Interacting spectral and temporal properties in Jamaican English and Jamaican Creole vowel production

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Abstract: The study reported here provides a detailed acoustic characterization of the monophthongs and diphthongs utilized by 24 speakers in two regions along the theoretical creole continuum in Jamaica, in an investigation of phonetic variation across speakers of Jamaican Creole and Jamaican English. Data analyzed suggest that the two groups of speakers make different use of acoustic (F1/F2) vowel space. Jamaican Creole speakers show more contrasts achieved by duration rather than vowel quality. For Jamaican English speakers, vowel duration appears to function to enhance slight spectral distinctions, as in American English.

INTRODUCTION

Certain quantifiable properties of vowel sounds are carried in the acoustic signal (2). These properties reflect both the constraints of human physiology and the behavior of the human vocal tract during speech, as well as language-specific parameters. Cross-language differences in vowel production may be observed in spectral and temporal features of the acoustic signal produced by speakers. Spectral features include the height of the vowel (correlated closely with the location of the first formant (F1)), and its relative frontness or backness in acoustic space (correlated with the distance between the first and second formants (F2-F1)). Temporal features include the duration of the vowel and the relative stability or changes in its formant structure over time. The former features allow description of vowel quality, the latter, of vowel quantity. Linguistic systems achieve contrasts by making some use of either or both of these types of features. For example, British and American English use primarily contrasts of quality to distinguish vowels, while Akan languages of West Africa, such as Ewe and Twi, show contrasts based on vowel quantity. This study investigates the uses of vowel quantity and quality by speakers of a language system, Jamaican Creole, which came about after sustained contact between speakers of both English and Akan varieties. Language in Jamaica ranges along a continuum from what is essentially a regional variety of English to a phonologically, morphologically, and grammatically different Creole. Several of the accounts in the sociolinguistic literature of Jamaican Creole phonology which have received wide attention have suggested that phonemic contrasts in all dimensions of the Jamaican Creole vowel space obtain from vowel length or tone alone (1, 3). However, these accounts are based on the researchers' auditory impressions. Creole systems have gone largely unexamined by linguists conducting instrumental phonetic research, in part due to difficulties in data collection and lack of instrumentation for obtaining a high-quality representation of the acoustic signal. Instrumental characterization of the spectral and temporal properties of Jamaican speech is yet needed. This study represents the first large-scale acoustic study of speech data drawn from a sample of speakers at different regions of the Jamaican continuum.

METHODOLOGY

24 speakers participated in this study, who conformed to demographic profiles of two basic types: 12 were Creole-dominant speakers whose social networks of communication were locally-based in a rural, tightly-knit community and 12 were Jamaican-English dominant speakers from a metropolitan area, whose social networks were characterized by frequent contact with American or British English via personal or media exposure. The approach taken here is within the framework of "network theory" developed by Milroy (4). Test sentences contained real-word monosyllables with the target vowel in the following consonant contexts: /b, d, k/ V /p, b, t, d, k, g, s, z, n/. Target words were embedded in the carrier frame, Unu rait pon it "You (pl) wrote on it." Each speaker read 4 randomizations of a list of 226 sentences for a total of 904 possible tokens per speaker. 35 minutes of conversational data was also recorded for each speaker. Target monosyllabic words were digitized at 11kHz sampling rate. Temporal and spectral information were collected for each vowel. Vowel duration was defined as time at Vowel offset minus time at Vowel onset. Fundamental frequency and the first three formants, F1, F2, F3
were measured for each vowel at 3 positions—onset, midpoint, and offset. To obtain a record of the trajectory of vowel formants in gliding or diphthongal vowels, F1, F2, and F3 measures were taken at 12.5 ms intervals between vowel onset and offset for vowels which changed in F2 more than 3Hz/ms. Relatively steady-state vowels were plotted using F1 and F2 at vowel midpoint. For diphthongal and gliding vowels, the arithmetic mode was used as the provisional measure of central tendency. That is, by taking interval measures for the gliding vowels it was often the case that a single F2 value occurred more than once, generally suggesting that the speaker sustained its corollary articulatory position for more than 12.5ms. This position was taken to represent the nucleus of a complex glide plus nucleus sequence. Vowels were grouped for analysis according to their orthographic category in English. Speakers’ use of falling diphthongs [ie, uo] relative to monophthongal long vowels [e:, o:] was noted.

**FINDINGS**

Although inter-speaker variability was observed, general tendencies held within these two groups of speakers, who were classed according to their demographic and social network profiles. More specifically, these two groups made different use of spectral (quantity) and temporal (quality) features in their vowel production. Summary information is provided in Table 1, below. The Jamaican Creole speakers often showed complete spectral overlap for vowels which concurrently showed durational contrast, while Jamaican English speakers contrasted these same vowels by quality alone. For example, Jamaican Creole speakers achieved the /i, i/ contrast temporally, with /i:/ on average 60% longer than /i/, while Jamaican English speakers achieved this contrast spectrally, similarly to the English tense/lax distinction. Likewise, /u, o:/ were often spectrally indistinguishable for the Creole speakers, but /o:/ was often 40% longer. Second, acoustic space for both Jamaican Creole and Jamaican English speakers showed sites of partial overlap with greater durational contrast such as /a:, a, o/. Overall, Jamaican Creole speakers showed a greater tendency for both partial and complete spectral overlap.

**TABLE 1.** Phonetic realizations of vowels produced by Jamaican Creole and Jamaican English speakers where certain spectral and durational relationships obtained: from left to right, Complete spectral overlap with durational distinctness, Partial spectral overlap with durational distinctness, and both spectral and durational distinctness.

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<tr>
<th>Complete overlap/distinct</th>
<th>Partial overlap/distinct</th>
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<tbody>
<tr>
<td>/i:, i/</td>
<td>/e, e/</td>
<td>/a:, a, o/</td>
</tr>
<tr>
<td>/o:, o/</td>
<td>/a:, a, o/</td>
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<td>Jamaican Creole:</td>
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**REFERENCES**