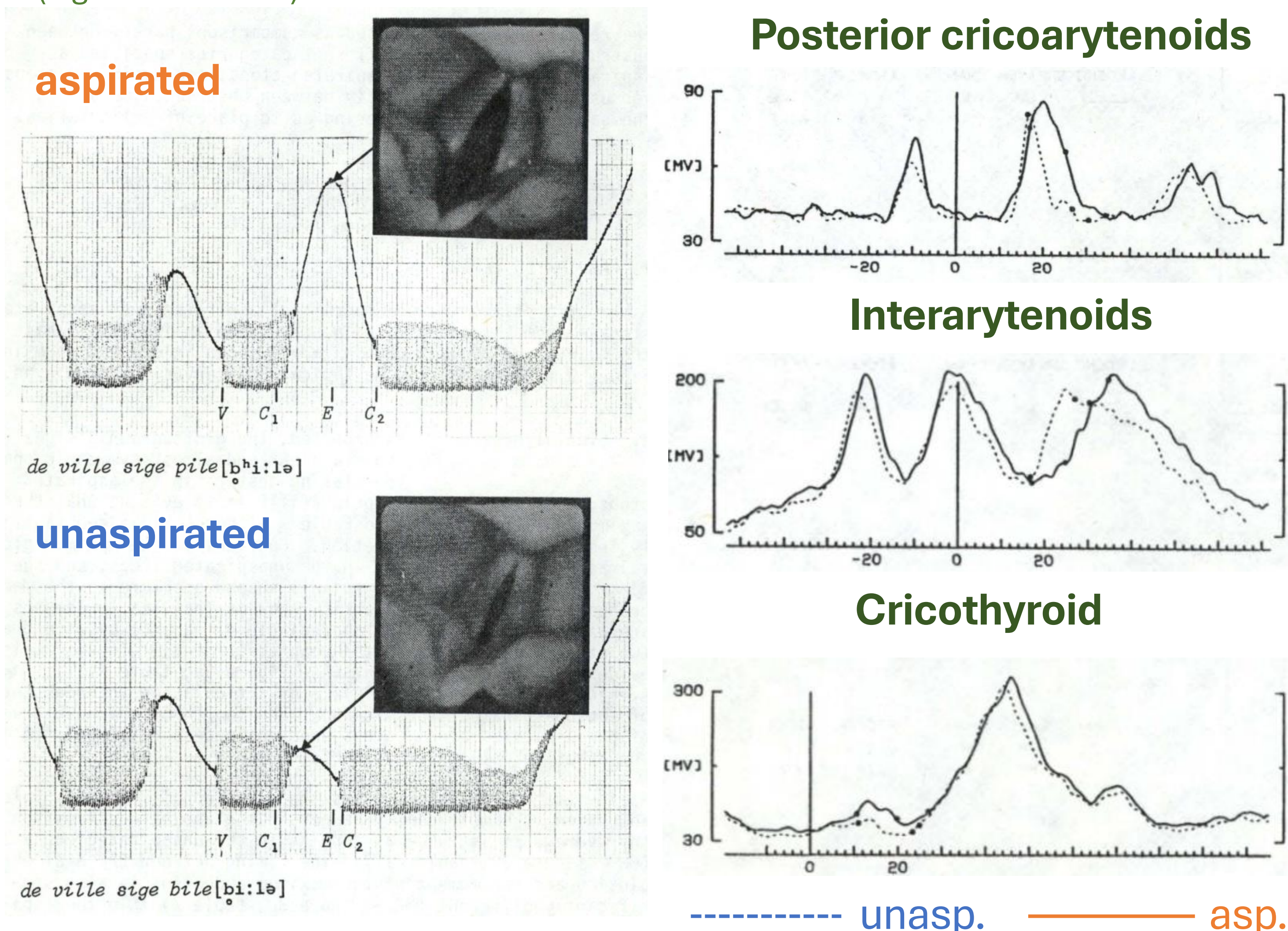
How does CF0 interact with other sources of prosodic modification?
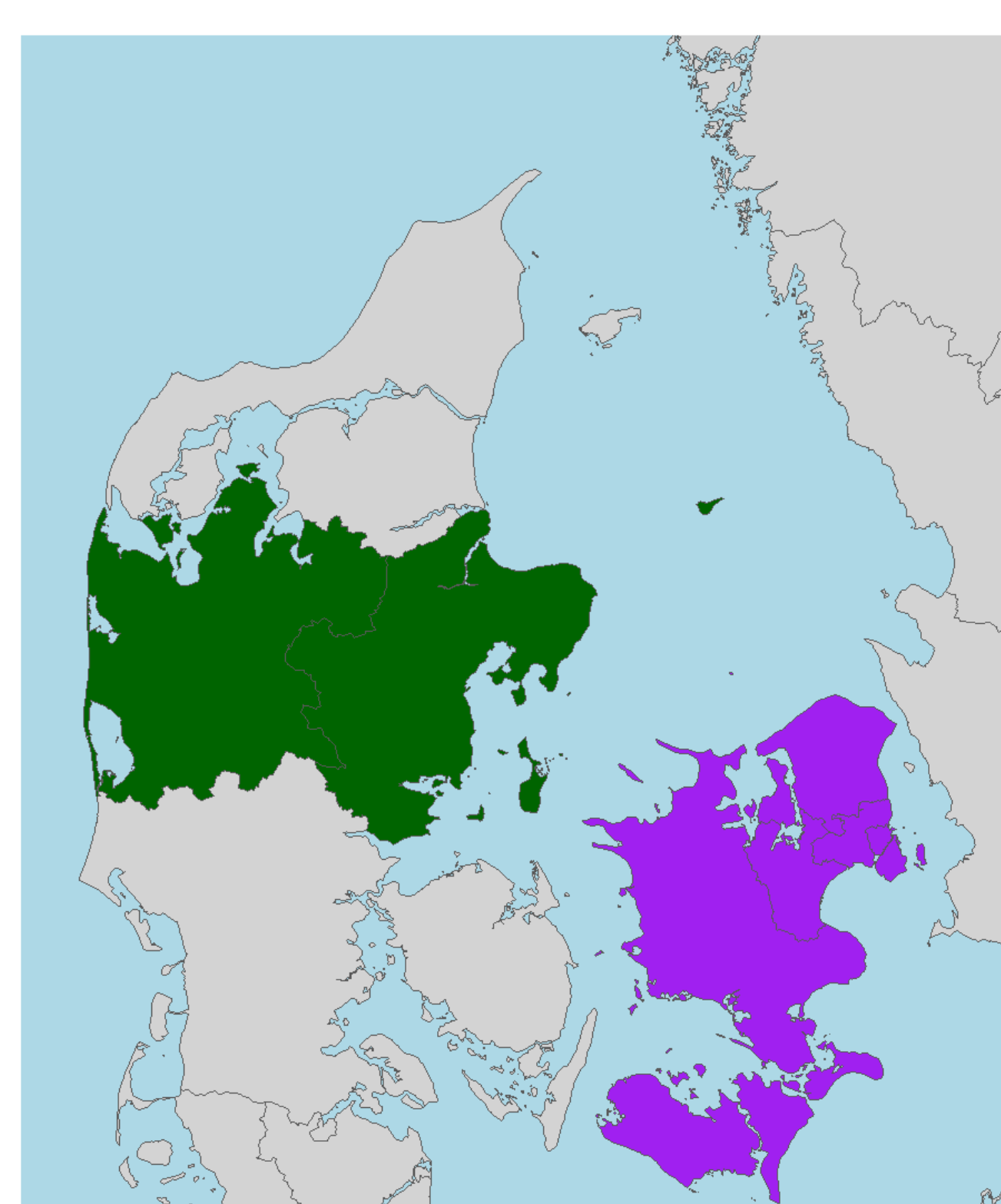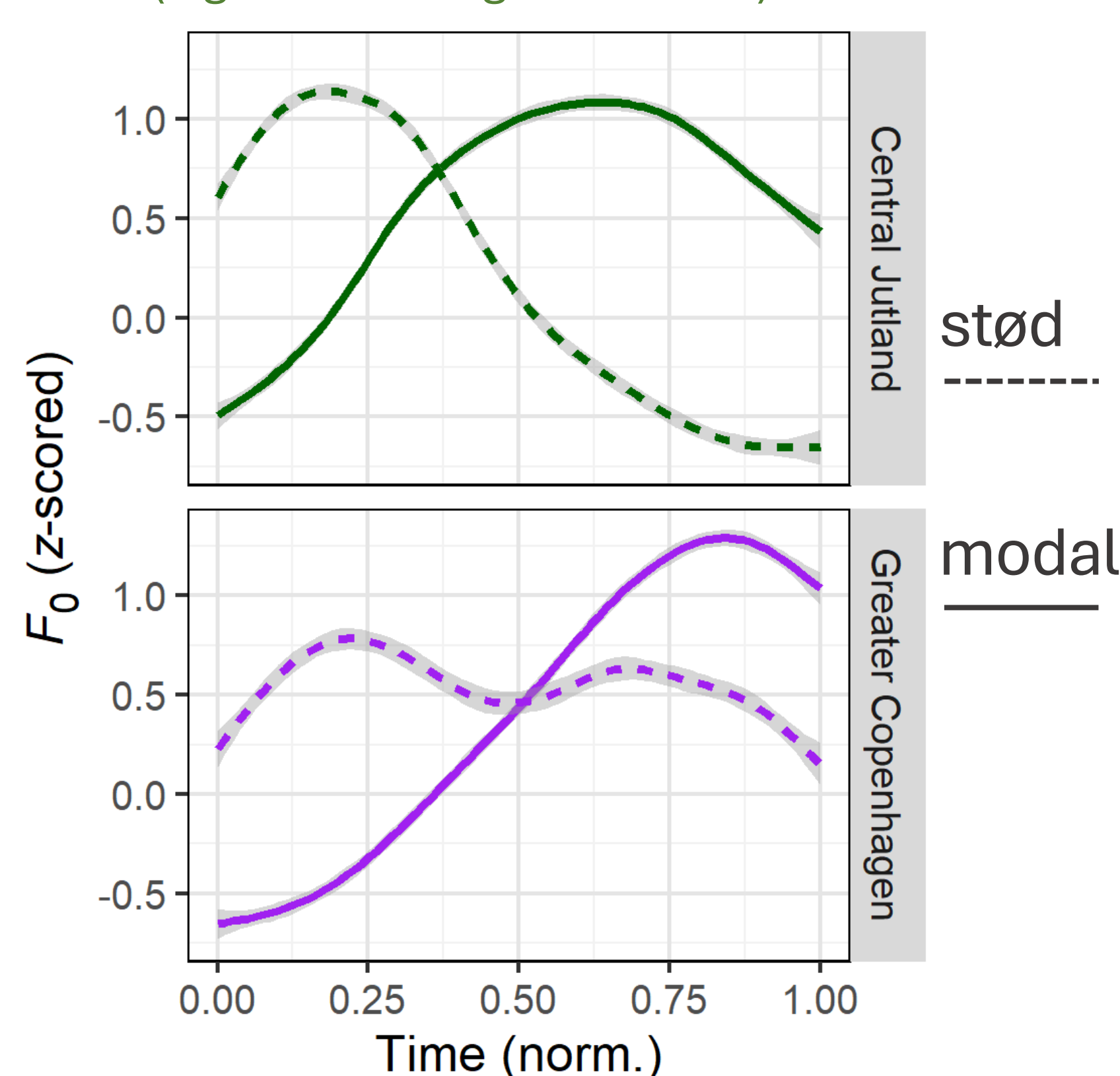
Enter... Danish!

Danish contrasts two series of stops

- Voiceless unaspirated **/b d g/ ↔ [p t k]**
- Voiceless aspirated **/p t k/ ↔ [pʰ tʰ kʰ]**

The articulatory implementation has been described in detail (e.g. Hutters 1985)

Posterior cricoarytenoids

Interarytenoids

Cricothyroid

----------- unasp. ——— asp.

The voice quality contrast **stød** affects F0 at the syllable onset and places certain constraints on the larynx (e.g. Fischer-Jørgensen 1989)
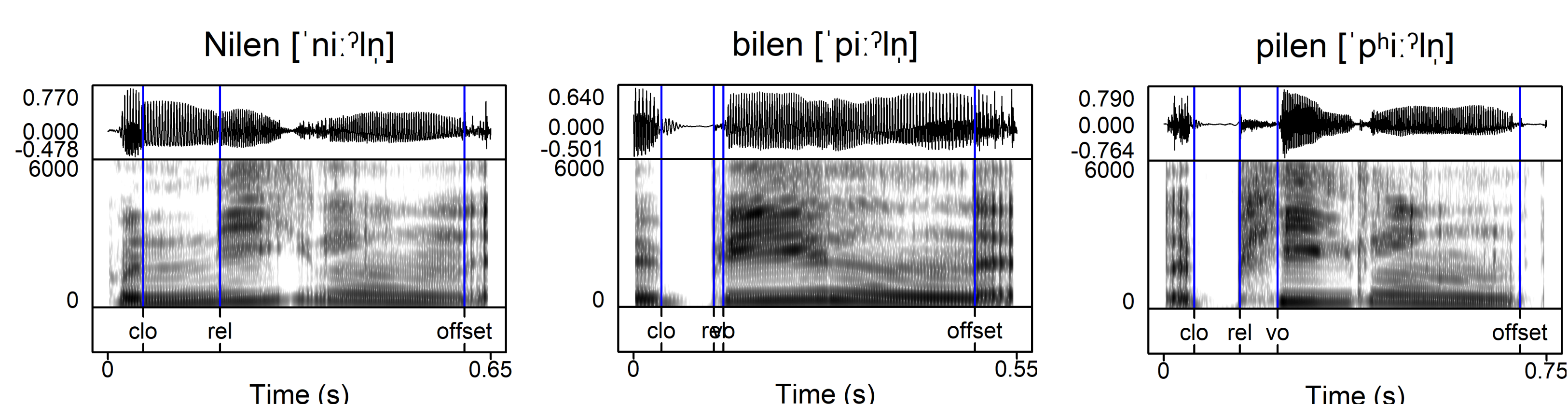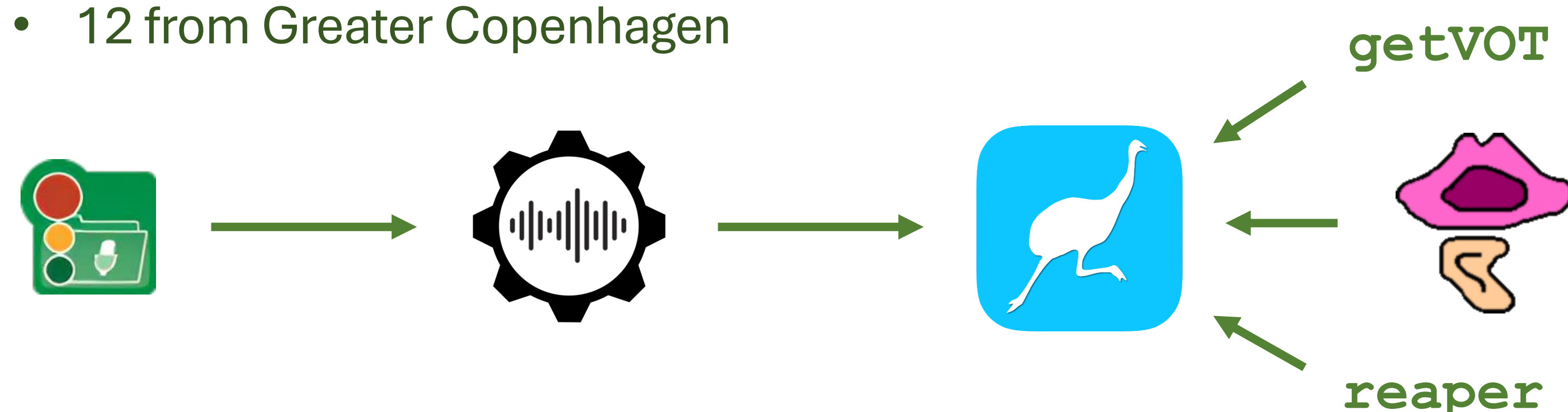

Methods and materials

132 alternative question sentences of the form

*Er det **dine** eller er det mine?*
'are they yours or are they mine?'

alternating onset category, PoA, vowel height, and stød

31 speakers of Danish recorded in Aarhus and Copenhagen
- 17 from Central Jutland
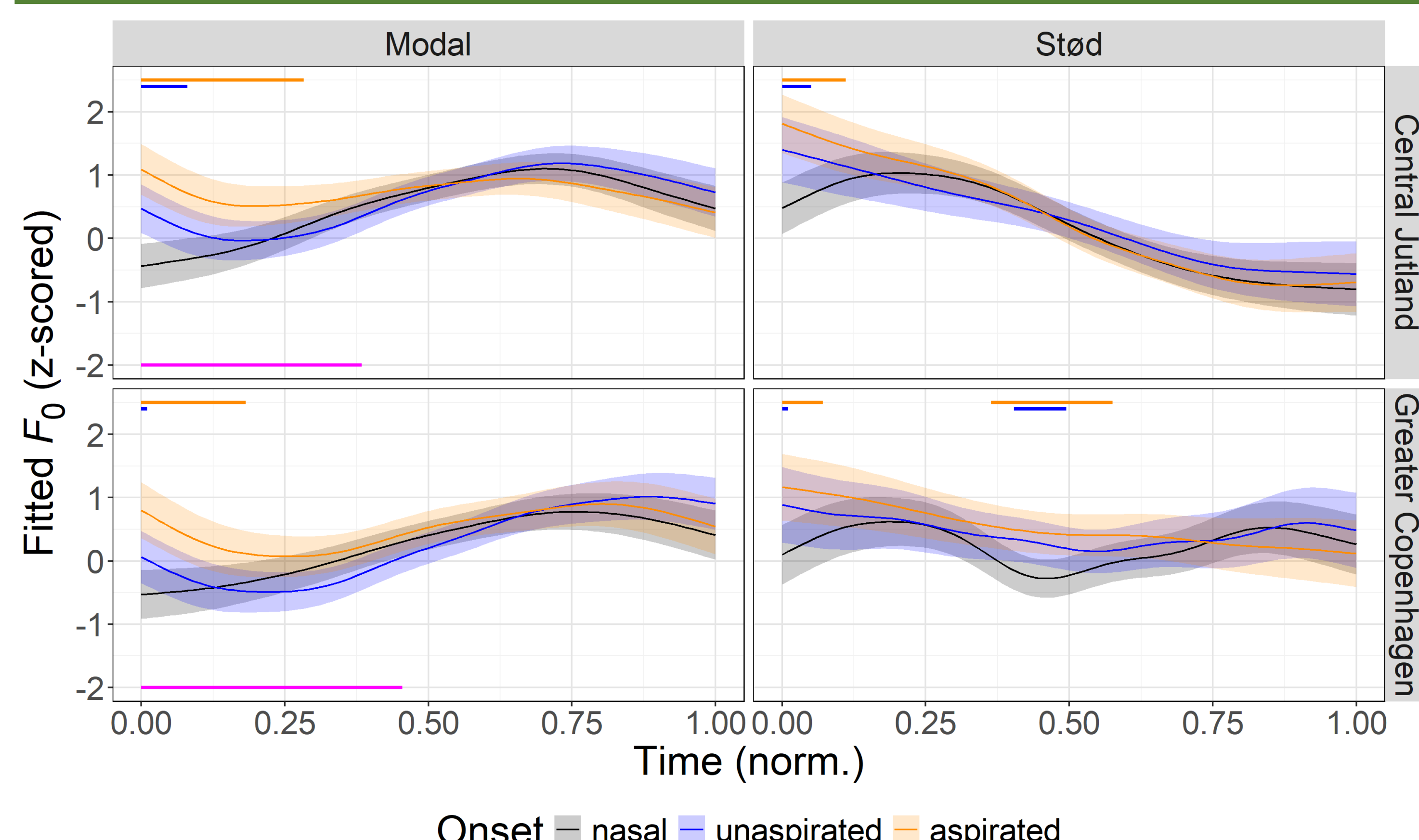- 12 from Greater Copenhagen

getVOT

reaper

F0 analyzed in the range between **vo–offset** (time-normalized)

Statistical analysis

Data analyzed with **generalized additive mixed models** using the `bam()` function with `mgcv` in R

- Dependent variable **z-scored F0**
- Predictors
  - (parametric) **onset category : stød : variety, vowel height**
  - (non-parametric) **onset category : stød : variety** smoothed with 10*k* thin plate regression splines
  - (random non-parametric) **speaker | onset category : stød**, **item | variety**, 5*k* TP splines, 1st order difference penalty
- Scaled-*t* error distribution, discretized values for covariates
- AR(1) error model following e.g. Wieling et al. (2016)

Results

Discussion

What is the source of CF0?

- No evidence of F0 lowering after underlyingly voiced obstruents
- **CF0 effects** in spite of **little evidence of cricothyroid tensing**
- Results support CF0 as a **generalized biomechanical side effect** of **gestures that inhibit phonation**
  - Such effects are **scalar**: magnitude and temporal extent differ

Other sources of prosodic modification

- The temporal extent of CF0 is **inhibited** when there are competing demands on the larynx and pitch