Phonology of Nasal Consonant Deletion in African American English

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Introduction

- In this paper, I closely examine the phonological environments which condition patterns of coda nasal consonant deletion in African American English (Wolfram, 1989).
- My ultimate goal is to provide an account of coda nasal consonant deletion based on the perceived similarity between the nasal consonant and the preceding nasalized vowel (Steriade, 2000).
- A more robust cue to nasality on the preceding vowel is predicted to fortify the odds of deleting a following nasal.

Sound Change

- In English, numerous studies show that vowels before nasal consonants are nasalized to a degree which must be phonological rather than purely phonetic, (Byrd et al., 2009; Solé, 2007).
- In terms of diachronic change, the cue to nasality shifts from the following nasal consonant to the vowel facilitating the "destruction" of the phonetic precursor (Hyman, 1976).
- Historically speaking, this is the typical path which leads to the emergence of phonemic nasal vowels in a given language and regressive spread is the more common mechanism (Ferguson, 1975, pg. 181).

Acoustics

- Vowel nasality is produced by effects of coupling as a result of the simultaneous opening of the velopharyngeal and oral ports.
- In the case of coarticulatory vowel nasalization, the distinct prominence at F1 of oral vowels is replaced by a "broader prominence consisting of two peaks" (P0) in nasalized vowels (Chen, 1996, pg. 40).
- Because P0 is fixed at about 270 Hz[1] (Chen, 1997, pg. 2362) and F1 varies as a function of **vowel height**, the distance between these prominences can differ.

[1] Other studies place it between 250 and 300 Hz (Feng and Castelli, 1996; Maeda, 1993).

Perception

- The robustness of a cue should determine whether or not the nasal consonant is more likely to be implicated in a phonological process of deletion (Wright, 2004).
- Coetzee (2004, pg. 222) says: "The idea is that a contrast is preserved (licensed) more easily in contexts where the cues for its perception are more salient than in contexts where these cues are less salient."
- Two formants which are critically close are perceived as a single prominence; this is termed the center-of-gravity effect and the critical distance has been identified as about 3.5 Bark (Christovich and Lublinskaya, 1979).

Cue Robustness & Vowel Height

- I used theoretical F1 Bark values given by Schwartz et al. (1997, pg. 266) to determine that **low vowels** have F1 values **distinguishable** from P0 at 270 Hz (2.72 Bark). Non-low vowels do not.
- **Robust**: If listeners can reliably determine that a vowel is nasalized due to a following nasal consonant (low vowels), then they realize that the cue to the nasal consonant is redundant.
- **Less Robust**: Speakers may be less inclined to delete a coda nasal consonant if they are prone to reanalyzing vowel nasalization as a property of F1 (i.e., vowel height) instead of as a cue to the following nasal consonant (non-low vowels).

Research Question & Prediction

- **RQ**: What phonological factors condition nasal consonant deletion in codas in African American English?
- **Prediction**: A speaker is more likely to delete a coda nasal consonant following a low vowel than a non-low vowel.

The Data

- Data come from an hour-long informal interview with an African American adult male from Durham, North Carolina.[2]
- **Nasal consonant deletion**, was coded as "not deleted" or "deleted" in word-final coda (CVN) and coda cluster environments (CVNT).
- The vowels coded as **low** include /æ,ɑ,ɔ/. All other vowels were coded as **non-low**.
- Also: **following environment** of the nasal consonant, the scaled log of **duration of the preceding vowel**, **POA of the nasal consonant**.

[2] Tabulation was aided by the use of force-aligned TextGrids created from transcripts and P2FA (Yuan and Lieberman, 2008).

Results & Analysis

Descriptives

- Overall, the speaker deleted a nasal coda consonant in 69 out of a total of 126 possible cases for a deletion rate of about 54.8%.
- Unfortunately this is a very small token count, but as far as I know, it's the strongest data available from the corpus (so far).
- Deletion rates for the low vowels (68%) do appear to be higher as compared to those for the non-low vowels (51%), but it's not statistically significant, $\chi^2 = 1.101$, $p = 0.294$.

Token Counts: Deletion by Vowel Height

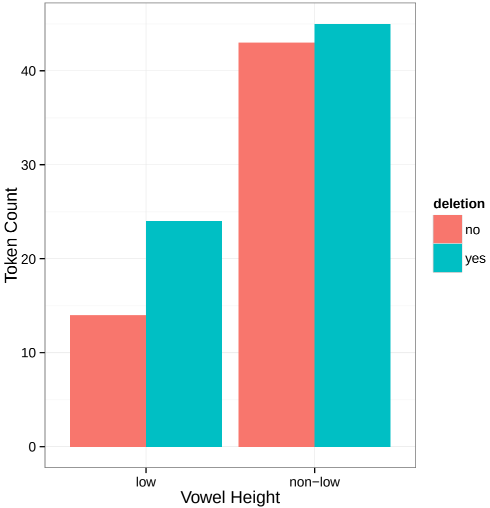

Figure: Presence versus absence of coda nasal consonant in low and non-low vowels.

Logistic Regression

- I did all stats in `R` using the `lme4` package (Bates et al., 2014; R Core Team, 2014). Likelihood ratio tests used to compare model residual deviances and provide *p*-values.
- Constructed a GLM of the inverse logit probability of retention of the nasal consonant conditioned by **following environment**, **POA** of the nasal consonant, and an interaction between **vowel height** and **duration** (Hillenbrand et al., 1995).
- **Best predictor**: The percent change in probability of retaining a nasal consonant per SD from the mean scaled log of **vowel duration** is about 20%, $p < 0.001$.
- No other factors contributed significantly (not enough data), so I plotted the predicted values from this maximal model ...

Logistic Regression: Predicted values

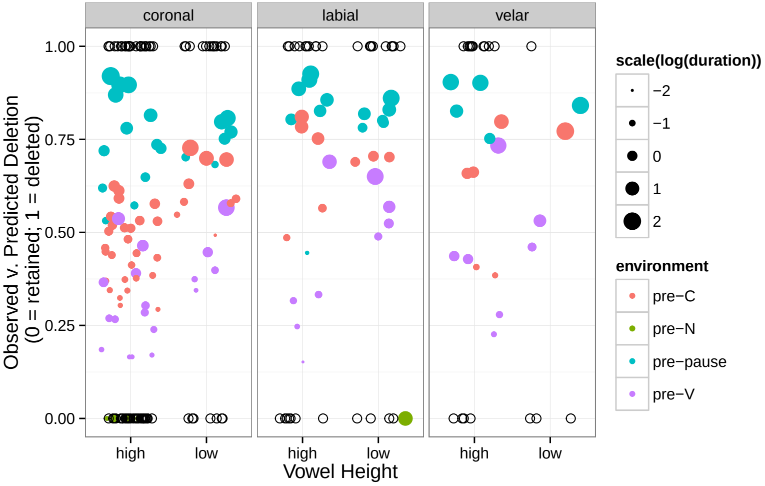

Figure: Fitted probabilities and actual values (0 = retained; 1 = deleted) for a logistic model predicting the inverse logit probability of nasal coda consonant retention versus deletion. Note: high = non-low.

Summary of Logistic Regression

- Vowel height was **not** a significant predictor of nasal consonant retention rates, $p = 0.244$.
- The relationship between vowel duration and deletion of the following nasal consonant is very apparent visually.
- Within pre-pausal and pre-N levels, predicted fits seem to hit ceiling and floor values respectively (**no effect of vowel height**).
- Slight differences between non-low and low vowels in the predicted direction are visibly detectable for coronal and labial coda nasal consonants (**possible vowel height effect?**).

Conclusions

- **Vowel duration as the best predictor**: in a longer vowel, a listener has time to more confidently identify nasality on the vowel as belonging to a following nasal consonant which then licenses its deletion.
- I hope to find more data to be able to propose OT constraints and carry out a maximum entropy model to determine constraint rankings and weights which would produce the observed distributions.
- **Synchronic variation**: Are languages with phonemically nasalized vowels more likely to have low (or non-high) vowels in their inventories?

Thank you!

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Questions?

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