

PHONETIC AND PHONOLOGICAL INFLUENCE OF A SPEECH-IMPAIRED SPEAKER ON RHYTHM

Gurnikaita Chhina¹, Tae-Jin Yoon², and Karin Humphreys³

¹Dept. of Life Science, McMaster University, 1280 Main St. W., Hamilton, Canada, L8S 4M2

²Dept. of Linguistics, McMaster University, 1280 Main St. W., Hamilton, Canada, L8S 4M2

³Dept. of Psychology, Neuroscience, and Behaviour, McMaster University, 1280 Main St. W., Hamilton, Canada, L8S 4M2

1. INTRODUCTION

We present detailed phonetic analyses of a 61 year-old monolingual female English speaker. The speaker from Halifax, Nova Scotia, acquired a speech disorder from a motor vehicle accident. The disordered speech was detected three years after the brain injury she suffered from the accident, and perceived by her family and friends as being similar to Southern U.S. dialect or Scottish English. It is reported that her disordered speech is a rare but possible case of Foreign Accent Syndrome (FAS; Louch 2009). FAS may lead to long-term muscular adjustments of the vocal apparatus that lead to changes in articulatory, phonatory, prosodic settings (Moen, 2000). There is considerable variability among reported cases of FAS in terms of phonetic characteristics and impairments (Varley, Whiteside, Hammill & Cooper, 2006). We hypothesize that one of the factors that make the accent change in her speech is due to a change in her rhythmic characteristics. In order to test the hypothesis, we calculated %V (proportion of vocalic duration over the total duration of an utterance) as a measure of rhythm. In order to find out factors that may affect the %V value, we further conducted detailed phonetic analyses to understand the impact of the speaker's speech characteristics on the %V that deviates from that of Canadian English. The results indicate that both phonetic and phonological factors contribute to her non-canonical rhythmic pattern.

2. DATA

The speaker, LA, is a monolingual English-speaking Canadian Woman and she was 61-year old when the data were collected. She was born in St. Catherines, Ontario, moved out east around age 6, and has resided in Nova Scotia since the fifth grade. She has lived in Eastern Atlantic Canada for most of her life. She was a retired special education teacher. The speaker acquired a speech disorder three years after suffering from a brain injury from a motor vehicle accident. One day three years after the accident, her family member observed noticeable changes in her speech such as word searching, stuttering, and a robotic style of speech. These changes were salient when the speaker was extremely tired or anxious. According to the family members, she woke up one morning speaking with slow and broken speech sounding like a foreign accent. Her speech is regarded as often shifting from her Atlantic Canadian

English to what was perceived as Scottish English at times or as Southern United States English at times (Louch 2010).

Upon request by the family members, the third author visited the speaker and collected the speech recordings through sessions with the patient. The collected recordings range from simple read sentences to passages, and to spontaneous description of pictures. In this study, we report our preliminary analysis of a subset of the recordings of simple sentences.

In the subset of the collected data, the speaker pronounced 11 monophthongal vowels that are inserted in a /hVd/ context: *heed*, *hid*, *hade*, *head*, *had*, *who'd*, *hood*, *hoed*, *hud*, *hawed*, and *hod*. Each target was embedded in one of two carrier phrases, "the next word is /hVd/." and "I said /hVd/ again." In order to conduct phonetic analyses including %V, we segmented the utterances phonetically and then collapsed the segments into consonant intervals and vocalic intervals, using a custom-made script in Praat (Boersma & Weenink, 2010).

3. RESULTS

Typical stress-timed languages such as English have complex syllable structure and tend to have reduced vowels in unstressed positions. Therefore, the average vocalic duration is expected to be relatively shorter than the average consonantal duration. Indeed, Ramus *et al.* (1999) reports that the %V is about 40.1 in English. Given the complex syllable structure and reduced vowels in unstressed positions, relatively lower value of %V is expected. But measurement can be affected by different phonetic characteristics even within the same language group, or even between different dialects of the same language. For example, Grenon (2010) reports that the %V value is 47 in Canadian English, and she attributes the higher %V than the one reported in Ramus *et al.* (1999) to the relatively longer aspiration in Canadian stops. We found the %V of the speaker is 52, even higher than the average for Canadian English. At least two possibilities can be entertained: (1) disordered speech characteristics of our subject prolonged vocalic duration more than consonantal duration, or (2) the rhythmic characteristic of her speech may resemble syllable-timed languages (with simpler syllable structure).

4. DISCUSSIONS AND CONCLUSION

We conducted detailed phonetic analyses to understand the impact of the speaker's speech characteristics on the relatively higher %V than that of Canadian English. Speech characteristics of the speaker include slow, enunciated, and prolonged realization of segments, frequent insertion of pauses, and release of word-final stop consonants, as well as the following non-canonical characteristics: (1) Occasional modification of syllable structure via a schwa-like vowel insertion, as in Figure 1, (2) fully aspirated stop in the intervocalic context, as in Figure 2, and (3) a variant realization of [aj] to [a] (monophthongization), as in Figure 4 compared to Figure 3. The perception of her speech sounding as though Southern US English can be attributed to the occasional monophthongization of a diphthong [aj] to [a].

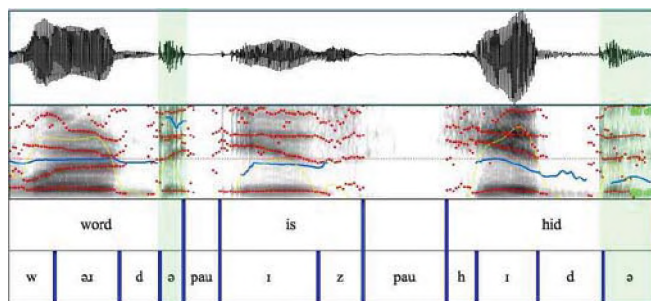


Figure 1. Insertion of two schwa vowels in words of the CVC structure. The words 'word' and 'hid' have modified syllable structure (i.e., CVCV) due to the vowel insertion.

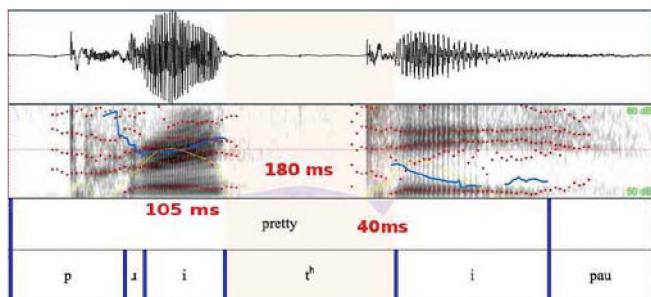


Figure 2. Fully aspirated stop in the intervocalic context. The intervocalic 't' is realized with long closure duration (180ms) and aspiration (40ms).

Some of these non-canonical phonetic properties work toward reducing the %V value. The vocalic duration is asymmetrically longer than the consonantal duration. In addition, the perception of her speech sounding as though Southern U.S. English can be attributed to the occasional monophthongization of a diphthong [aj] to [a]. These phonetic differences make the speaker's post-stroke speech so distinctively different from her pre-stroke speech that her family and friend think she speaks a foreign accent. These characteristics of disordered speech that deviates from canonical speech properties of mainstream English poses a challenge on models of speech production that does not take

into account possible modifications of phonetic properties and phonological structure. Further analyses and tests are needed to see whether these %V has indeed perceptual consequences.

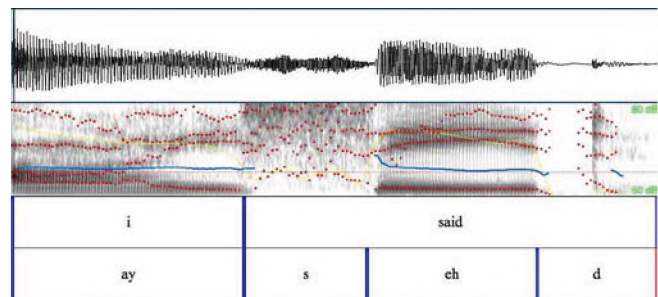


Figure 3. The canonical realization of the word 'I' as a diphthong is shown by two diverging F1 and F2. The release of final consonant is indicated by the stop burst on the final consonant in the word 'said.' The release of final consonant is optional in English, but the speaker tends to release most of the word final consonants.

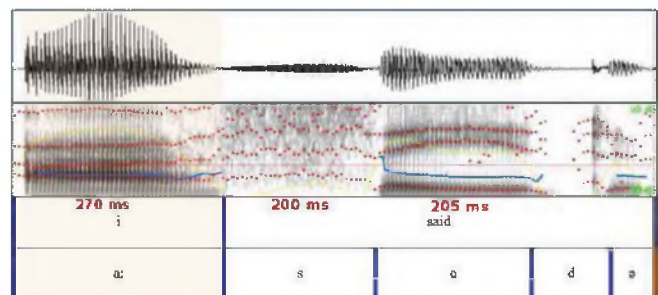


Figure 4. The non-canonical realization of the word 'I' as diphthong is shown by low two stable formants (F1 and F2). The final consonant is released and then followed by non-canonical schwa-like vowels as shown by voiced waveform and spectrogram at the end of the word 'said.' The figure is in contrast to Figure 3.

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AUTHOR NOTES

The work was conducted while the first author, Gurnikaita Chhina, was a student at McMaster University.