# Tongue root advancement and vowel duration: a gradient effect?

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# Background

- Correlates of voicing
  - shorter VOT (Westbury, 1983; Davidson, 2016; Abramson & Whalen, 2017)
  - tongue root advancement TRA (Westbury, 1983; Ohala, 2011)
  - correlation VOT ~ TRA (Ahn, 2015)
  - longer vowel duration (House & Fairbanks, 1953; Peterson & Lehiste, 1960; Chen, 1970; Klatt, 1973; Lisker, 1974; Fowler, 1992; Lampp & Reklis, 2004)
- *Relation between vowel duration and TRA*

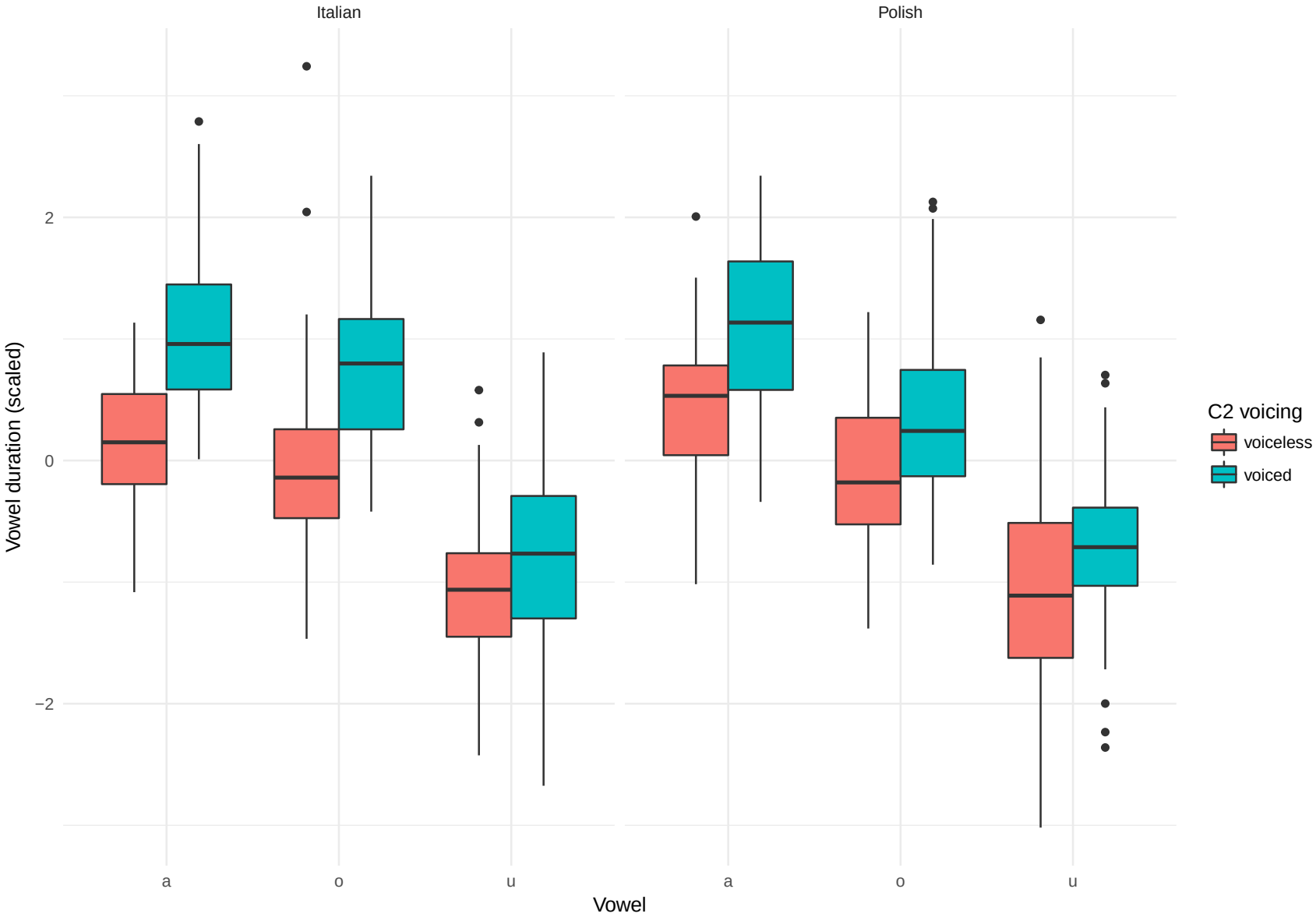
# Background

- **Voicing effect**: vowels are longer when followed by voiced stops
  - *Italian*: voicing effect of 35 msec (Farnetani & Kori, 1986)
  - *Polish*: mixed results
    - Keating (1984): no effect
    - Nowak (2006) PhD dissertation: 4.5 msec effect
- Timing of laryngeal and tongue activity
  - simultaneous UTI + EGG + audio

# Methods (a summary)

- **Participants**: 4 Italians (2 F, 2 M), 4 Polish (2 F, 2 M)
- **Procedure**:
  - simultaneous ultrasound tongue imaging and audio recording
  - stabilisation headset (Articulate Instruments Ltd™, 2008)
- **Materials**:
  - $C_1V_1C_2V_1$
    - $C_1$ = /p/, $V_1$ = /a, o, u/, $C_2$ = /t, d, k, g/
    - *pata*, *pada*, *paka*, ..., *poto*, *podo*, ...
    - stress on first syllable
  - frame sentence
    - *Dico X lentamente*, 'I say X slowly'
    - *Mówię X teraz*, 'I say X now'
    - no pauses between words

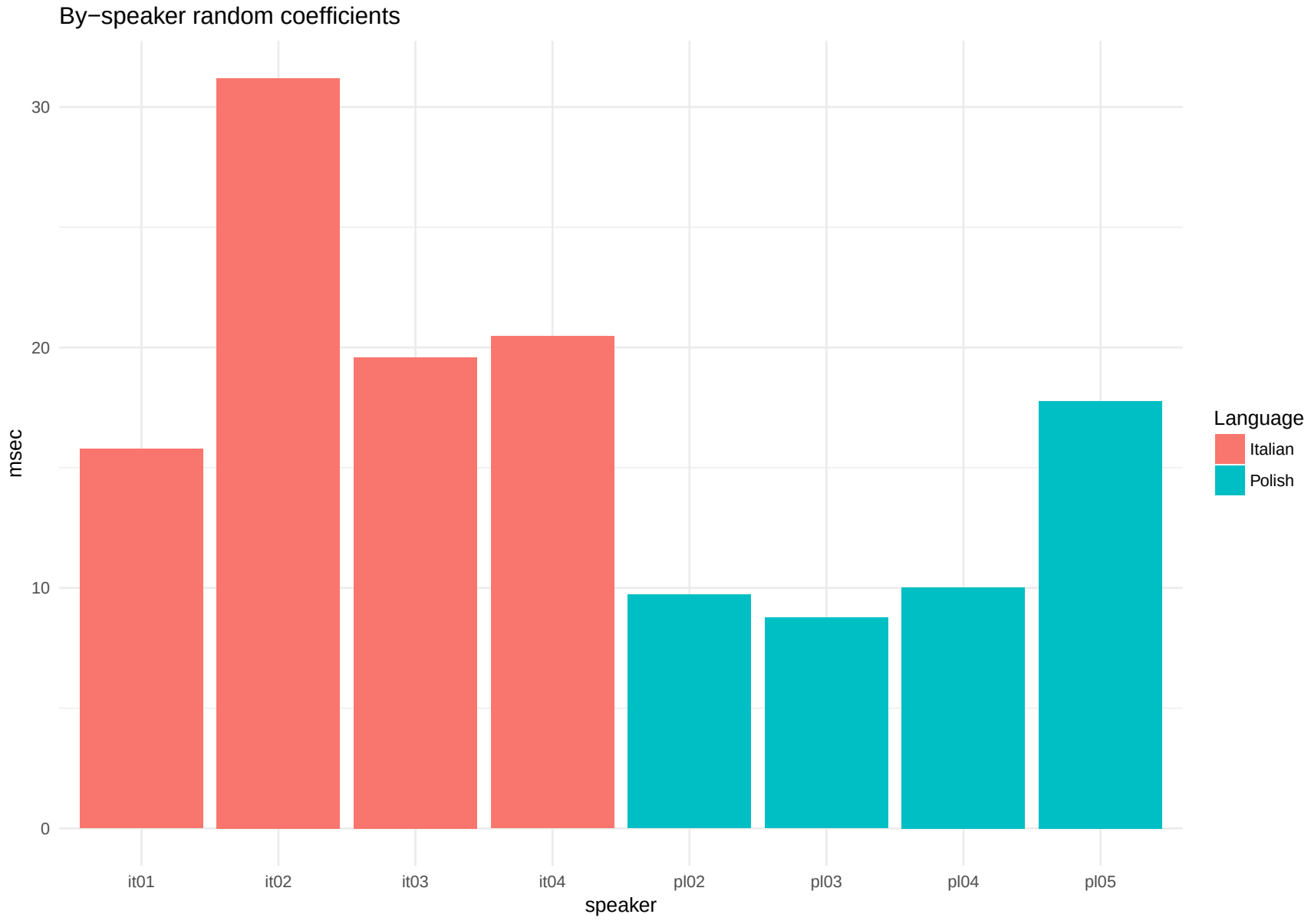
# Results: Vowel duration



# Results: Vowel duration

- Linear mixed-effects models (Bates et al., 2015; Kuznetsova et al., 2016)
- Italian
  - `voicing + place + vowel + sentence duration + voicing:vowel`
  - `(1+voicing|speaker) + (1|word)`
  - $\beta$ = 22 msec, $\chi^2(3) = 15.8$, p = 0.0012434
- Polish
  - `voicing + place + vowel + sentence duration + voicing:vowel + place:vowel`
  - `(1+voicing|speaker) + (1|word)`
  - $\beta$ = 12 msec, $\chi^2(3) = 12.39$, p = 0.0061556

# Results: Vowel duration



# Results: Tongue contours

- **Tongue contours polar coordinates** (Heyne & Derrick, 2015b,a; Mielke, 2015)
  - at acoustic closure onset
  - at maximum displacement (within closure, Strycharczuk & Scobbie, 2015)
- **Generalised additive mixed effects models** (Wood, 2006; Sóskuthy, 2017; van Rij et al., 2017)
  - `rticulate` R package (Coretta, 2018a,b)
- **General trends**
  - idiosyncratic use of TRA
  - speakers with appreaciable TRA have stronger voicing effect

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