Voice Quality Variation over the Course of the English Utterance

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Introduction

- Non-modal voice is often associated with phrasal position in English:
  - Phrase-final creak at phrasal offsets can occur with more or less constriction of the vocal folds [1-3].
  - Phrase onsets also tend to be breathier than later points in phrase [4].
  - In languages with breathy voice, lower constriction is accompanied by higher increase in contact [5].
- F0 declines over the course of declarative utterances,
  - Unclear how declination relates to voice quality changes.
- **How is voice production affected by position in utterance and utterance length? How predictable is voice quality from the fundamental frequency (f0)? How consistent is the relationship between CQ and PIC?**

Methods

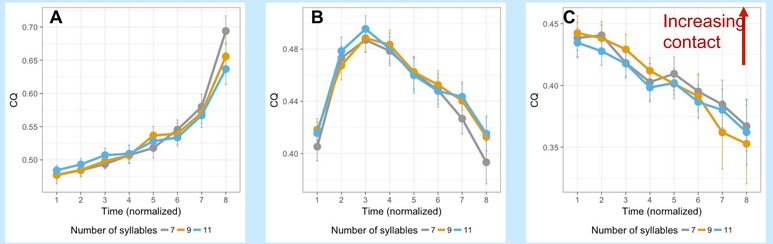
- Audio and electroglottograph (EGG) recordings of read, declarative sentences designed to avoid non-modal sounds
  - Sentences 7 – 11 syllables long
  - n = 10 speakers (4 male, 6 female)
  - Native speakers of Californian English
- Sentences and EGG signal annotated and segmented in Praat
- Acoustic and EGG analysis performed over 9 intervals of each utterance (using VoiceSauce and EggWorks).
- Sentences analyzed for f0, peak vocal fold velocity at moment of contact (PIC) and, contact quotient (CQ) in R

Hypotheses

- Hyp 1: Utterances will have: (a) **Lower CQ** at onset and (b) either **higher or lower CQ** at the end of the utterance.
- Hyp 2**: F0 will decrease** over the utterance. PIC will be inversely proportional to CQ.
- Hyp 3: Number of syllables should affect slope of measures.

Results: Contact Quotient Patterns

Characteristic Contact Quotient Patterns



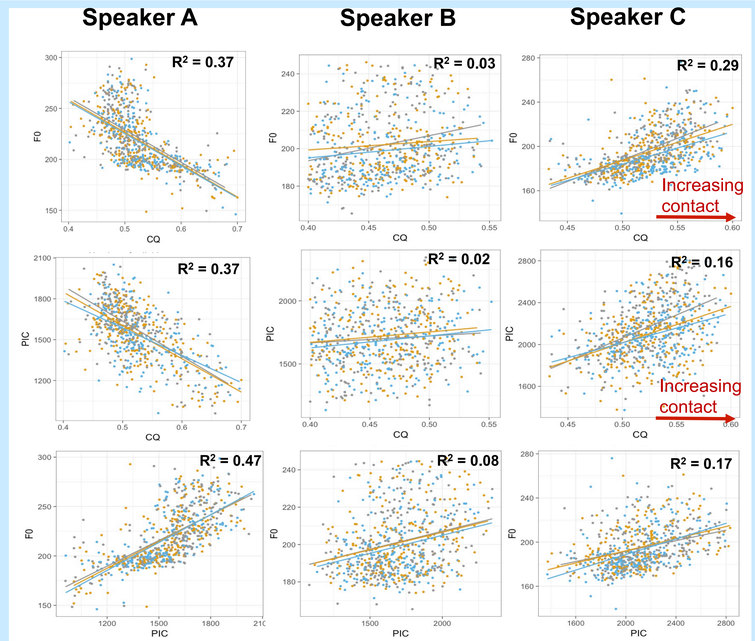
Contact quotient patterns of 3 different speakers (speakers A-C) for time segments 1 – 8 (out of 9).

- **Three patterns** identified for contact quotient variation over utterances
- Number of syllables has **minimal** effect on CQ pattern
- PIC and F0 descend over utterance, **regardless of CQ**

Total speaker number and gender for each CQ trend

CQ Trend	# speakers (M/F)	PIC Trend	F0 Trend
A. Convex decreasing	4 (2/2)	decreasing	decreasing
B. Increasing	2 (0/2)	decreasing	decreasing
C. Linear decreasing	4 (2/ 4))	decreasing	decreasing

Results: Covariation between measures



Scatterplot of average CQ vs F0 (**A-C**), average CQ vs PIC **(D-F)**, and average PIC vs F0 **(G – I)** for an utterance. Data for speaker A (**left)**, speaker B **(middle)**, and speaker C **(right)** is shown.

- Correlation between CQ and F0 may be **positive** (speaker C), **negative** (speaker A), or **non-significant**.
- **Similar** results for the relationship **between CQ and PIC**.
- **PIC and F0** appear **positively correlated** for all speakers

Discussion

- CQ shows 3 different patterns over utterances, increasing, decreasing, or with a peak in the first third.
- Only 60% of speakers show phrase initial breathiness (indexed by lower CQ). (Hypothesis 1a)
- Because all speakers show phrase final creak, there is evidence that creak can be both constricted (higher CQ, Pattern A) or unconstructed (lower CQ, Patterns B/C). (Hypothesis 1b)
- F0 and PIC both decrease over the course of the utterance, but neither is consistently inversely proportional to CQ.
- More work needed to determine if PIC relates more closely to voice quality, f0, or vocal intensity.

References

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[5] Kuang, J. Phonation in Tonal Contrasts, PhD. thesis, University of California Los Angeles, Los Angeles, CA, 2013: 1–171.