The implementation of voicing in obstruents in American English connected speech
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Descriptions of English obstruent voicing

- Utterance-initial stops mainly have voiceless closures and short lag VOT (e.g., Lakser & Abrams 1964, Keating 1984).
- Medial and final stops contain at least partial voicing, but studies often focus on one place of articulation and/or are produced in carrier phrases (e.g., Jacewicz et al. 2009, Lacero & Koong 2008, Pege & Brown 1982, Keating 1984, Docherty 1992).
- Utterance-initial and word-initial (but phrase-medial) stops are often erroneously conflated (see quotes from textbooks in Gonet 2012).

Current questions & goals:

- What segmental and positional factors condition the amount of voicing during closure/frication for voiced obstruents in American English naturalistic speech?
- When voicing is partial, what shape does it take? Five possibilities:
  - (a) Complete voicing, (b) Bleed: starts initial then dissipates, (c) ‘Classic negative VOT’: Starts partial, (d) Trough: voiced, (e) Complete devoicing
  - Environmental & prosodic factors obtained for each obstruent.
- Preceding segment (3) Effect of preceding segment (phrase-medial and final)

Methodology

- All voiced stops and fricatives collected from 37 speakers in 2 studies designed for other purposes:
  - Study 1: Five short passages read by 13 native speakers of Midwestern English
  - Study 2: Three short passages read by 24 native speakers from various regions (collected in NY)
- Obstruents segmented in Praat, first using Penn Forced Aligner & then boundaries manually adjusted
- For stops, closure & burst separated separately; only closure voicing examined here
- Environmental & prosodic factors obtained for each obstruent
  - Preceding & following segment, word position, phrase position, preceding or following stressed syllable (not reported here)

Results and Discussion

Mixed effects analyses are binomial comparisons of unvoiced vs. collapsed voiced, partial
- Phrase-initial position (1) favors complete devoicing in stops ($\beta = -3.79, p < .001$), few frics in this position.
- Word position (2) (phrase medially)
  - Fricatives: final devoicing slightly favored ($\beta = -0.47, p = .05$)
  - Stops: initial devoicing favored ($\beta = 0.69, p < .001$)
- Preceding segment (3)
  - Fricatives: Devoicing higher after nasals, voiced stops compared to approximants (Tukey tests $p < .05$)
  - Stops: Devoicing preferred in voiced fricative, voiceless stop & fricative as compared to approximants, nasals, voiced stops (Tukey tests, $p < .05$)
  - Preceding silence and obstruents favor devoicing (esp. for stops); at least partial voicing is present medially & finally

Voicing measure

- Stop/affricate closures, frication duration divided into 3 intervals
- Percent voicing for whole duration and for each of 3 intervals obtained using Praat’s Voice Report
- % Voicing: 0% voicing = “Voiceless”, 100% voicing = “Voiced”, 0% < Obs < 100% = “Partial”
- Voicing shape (determined for individual items): Devoiced, Bleed, Trough, Fully Voiced (phrase medial), Prevoiced (phrase initial)
- No clear examples of Medial/strengthening (negative VOT)
- Very small # of ‘Hump’ pattern: voicing starts just after obstruent onset and ends just before offset (possible artifact of Praat Voice Report)

Partially voiced tokens

- Fricatives (dotted lines in (4)): Show Trough pattern of voicing overall across intervals
- “Voicing shape” in (5): almost equal proportions of Bleed and Trough patterns, except final position, where there is more Bleed ($\beta = -1.36, p < .001$)
- Stops (solid lines in (4)): Linear decrease in % of voicing across the 3 intervals; consistent with high proportion of Bleed in (5)

Characterization of “negative VOT” in English

- Negative VOT is often defined as voicing extending leftward from a vowel into an obstruent constriction (e.g., Catford 2001)
- For partial stop voicing, this pattern never occurs
- Related ‘trough’ pattern in fricatives: voicing from overlap with vowels is aerodynamically more sensible for fricatives
- Partial voicing is largely characterized by ‘bleed’ from preceding sonorants (see also Wisconsin speakers in Jacewicz et al. 2009, Keating 1984 for German)
- Next step: compare to bleed duration in voiceless obstruents to determine if speakers intentionally prolong bleed to serve as voicing during constriction