Vowel Production in a Korean-Australian English Bilingual Speaker

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한국어-호주 영어 이중 언어 사용자의 모음 생성

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Abstract

Purpose: Vowel production in a Korean-Australian English bilingual single speaker was examined using personal computer-based analysis software, Pratt to compare Standard Australian English (SAusE) vowel production. Methods: The produced vowel quality of spectral and durational characteristics of Australian English stressed vowels were analyzed as first formant (F1), second formant 2 (F2), and temporal values. Results: Korean-English bilingual's vowel production showed altered vowel spaces and durations from its' SAusE. The trajectories of diphthongs showed unpredictable movements in contexts. Conclusions: The results implied that the speaker's articulators were limited, affecting the variety of formant values, and the dominant language influenced the participant's English vowel productions with a notable accent. Additionally, the vowel productions were affected by the varied consonantal environments. Vowel variations conveyed meaningful information of the speaker.

1. Introduction

The term of foreign accent is widely accepted as English used as a lingua franca in this modern world (Jenkins et al., 2017). However, strong accent increases listener's listening effort (Porretta & Tucker, 2019) and ultimately, the difficulty of understanding will be likely to lead to a breakdown in communication. In acoustic measures of speech, vowels are frequently described regarding their formant structures as the resonance produced in vocal tract (Heo & Kang, 2017; Siddiqi at al., 2019; Cavalcanti et al., 2021).

The aim of this research is to investigate the vowel quality that a single speaker produced in a standard consonantal context by examining the spectral and durational characteristics of Australian English stressed vowels to understand the vowel production of the bilingual speaker who speaks Korean as a first language (L1).

2. Participant and Methods

2.1 Participant

A single female speaker who spoke Korean as L1 and Australian English as second language (L2) participated in the study. The participant had a university education with formal instruction in Australian English. In addition the subject had resided in Sydney, Australia, for five years.

2.1 Methods

Seventeen vowel samples were collected from the subject produced in standard consonantal contexts. The formant data from Standard Australian English (SAusE) stressed vowels were examined in the /hVd/, /hVt/, /hV/ contexts. The revised symbols to represent SAusE that corresponding cardinal vowels and word examples were from Harrington, Cox & Evans (1997). The list of symbols with associated vowel were /iː, ɪ, e, æ, ɐː, ɐ, ɔ, oː, ʉː, ʊ, ɜː, eː, æɪ, ɑe, oɪ, əʉ, æɔ/.

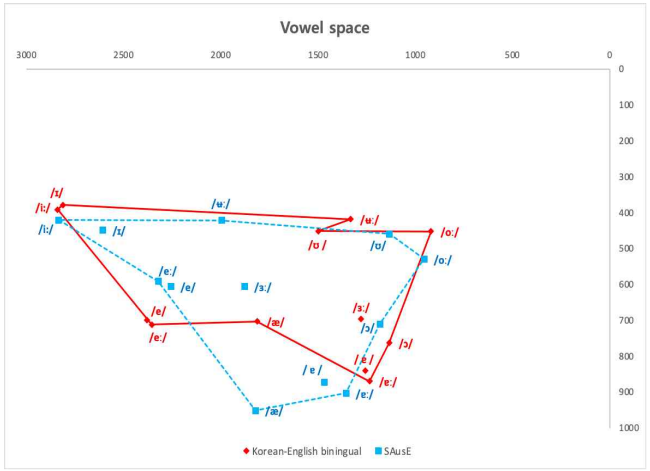
The participant produced 44 words of stressed vowels of SAusE in three consonantal contexts including 17 words in the /hVd/, 16 words in the /hVt/ and 11 words in the /hV/ context.

The recording was conducted in a soundproof room, using a Behringer C2 microphone placed in front of the participant. The participant was instructed to read the words on a computer

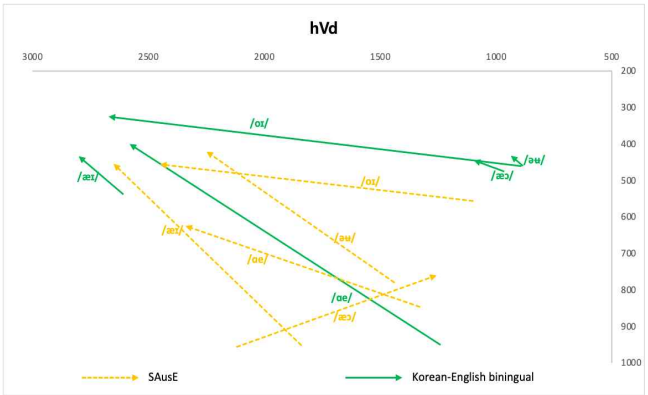
display while the speech productions were recording connected to a Mac computer running Pro tools Le. From the obtained data, personal computer-based analysis software, Praat version 4.4.01, was used to derive English stressed vowel space, formant frequencies and durations. The data obtained from the participant were compared with the values from SAusE vowel productions by Cox (2006). The vowel duration was determined in milliseconds for the three contexts of /hVd/, /hVt/, and /hV/.

3. Results

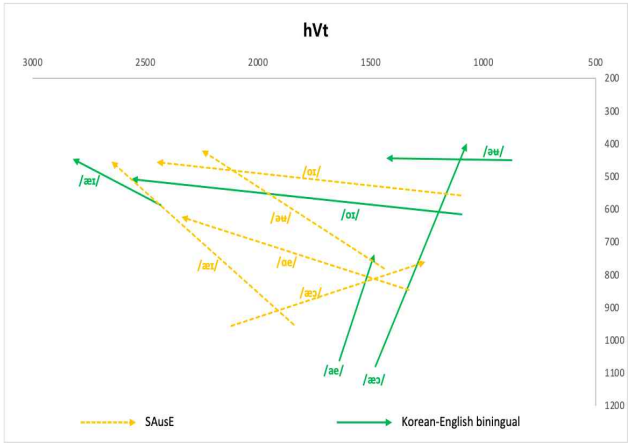
3.1 Spectral properties



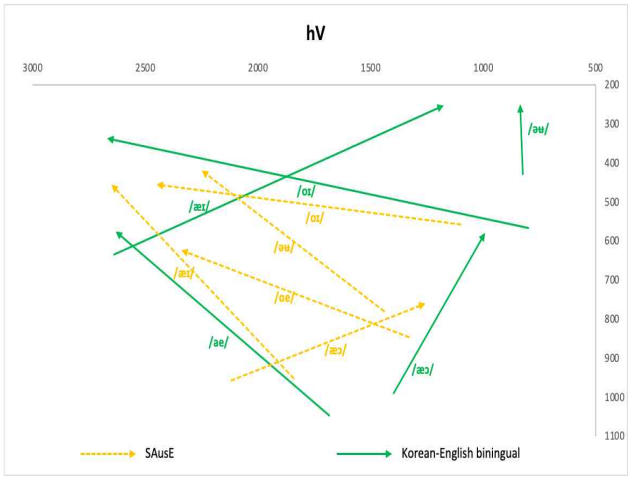
[Fig. 1] Monophthongs spaces of Korean-English bilingual and SAusE



[Fig. 2] Formant trajectory of diphthongs in /hVd/ context



[Fig. 3] Formant trajectory of diphthongs in /hVt/ context



[Fig. 4] Formant trajectory of diphthongs in /hV/ context

]Korean-English bilingual and SAusE. Monophthongal spaces were illustrated in Fig. 1.

The formant trajectories of diphthongs' movements across the vowel space showed unpredictable movements. Fig. 2-4 illustrated the formant trajectory diagrams in each context.

3.2 Temporal properties

The mean duration of short monophthong /ɪ, e, æ, ɐ, ɔ, ʊ/ was 175ms, that of long vowel /ɐː, oː, ʉː, ɜː, eː/ was 261ms. The mean duration of diphthongs, /æɪ, ɑe, əʉ, oɪ, æɔ/ was 231ms.

In /hVd/ context, /ɐː/ was the longest with 390ms followed by /æ/ with 380ms. In /hVt/ context, /æ/ was produced as the most extended vowels with 220ms whereas /ʊ/ recorded as shorted one with 70ms. In /hV/ structure, /eː/ was the most prolonged long vowel with 410ms. The data showed that short vowels were roughly 67% length of the long vowels.

4. Discussion and Conclusion

This study analyzed a vowel quality that a single speaker produced in a standard consonantal context by examining the spectral and durational characteristics to compare SAusE vowel productions. There were differences in vowel spaces, frequencies and durations between the participant's vowel production and SAusE vowel characteristics.

Compared to the vowel space of SAusE, the participant's vowel production /æ/ contributed the most to the vowel space differences. Monophthong /æ/ produced at higher area with lowered first formant (F1) and slightly raised second formant (F2) value in /hVd/ and /hVt/ contexts. This variation implied that the speaker's tongue position for vowel /æ/ were limited with lowered F1 value, less openness of jaw and forming the stricture in the frontal area of the vocal tract. Korean speakers prone to produce English vowel /æ/ as to /e/, making lowered F1 value (Kim, 2017).

Modern Standard Korean has seven vowel system and there is no distinction between mid and low-mid vowels (Heo, 2013). Thus vowel /æ/ production might be difficult to distinguish between /æ/ and /e/ due to late L2 learning (Lee & Rhee, 2019). L1 and L2 are mutually influencing each other, and unfamiliar vowels are more voluntarily adapted than other vowels (Park, 1998).

An additional explanation for these differences regarding /æ/ production might be that Australian native speakers produced further lowering /æ/ vowel. There was a tendency for Australian English vowel /æ/ in 'had' to be more lowered than New Zealand English vowels (Watson et al., 1998).

The mid-back vowel /ɔ/ was articulated by forming more lip rounding in /hVd/ structure as lip rounding and protrusion decreases formant values. Furthermore, the speaker's jaw openness was inconsistent during producing /ɔ/, showing diverse F1 values in each structure. Yet, the varied F1 values did not affect vowel duration, where its durations were recorded as similar in each syllable structure. This result implied that vowel duration provides a weaker cue to foreign accent identification in English; thus, the combination of formant frequencies and duration parameters yields the best phonetical measurements to identify speech production (Wang & van Heuven, 2018).

Other observable results from the data were inconstant diphthong trajectories. Vowel production intelligibility likely contributed to the distorted diphthongal qualities. The accuracy of vowel production correlates with the participant's English proficiency (Chen et al., 2001). Although monophthongs are not exact components of diphthongs (Cox & Fletcher, 2017; Kim et al., 2019), the variations in monophthong production could lead to variations in diphthongs productions.

The mean duration of short monophthong was 175ms whereas long vowel was 261ms. The short vowels were roughly 67% the length of long vowels. Compared to 60% in SAusE, the durations of subject's short vowels were longer. This indicated the subject slow speaking rate during short vowel production. Variations of vowel durations were also observed in the different consonantal environments. The mean duration of vowels was longer in /hVd/ than /hVt/. The voiced/voiceless features of the final consonant might affect the unclei of vowel duration(Cox, 2006; Ko, 2021).

This study provides empirical evidence for vowel properties of the Korean-English bilingual speaker. The altered spectral and durational features point out a problematic vowel due to a different vowel inventory system` between L1 and L2, and late L2 learning. Vowel variations convey meaningful information of a speaker.

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