Incomplete neutralization in African American English: The role of vowel duration

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African American English

• We know a lot about a few consonantal features of AAE varieties (Thomas 2007; Thomas & Bailey 2015)
  • r-lessness
  • (ing)
  • consonant cluster reduction
  • stopping/labialization of interdental fricatives

• But several more have been underexamined
  • nasal deletion
  • /skr/ for /str/
  • devoicing/glottalization of final consonants
Final Consonants in AAE

• In some varieties of AAE, final obstruents can be replaced with a glottal stop or deleted...
  • /t/, /d/  
    • “Ever since then, I had: transferred- cause I was at, you remember I had went to Northern, I had transferred from Northern to Riverside, then from Riverside to Hillside...” (Durham, male, 21)

• Glottal stop replacement of /k/, /g/ 
  • “take a check” (20, male, Durham) 
  • “that big” (19, male, rural Durham)

• But also deletion of final obstruents 
  • e.g., “you know when that Above The Rim came out” (19, male, Memphis) 
  • “my car was sitting right in front of my momma house” (22, male, Memphis)
Final Consonants in AAE

• In the case of final stops...
• How are words like bat, bad, back, and bag distinguished?

• Today, I’m focusing on the first step, looking at the consonant realization of word final /t/ and /d/ in three varieties of AAE
• And whether vowel duration plays a role, specifically in glottal replaced stop contexts
Glottalization in AAE

- Glottal stop replacement of /d/
  - Unique to AAE (especially in stressed syllables) (Fasold 1981)
  - Several geographic settings
    - Detroit (Wolfram 1969; Kohl & Anderson 2000; Nguyen 2006); Houston (Koops & Niedzielski 2009, 2010); Durham, NC (Farrington 2011); Washington DC (Fasold 1972; Grieser 2014), NYC (Labov et al. 1968); Los Angeles (Legum et al. 1971), Minneapolis, MN (Pederson 1967)
    - Well studied in speech pathology literature (Moran 1993; Williams 1998; Stockman 2006)

- Glottal stop replacement of /t/
  - Common across regional varieties (Roberts 2006; Eddington & Taylor 2009; Eddington & Channer 2010)
  - Glottal variant is part of regular variation in American English /t/ (Sumner & Samuel 2005)
  - Acoustic characteristics (Garellek 2013, Garellek & Seyfarth 2016; Dilley & Pitt 2007)
  - Occurs in AAE (Thomas 2007; Koops & Niedzielski 2009; Farrington 2015)
Deletion in AAE

• Consonant cluster reduction
  • We know a lot about the constraints on CCR in AAE
• Final consonant singleton deletion (Thomas 2007)
  • Common as a result of connected speech processes (Temple 2014), especially when a consonant follows (Wolfram 1969)
  • But can also occur in pre-pausal environments
    • Some previous work in Atlanta AAE (Harrison 2007)
Word final neutralization in AAE

• The loss of place of articulation through debuccalization, and consonant deletion result in coda neutralization
Word final neutralization

• Common across languages, with devoicing being one of the classic examples of neutralization (Yu 2011; Myers 2012)
  • Investigated in many language varieties (Silverman 2012; Kharlamov 2012)
  • Incomplete neutralization (Kharlamov 2012)
  • Vernacular universal (Chambers 2000)

• Occurs in American English varieties (Wisconsin German English, Purnell et al. 2005; Iverson & Salmons 2012)
Phonologization

• The development of a phonetic feature into a phonemic one
• In the case of incomplete neutralization, there are often cue-trading relationships between what was a primary cue (e.g. consonant voicing) and a secondary cue (e.g. vowel duration) (Kirby 2010)
  • In Wisconsin German English, e.g. duration of preceding vowel, glottal pulsing (Purnell et al. 2005)

• Much has been said about the vowel length difference in English
Phonologization

• Solé (2007) shows that English duration varies by speech rate, which suggests a clearer phonological target when compared to other languages in the study (Arabic and Catalan)
• Partially phonologized consonant voicing in vowel duration (Yu 2011)
• Step in phonologization process, where a new distinction leads to the loss of another distinction (Hyman 1976)
AAE and Phonologization

• AAE exhibits glottal stop replacement for both word final /t/ and /d/, which presents a unique testing ground for the continued phonologization of vowel duration in an American English variety

• Vowel duration in AAE
  • Recent work by Holt, Fox & Jacewicz (2015, 2016) in North Carolina AAE
AAE Vowel Duration

• In a lab study, AAE speakers have longer vowels before canonical /d/ when compared to Mainstream American English speakers, while vowels before /t/ were not significantly different.

• Holt et al. (2016) suggest extensive vowel duration lengthening might be a primary cue for consonant voicing distinctions in AAE.
Vowel duration and phonologization

• In a lab setting, Holt et al. (2016), they found that AAE shows a large distinction between vowels before /d/ when compared to vowels before /t/
  • Is this distinction robust in conversational data?

• If we code for the phonetic realization of the consonant....
  • Are vowels before /d/ longer before glottal stops than coronal stops (neutralized vs non-neutralized situations)?
Methods – Data Sources

• Memphis, TN (N=12)
  • Collected in 2001 by Valerie Fridland (see Fridland 2001, 2003)

• Durham, NC (N=12)
  • Collected in 2012 for the Frank Porter Graham longitudinal study of AAE (see Van Hofwegen & Wolfram 2010)

• Washington, DC (N=12)
  • Collected in 2015-16 for the Corpus of Regional African American Language (CORAAL; Kendall & Farrington 2017)
Methods

• Analysis conducted in Praat using acoustic correlates
  • Coded word final /Vt/ and /Vd/ words for phonetic realization
  • Extracted duration of preceding vowel
Methods – Coding /t, d/

• Tokens were coded as a coronal stop, glottal replaced stop, glottal reinforced stop, or zero coda

• Without articulatory data, this study draws on acoustic and auditory observations, acknowledging that there are issues of articulations which aren’t necessarily audible or observable from the acoustic signal (Temple 2014)
## Methods – Coding /t, d/

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Coronal Stop</strong></td>
<td>[d]</td>
<td>Full alveolar with voice bar, no evidence for glottalization</td>
</tr>
<tr>
<td></td>
<td>[t]</td>
<td>Full alveolar without voice bar, no evidence for glottalization, released and unreleased</td>
</tr>
<tr>
<td><strong>Reinforced Stop</strong></td>
<td>[ʔd]/[ʔt]</td>
<td>Slowed glottal pulses leading up to oral closure; formant transitions evident (F1 decreases, F2 increases)</td>
</tr>
<tr>
<td><strong>Glottal Stop</strong></td>
<td>[ʔ]</td>
<td>No formant transitions, F0 drops</td>
</tr>
<tr>
<td><strong>Zero Coda</strong></td>
<td>Ø</td>
<td>No evidence for oral closure; may trail off into breathiness</td>
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- Glottal reinforced stops accounted for four percent of the data, and for the current analysis were collapsed together with coronal stops due to lack of perceived neutralization.
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Methods – Zero Coda /d/
Methods – Glottal stop for /d/
Methods

• Overall distribution of final stops by realization in the data
• Strikingly, /t/ glottalization accounts for 72% of /t/ realizations

<table>
<thead>
<tr>
<th>Consonant</th>
<th>Glottal</th>
<th>Zero Coda</th>
<th>Coronal</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>/t/</td>
<td>1368 (72.8%)</td>
<td>205 (10.9%)</td>
<td>307 (16.3%)</td>
<td>1880</td>
</tr>
<tr>
<td>/d/</td>
<td>680 (38.6%)</td>
<td>544 (30.9%)</td>
<td>534 (30.4%)</td>
<td>1758</td>
</tr>
<tr>
<td>Totals</td>
<td>2048 (56.3%)</td>
<td>749 (20.6%)</td>
<td>841 (23.1%)</td>
<td>3638</td>
</tr>
</tbody>
</table>
Methods

• If we look at the distribution by field site...
• Memphis deletes /t/ more than Durham and DC
• Memphis also has more coronal stop realizations of /d/
• Each of the variants (glottal stop, zero coda, and coronal stop) occurs in every speaker in the analysis
Analysis

• How vowel duration interacts with consonant type and consonant realization
• Linear mixed effects regression with speaker and word as random effects in all models tested
  • DV: Log vowel duration (stressed tokens only)

<table>
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<tr>
<th>Consonant</th>
<th>Realization</th>
<th>N</th>
<th>Mean Duration (ms)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Glottal Stop</td>
<td>1290</td>
<td>176.96</td>
<td>0.066</td>
</tr>
<tr>
<td>/t/</td>
<td>Zero Coda</td>
<td>178</td>
<td>145.11</td>
<td>0.069</td>
</tr>
<tr>
<td></td>
<td>Coronal Stop</td>
<td>298</td>
<td>137.40</td>
<td>0.066</td>
</tr>
<tr>
<td>/d/</td>
<td>Glottal Stop</td>
<td>545</td>
<td>268.22</td>
<td>0.105</td>
</tr>
<tr>
<td></td>
<td>Zero Coda</td>
<td>479</td>
<td>186.18</td>
<td>0.089</td>
</tr>
<tr>
<td></td>
<td>Coronal Stop</td>
<td>468</td>
<td>206.19</td>
<td>0.101</td>
</tr>
</tbody>
</table>
What we expect

• There are several internal factors that we know affect the duration of the vowel (Peterson & Lehiste 1960; Jacewicz et al. 2007; Holt et al. 2016), including:
  • Vowel Tenseness: Tense > Lax
  • Vowel Height: Low > Mid > High
  • Vowel diphthongality: Diphthong > Monophthong
  • Utterance Position: Final > Medial

• Tenseness, height and utterance position were in the final model
  • Vowel diphthongality not included
Vowel Height and Tenseness

![Graph showing the relationship between Vowel Height and LogDur](image1)

![Graph showing the relationship between Vowel Tense and LogDur](image2)
Variables

• In addition to those vowel quality factors, we included
  • Consonant type: t, d
  • Consonant realization: glottal, zero coda, coronal
  • Sex: female, male
  • Field Site: Memphis, Durham, DC
Sex

• Females have longer vowels than males
• In line with some previous work on AAE (Holt et al. 2016) and other varieties of American English (Jacewicz et al. 2007)
• But this is likely a speech rate effect (Kendall 2013)
Consonant

• Significant main effect
• Vowels before /d/ are longer than vowels before /t/
Consonant*Utterance Position

- Interaction p=0.06
- Vowels in utterance final position are longer than utterance medial
Consonant*Realization

- Significant interaction between consonant and realization
- Zero coda longer than glottal for /t/
- Glottal and coronal stops are not significantly different.
Realization*Utterance Position

- Significant interaction
- In utterance final position, zero codas are longer than glottal stops and coronal stops, regardless of consonant type
- In medial position, vowels before glottal stops are longer than zero codas or coronal stops
Summary

• Vowels are longer before /d/ than before /t/
  • This is expected based on the preponderance of evidence from other languages (and other varieties of English)
  • And also what we know from Holt et al. (2016) in a comparison of AAE to MAE in North Carolina

• We also see expected results for vowel height, vowel tenseness, and utterance position
Summary

• Looking at the relationship between consonant realization and vowel duration we find somewhat surprising results
  • Vowels before /d/ are similar to each other regardless of realization
  • For /t/, zero coda vowels are significantly longer than coronal and glottal stops
Conclusion

• AAE exhibits incomplete neutralization of word final /t/ and /d/
  • Glottal stop replacement and deletion
• Vowel duration is a cue to consonant voicing
  • But duration isn’t heightened when compared to non-neutralized contexts
  • Interactions between utterance position and phonetic realization
Future Directions

• Only looked at /t/ and /d/
• But debuccalization and deletion are key phonological processes beyond coronal stops

• So we know that bat and bad are clearly differentiated by vowel duration
  • But what about *bat* from *back* and *bad* from *bag*?

• Underlying vowel quality differences maintained?
Selected References


Kendall, Tyler, & Farrington, Charlie. (2017). The Corpus of Regional African American Language. Version #0.5. BETA. Eugene, OR: The Online Resources for African American Language Project.


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