Bermudian English: An acoustic analysis of vowels with implications for sociolinguistic variation

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Bermudian English (BE) is of interest due to its distinctiveness from most varieties of British and American English, but to date, few studies have examined the variety, with the last phonological description of BE published by Ayers in 1933. This paper provides an initial description of the vowel systems of young, black, Bermudian English speakers, especially as compared to the systems of speakers of Mainstream U.S. English (MUSE). The study was conducted with five native Bermudian speakers who participated in a word list task and a picture task to elicit naturalistic speech. Results of analyses of vowel plots comparing formant values of Bermudian speakers with formant values of Mainstream U.S. English speakers from Hillenbrand et al. (1995), indicate that Bermudian speakers differ from MUSE speakers in several striking ways. For instance, [a] and [ɔ] are backer and higher for these BE speakers than for the MUSE speakers. Also, [o], [u], and [ʊ] are substantially more fronted in BE. Results of regression models also show that these Bermudian speakers have a near complete merger of /ɛ/ and /æ/, and prerhotic centralization and merger of /iɹ/ and /ɛɹ/. These findings provide directions for future phonetic and sociolinguistic descriptions and analysis of Bermudian English.
1. INTRODUCTION

The last phonetic description of the English spoken in Bermuda was conducted over 80 years ago, in 1933, by the linguist Harry Morgan Ayers. In his brief, informal description, Ayers argues that Bermudian English is a variety of American English, primarily providing impressionistic observations as evidence for this claim. Among the features highlighted by Ayers are a vowel system that sounds similar to American English, a merger of front lax vowels, and some prerhotic vowel mergers (ibid). Since Ayers’ seminal work, there have been few phonetic studies on the Bermudian English (BE), despite the fact that the variety is spoken by over 70,000 on the island of Bermuda (CIA World Factbook 2016) The current study builds on the work of Ayers, as well as other impressionistic descriptions of BE to address the following questions: 1. What are the formant characteristics of the Bermudian vowel system, and how does it compare to Mainstream U.S. vowels? 2. Is there a merger of [æ] and [ɛ] in Bermudian English and 3. Is there word-final prerhotic merger and/or centralization of [i] and [ɛ], as described by Ayers? Finally, this project aims to act a starting point for future research about the acoustic qualities of Bermudian English as well as sociophonetic questions about variation in BE. Bermudian English represents a new front for documentation of English variation, as well as understanding how cross-generational cyclic movement patterns affect community-level patterns.

2. METHODOLOGY

Bermudian students at a university in New York City were recruited via email and friend of a friend methods. The participants were five students, three women and two men, aged 18-22. All of the students had lived in the United States for no longer than two years at the time of recording, though they each reported that they had at least one family member living in the U.S. or Canada. The participants were each recorded in a sound-attenuated booth using the Marantz PMD660 recorder and Audio Technica ATR 3350 Omnidirectional Condenser Lavalier microphones. The experiment proceeded in two parts, designed to address questions related to the characteristics of the vowel system of Bermudian English (BE). The subjects read sentence lists and performed a picture task in which they were asked to describe photos designed to elicit target words in casual speech. In Part 1, in order to obtain a basic description of the vowel formants of BE, as well as compare Bermudian vowel formants to American vowel formants, speakers of Bermudian English were recorded producing the vowels [a], [ɔ], [ʌ], [o], [u], [ʊ], [æ], [ɛ], [e], [ɪ], and [i] in the environment [h]V[d], following the methodology of Hillenbrand et al. (1995). Speakers read sentences containing each of these vowels three times each, for a combined total of 15 tokens of each vowel in the data set. Words with the target vowels were couched in the frame sentences “say h[V]d again” in order to avoid list intonation that has the potential to affect vowel characteristics. The target sentences appeared one by one on Powerpoint slides that the subjects could click through and read aloud at their own pace.

In the second part of the experiment, in order to describe the relationship between [i] and [ɛ] and check for the potential prerhotic merger described by Ayers (1933), each of the speakers was recorded describing 40 photos. In this task, the photos were presented to participants one at a time on slides that the participants could click through at their own pace. 10 of these photos had target
words ending in [i], 10 had target words ending in [ɛi], and there were 20 fillers in order to control for task effects.

The data from part 1 was then analyzed via the segmentation of each target vowel in Praat and subsequent measurement of F1, F2, and F3 for each vowel at its midpoint. The data from the five Bermudian speakers was then normalized using the Labov ANAE method (Labov et al. 2006) and plotted using the Vowels package in R (Kendall and Thomas 2010). The BE data was subsequently compared to data from Hillenbrand et al. 1995, which had recorded 93 speakers of Ohio Mainstream U.S. English (MUSE), producing the same vowels in the same environment. The BE and MUSE vowels were then plotted against each other for comparison. Following plotting in R, statistical comparisons between Bermudian vowels were made using mixed effects regression models in the lme4 package in R (Bates et al. 2015), with F1 and F2 as dependent variables and speaker as a random effect, following the methodologies of Jacewicz et al. (2011) and Fridland et al. (2014). Vowels from the picture task in experiment Part 2 were segmented in Praat and F1, F2, and F3 were measured at 20% and 50% of vowel duration in order to see effects of [ɜ]. LMER models in R using lme4 were implemented to test for differences between formants at each time point, with speaker as a random effect.

3. RESULTS

i. Bermudian Space

In general, the vowel space of these young, black Bermudian English (BE) speakers in New York is characterized by an extremely fronted [u] and [o], and backed [a], [ʌ], and [ɔ] productions. Figure 1 shows the results of Experiment 1, in which the five BE speakers produced each of 11 vowels in the frame sentence “say h[V]d again”. These are the Labov ANAE normalized values as normalized and plotted in the Vowels package in R (Kendall and Thomas 2010).
In addition to the fronted high back vowels and backed mid vowels, there is also substantial distance between [i] and [ɪ]. This space also shows substantial overlap in both F1 and F2 between front lax vowels, especially [æ] and [ɛ], which will be discussed in more detail in iii.

ii. Bermudian Vowels Formants as Compared to American Vowel Formants

As Ayers (1933) notes, Bermudians have long had sustained contact with the US, as Bermuda is 640 miles off the coast of North Carolina and substantial trade and tourism occur between the island and the U.S. The Bermudian participants in this experiment each lived in Bermuda until approximately age 18, when they came to the US for university studies, so it is important to note that these participants have also had personal contact with American English. In this way, their vowels may be affected by contact with American English, though without a comparison set of Bermudians who had never left the island, it would be difficult to precisely measure the effects of this contact. In general, the participants report that it is common in their families for individuals to leave Bermuda for their education in the United States or Canada, and then to return to the island. As a result, the fact that these participants have had some contact with American English is not unusual for Bermudian speakers of their age and educational level, since many have left the island for the U.S. and may or may not have returned at the conclusion of their university studies.

Figure 2 (below) shows Bermudian vowels (in blue) plotted against vowels for MUSE from Hillenbrand et al. (1995) (in red), both normalized using the Labov ANAE method (Labov 2006).
iii. \[ae\] /\[ɛ\] Merger in Bermudian English

In 1933, Ayers noted that he observed a merger of \[æ\] and \[ɛ\] in Bermudian English, such that item like “hat” were pronounced [het], but also that \[ɛ\] may be slightly raised and fronted in words such as “bet”. In order to test this observation, I compared each speaker’s formants from sentence reading task pronunciations of \[æ\] and \[ɛ\]. An LMER model conducted in R using the lme4 package (Bates et al. 2015), with speaker as random effect, found no significant differences in the F1 measurements of \[æ\] and \[ɛ\], indicating a potential height merger \((t=1.379)\). An LMER model for F2, found a difference such that \[ɛ\] is fronter than \[æ\] \((t=3.191)\). The results of both of these LMER models are presented below in Table 1, and Figure 3 shows the vowel plots for \[æ\] and \[ɛ\].
Table 1. LMER model results comparing for F1 and F2 of Bermudian [æ] and [ɛ], with speaker as random effect.

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>F1</th>
<th>F2</th>
</tr>
</thead>
<tbody>
<tr>
<td>vowel_id [ɛ]</td>
<td>-56.582</td>
<td>235.977***</td>
</tr>
<tr>
<td></td>
<td>(41.023)</td>
<td>(73.956)</td>
</tr>
<tr>
<td>Constant</td>
<td>713.615***</td>
<td>1,936.491***</td>
</tr>
<tr>
<td></td>
<td>(58.110)</td>
<td>(146.697)</td>
</tr>
</tbody>
</table>

Observations 30 30
Log Likelihood -178.542 -196.525
Akaike Inf. Crit. 365.084 401.050
Bayesian Inf. Crit. 370.689 406.655

Note: *p<0.1; **p<0.05; ***p<0.01

Figure 3. All tokens of Bermudian [æ] (in red) and [ɛ] (in blue) with ellipses showing distribution.
Though the LMER model for F2 does show a significant difference in frontness between [æ] and [ɛ], it is clear from the vowel plot in Figure 3 that the spaces show substantial overlap in the F2 dimension as well. Overall, these results indicate that some speakers may have a full merger of [æ] and [ɛ], but further research is necessary to draw conclusions about the nature of this potential merger. Additionally, due to the nature of the small sample size, these results should be interpreted as a preliminary hypothesis about the nature of a potential [æ]/[ɛ] merger in this variety of Bermudian English.

iv. Word final [iɹ] and [ɛɹ] Centralization and Merger

Ayers (1933), as well as the participants in the current study, observe that there may be a prerhotic vowel centralization and merger in Bermudian English (BE) for [iɹ] and [ɛɹ]. This pattern is attested in at least one other variety of (American) English, as Blake and Shousterman (2010) note that St. Louis AAVE has vowel centralization and merger in this environment.

In order to explore the relationship between [iɹ] and [ɛɹ] word-finally, subjects were recorded describing 10 photos that had a target monosyllabic word ending in [iɹ], such as [biɹ], and [piɹ] and 10 that had a target monosyllabic word ending in [ɛɹ] such as [hɛɹ], [tʃɛɹ], and [pɛɹ].

In order to examine the acoustic properties of these prerhotic vowels, I again implemented LMER models using the lme4 package in R (Bates et al. 2015) to test values of F1 and F2 of [iɹ] and [ɛɹ] at 20% and 50% of vowel duration. When the interaction of vowel and time is considered with speaker as a random effect there is no significant difference in F1 between [iɹ] and [ɛɹ] (t=1.641) as well as no significant difference in F2 measurements (t=1.481) indicating a merger. These results are presented below in Table 2.
<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>F1</th>
<th>F2</th>
</tr>
</thead>
<tbody>
<tr>
<td>vowel_id[iɪ]</td>
<td>-49.430***</td>
<td>156.125***</td>
</tr>
<tr>
<td></td>
<td>(17.077)</td>
<td>(43.899)</td>
</tr>
<tr>
<td>Time50</td>
<td>14.379</td>
<td>-72.484*</td>
</tr>
<tr>
<td></td>
<td>(15.961)</td>
<td>(41.031)</td>
</tr>
<tr>
<td>vowel_id[r]:Time50</td>
<td>39.636</td>
<td>-91.947</td>
</tr>
<tr>
<td></td>
<td>(24.148)</td>
<td>(62.076)</td>
</tr>
<tr>
<td>Constant</td>
<td>497.517***</td>
<td>1,860.504***</td>
</tr>
<tr>
<td></td>
<td>(24.353)</td>
<td>(132.267)</td>
</tr>
</tbody>
</table>

Observations: 206  
Log Likelihood: -1,199.435  
Akaike Inf. Crit.: 2,410.869  
Bayesian Inf. Crit.: 2,430.837

<table>
<thead>
<tr>
<th>Observations: 206</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Log Likelihood</td>
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</tr>
</tbody>
</table>

Note: *p<0.1; **p<0.05; ***p<0.01

Table 2. LMER model results comparing for F1 and F2 of Bermudian [iɪ] and [ɛɹ], with speaker as random effect.

The model shows significant main effect differences between [iɪ] and [ɛɹ], as well as differences due to time point. However, for the interaction of vowel and time, there is no significant difference, indicating that once the model accounts for time point, the vowels appear to be merged. Additionally, at 50% of vowel, as we can see in Figure 4, the vowel space is more condensed than at 20% as we begin to see the effect of the rhotic consonant.
These results indicate that Ayers (1933) observation of prerhotic centralization and merger of \([i] \) and \([ɛ] \) is supported by the acoustic data, at least for these young black Bermudian speakers.

4. CONCLUSION

This study has found that for the young Black Bermudian speakers studied here, the vowel space of Bermudian English (BE) is substantially different from that of Mainstream U.S. English (MUSE). The BE system is characterized by fronted high and mid back vowels, a potential \([æ]/[ɛ] \) merger, and prerhotic centralization and merger of front vowels, at least in word final position. Further research will also be necessary to test for potential effects of leaving and returning to Bermuda on the vowels systems of these types of speakers, though participants report robust community-level mobility between the U.S. and Bermuda. Future research should collect more tokens of all vowels to better compare them to a number of American and British vowel systems in order to arrive at a more robust description of the Bermudian vowel space.

As this study represents a first step in the description of the vowels of BE, much more work is necessary to describe the ways in which variation may exist within the variety. Due to sustained contact with a number of varieties of Canadian, British, and American varieties of English, BE may have potentially be influenced by several English varieties. Additionally, there is the potential for significant differences between demographically different groups of speakers, especially with respect to race, educational levels, and contact with other English varieties. Future research will examine variation by ethnicity, age, and gender in vowel systems of Bermudian speakers, explore historical changes related to migration as explanatory factors for these results, and document additional phonetic and phonological properties of BE with the goal of a more thorough description of the variety.
5. ACKNOWLEDGMENTS

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6. REFERENCES

Ayers, Harry Morgan. 1933. “Bermudian English”. American Speech, 8(1), 3-10


