Maintenance of the COT-CAUGHT contrast among Detroit speakers: A multimodal articulatory analysis

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Overview

How do Northern Cities Vowel Shift (NCVS) speakers maintain the contrast between COT and CAUGHT?

- Early stage NCVS involves the fronting of COT and CAUGHT and the lowering of CAUGHT, although these vowels remain distinct.
- Increased formant values may be associated with either tongue-fronting or lip-unrounding, both of which shorten the vocal tract.
- Majors & Gordon (2008) find that among St. Louis speakers, rounding is preserved in CAUGHT, suggesting that CAUGHT-fronting and lowering may be accomplished through tongue position alone.
- This study employs video recording and ultrasound tongue imaging to determine the relative contributions of tongue position and lip configuration in maintaining this contrast.
- It is found that speakers employ differing articulatory strategies, despite similar acoustic realizations.

Methods

- Two 22–23 year-old female speakers, born and raised in Metro Detroit, read a randomized list of 100 monosyllabic words containing 20 words for each of the vowels /i/, /u/, /æ/, /ɑ/, and /ɔ/.

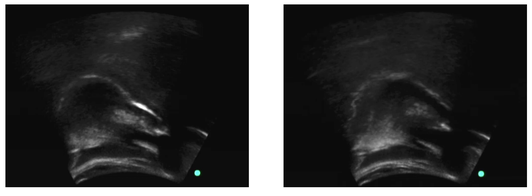

Figure 1: Extracted ultrasound frames for the tokens *caught* and *odd*, as produced by Speaker 2. The right side of the image corresponds to the front of the mouth. The tongue surface is visible as the white line near the center of the image.

- Audio, video, and ultrasound recordings were synchronized and measured at the point of F1 maximum.
- F1 and F2 measurements were taken using Praat (Boersma & Weenink, 2014) and normalized following the technique of Labov et al. (2006).
- Vertical lip openness and horizontal lip spread were calculated by measuring the number of pixels between the top and bottom of the lips and between the lip corners.
- Tongue contours were tracked using EdgeTrak (Li et al., 2005) and modeled with smoothing spline ANOVA (Gu, 2002; Davidson, 2006).

Results: Speaker 1

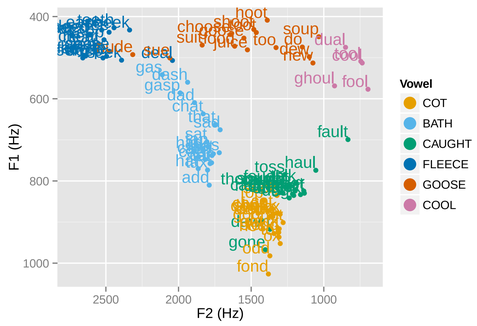

Figure 2: *ANAE* Normalized Vowel Formant Measurements for Speaker 1.

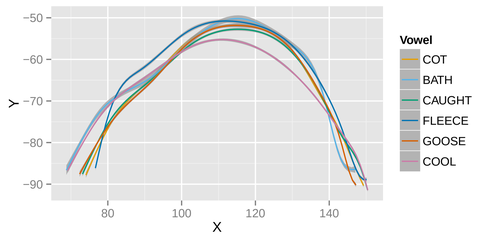

Figure 3: Tongue Contours for Speaker 1 with 95% Confidence Interval. Where CIs for two vowels overlap, the contours are not significantly different.

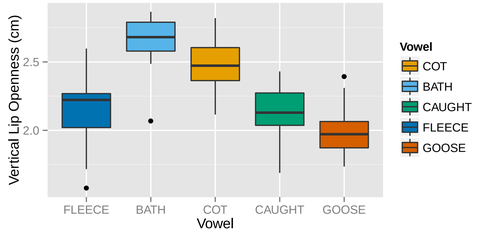

Figure 4: Vertical Lip Opening Measurements for Speaker 1. Lower value indicates greater degree of rounding.

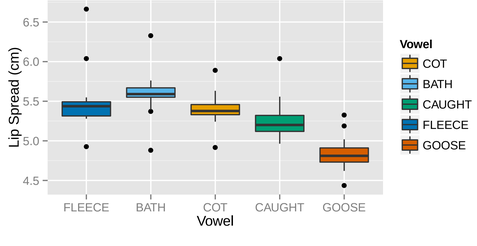

Figure 5: Lip Spread Measurements for Speaker 1. Higher value indicates greater degree of spread.

Results: Speaker 2

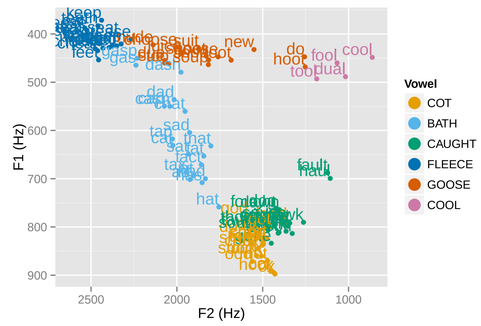

Figure 6: *ANAE* Normalized Vowel Formant Measurements for Speaker 2.

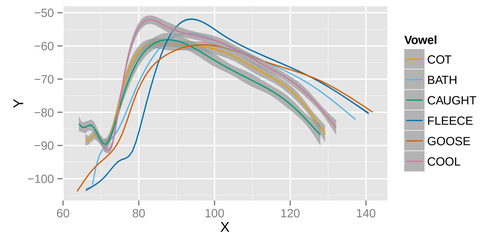

Figure 7: Tongue Contours for Speaker 2 with 95% Confidence Interval. Where CIs for two vowels overlap, the contours are not significantly different.

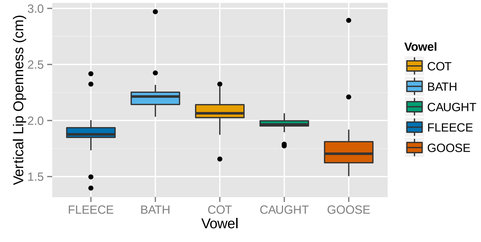

Figure 8: Vertical Lip Opening Measurements for Speaker 2. Lower value indicates greater degree of rounding.

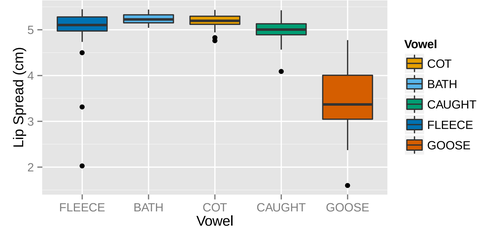

Figure 9: Lip Spread Measurements for Speaker 2. Higher value indicates greater degree of spread.

Discussion

Both speakers maintain an acoustic distinction between COT and CAUGHT, which differ significantly in F1, but not in F2. However, the two speakers differ in articulatory configuration.

Speaker 1:

- High degree of overlap between tongue contours for COT and CAUGHT (Figure 3).
- Significant difference between COT and CAUGHT in lip openness (Figure 4). CAUGHT is more round than COT.
- No significant difference between COT and CAUGHT in lip spread (Figure 5).

Speaker 2:

- No significant difference between COT and CAUGHT in either lip openness (Figure 8) or lip spread (Figure 9).
- Significant difference in tongue contours for COT and CAUGHT throughout tongue body and tip (Figure 7).

These results suggest that speakers participating in the NCVS may take differing paths in maintaining the contrast between COT and CAUGHT. Additional research is needed to determine the consequences of these findings on the transmission (or diffusion) of articulatory forms, and what implications this type of variation has for future linguistic change.

References

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