Vowel duration and tongue root advancement in Italian and Polish

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Background

• tongue root advancement (TRA)
  • voicing (Westbury 1983)
  • VOT (Ahn 2015)
  • also vowel duration?

\[\text{a. voiceless} \quad \text{b. voiced} \quad \text{c. TRA}\]
• voicing effect
  • House & Fairbanks (1953), Chen (1970), Klatt (1973), Lisker (1973)
  • no consensus on which factors play a role
Background

• **Italian** (Farnetani & Kori 1986)
  - +35 msec / _D

• **Polish** (Keating 1984)
  - no difference

→ **H1**: TRA in Italian (a), no TRA in Polish (b).

→ **H2**: TRA increases during closure in Italian.
• **pilot** study
• Italian (2 males), Polish (1 female, 1 male)
• $C_1V_1C_2V_1$
  • $C_1 = /p/$, $V_1 = /a, o/$, $C_2 = /t, d, k, g/$
  • *pata, pada, paka, …, poto, podo, …*
• frame sentence
  • *Dico X lentamente*, ‘I say X slowly’
  • *Mówię X teraz*, ‘I say X now’
Methods

- **equipment**
  - Articulate Instruments set-up: Echo Blaster 128, C3.5/20/128Z-3 ultrasonic transducer (2-4 MHz), probe stabilisation headset (Articulate Instruments Ltd 2011)
    - frame rate = 55-65 fps

- **data**
  - tongue contours with AAA (Articulate Instruments Ltd 2011)
    - at closure onset
    - at maximum tongue displacement (Strycharczuk & Scobbie 2015)

- **analysis**
  - generalised additive mixed effects models (Wood 2006, Sóskuthy 2017, van Rij et al. 2017)
  - data and code available at [https://github.com/stefanocoretta/2017-ultrafest](https://github.com/stefanocoretta/2017-ultrafest)
Results: Italian (maximum displacement), speaker IT01

![Graph showing voiceless and voiced categories with fit and est axes]
Results: Italian (closure onset), speaker IT01
Results: Italian (closure onset vs. maximum displacement), speaker IT01
Results: Polish (maximum displacement), speaker PL04
Results: Polish (closure onset), speaker PL04

![Graph showing voicing patterns with fit and est axes. The graph compares voiceless and voiced sounds, with data points and trend lines indicating the distribution of voicing characteristics across a range of X values.](image-url)
• results
  • TRA in Italian at closure onset and maximum displacement (H1a)
  • no TRA in Polish (H1b)
  • increases from closure onset to maximum displacement (H2)
    • TRA is initiated before closure onset
  • correlation between vowel duration and tongue root advancement is supported by the data
    • time to allow TRA → longer vowel (cf. Halle & Stevens 1967)
THANK YOU!

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Vowel durations

- methods
  - vowel durations from acoustics
  - four speakers per language, /a, o, u/
  - linear mixed effects models (Bates et al. 2015)

- results
  - Italian: 22 (±6) msec voicing effect
    - $\chi^2(3) = 16.61, p = 0.00085$ ***
  - Polish: 8 (±3.3) msec voicing effect
    - $\chi^2(1) = 5.4, p = 0.02$ *

- discussion
  - the Italian estimate is in line with previous work
  - Polish is surprising
    - one speaker had bigger slope


