

Production of English tense and lax vowels by young speakers of Korean dialects

Young-Shin Lim(Korea Polytechnic College)*

《 ABSTRACT 》

This study attempts to examine whether there is any difference in the acoustic properties of English tense and lax vowels by young speakers of Korean regional dialect speakers. A production test is developed to analyze acoustic manifestations of four phonetic parameters (F1, F2, vowel duration, and vowel distance) in English speech of Kyunggi Korean (KK) and North Kyungsang Korean (NKK) dialect speakers. The 184 collected data for the production test consisting of high vowels /i, ɪ, u, ʊ/ in CVC structure are taken from 20 female elementary school students (10 for each dialect group). The result shows no significant difference between two regional dialects, which indicates similar features of acoustic properties are uttered by both groups. However, despite this similarity between two groups, results from comparative analysis with native speakers show that NKK uses less vowel space from the calculated acoustic distance (Euclidean distance). Therefore, it can be argued that discrepancy in overall acoustic properties between young NKK and KK is insignificant but still distinguishing acoustic space of vowel would be harder for NKK. Based on these findings pedagogical implication for effective articulation training has been suggested.

Key Words: English tense and lax vowels, Speech production, acoustic distance, North Kyungsang dialect speakers, Kyunggi dialect speakers

* 1st Author: Young-Shin Lim(ly224@naver.com)

I . Introduction

Indistinct articulation places of vowels and supra-segmental features such as stress and tones are difficult for second language learners (L2 learners) to acquire. Particularly, many studies have been reported that Korean speakers have difficulty in distinctive acquisition of English tense and lax vowels due to the different vowel systems between Korean and English language; absence of the feature of [tense] in Korean (Bohn & Flege, 1990; Cho, 2003; Kim, 2010; Kim, 2015; Lee, 2017). In the other perspective, researchers attribute similar sounds to hinder Korean English learners' acquisition; English /i/ and /ɪ/ correspond to the category of Korean /i/ (Best, 1995; Flege, 1995; Sohn & Ahn, 2009). This argument has been widely studied based on the L2 assimilation model of the Speech Learning Model (SLM) by Flege (1987). According to the notion of the similarity of L2 phones, he claims that there is a discrepancy between phonological category and acoustic/phonetic category despite L2 phones' counterpart exist in L1 phonemic inventory.

This assumption has been evidenced by previous experimental studies; English vowels' phonetic differences are represented by the acoustic cues in terms of the quantity of vowels (vowel duration) and the quality of vowels (vowel formants; F1 and F2) (Jeong & Cho, 2016; Kim, 2006; Koo & Oh, 2001). Specifically, native speakers are reported to utilize various acoustic cues such as F1 for the tongue height and F2 for the frontness of the tongue that differentiate the space and the shape of the vocal tract to distinguish tense and lax vowels. However, the Korean vowel system only utilizes vowel duration to distinguish long and short Korean vowels. Based on this Korean vowel phonemic system, many previous studies have been reported that Korean speakers solely employ this vowel duration cue to distinguish English tense and lax vowels and ignore the other acoustic cues such as the formant structures (Moon, 1997). According to Koo and Oh's (2001) research, they find that Korean speakers use less articulation space by producing higher tongue height in mid and low vowels compared to those of native speakers. Furthermore, Cho's (2003) study demonstrates that Chungchung dialect speakers even do not show a distinct difference in vowel duration: some of

the results even show the reverse pattern of vowel duration, for instance, longer vowel duration in lax vowels instead of tense vowels. This experimental result shows that the contrastive vowel length does not necessarily function as a distinctive phonemic feature for Koreans when acquiring English vowels just as they neutralize vowel length in the Korean language (Kim & Han, 1998; Lee, 1971; Park, 1994). These inconsistent results show that Koreans would have difficulty in using both the vowel space and the vowel duration to distinguish English tense and lax vowels.

Given the dialectal differences of the vowel systems in L1, various studies report that acquiring L2 vowels is also differently affected. According to Koo and Oh's (2001) study, each dialect speaker produces English vowels in different patterns; Kyungsang dialect speakers show more difficulties in the back vowels while Cheolla dialect speakers do in the front vowels due to the different width of articulatory movements by each dialect. In the same light, Kim's (2013) recent study finds the regional difference in producing the English front vowels (/i, ɪ, ε, æ/) comparing to Kangwon dialect speakers. Specifically, the production of Kyungsang dialectal groups exhibit the most difficulties in discriminating English tense /i/ from the lax /ɪ/ vowels.

Based on this different acquisition of L2 vowels by regional dialects, generational differences in a regional dialect should also be considered. In Lee and Jongman's (2015) research, they find that dialectal acoustic distinctions of young Kyungsang dialect speakers have been reduced and gradually assimilated to the acoustic features of Seoul Korean.

A recent study concerning two different L1 dialect speakers in L2 acquisition reports that Kyungsang dialect speakers have difficulty in discriminating English front vowels /i-ɪ/ on the perception tests (Kim, 2006). Moreover, the most difficult phoneme pair to distinctively perceive is found to be the high back vowel pair of /u-ʊ/. Following this previous study on the perception experiments of different L1 dialectal speakers' L2 acquisition, this study will further investigate whether different regional phonemic systems influence production by young dialect speakers. Thus this study will conduct a production test to examine whether there are any distinctive acoustic differences between the two different young dialect groups concerning the following research questions:

First, how do young regional dialectal speakers (Kyunggi vs. North Kyungsang dialects) produce English tense and lax vowels?

Second, do they use different acoustic cues (i.e., vowel duration, F1, and F2) when they produce the pair of the tense and lax vowel?

Third, do this experimental result provide sufficient evidence of prerequisites for the production of English tense-lax vowels by regional dialects?

II. Methods

1. Participants

All of the participants are recruited at the age of 13 with a total of 20 elementary school students. Each regional dialect group consists of 10 Kyunggi dialect students from Icheon (East Southern area of Kyunggi-do)(KK) and 10 North Kyungsang dialect students from Sangju-Si (Western area of North Kyungsang province) (NKK) who are all female. In this production task, KK will be regarded as the Seoul standard Korean due to its adjacency to the Seoul region. All of the participants were born and have been educated in their dialect region. Their English proficiency are ranged from the low-intermediate to high-intermediate stage based on their performance test scores and teacher's cumulative records of their speaking performance¹⁾. None of them ever lived or stayed abroad for more than a month. The average time of exposure to spoken English is 29.3 minutes a day. None of either dialect group reported any hearing and speaking disorders.

All of the three native speakers are female native speakers who speak General American English. One of the native speakers is from the State of Illinois in 26 years old, but the rest of the native speakers voices are taken from the two top sites in South Korea²⁾.

1) Here I will define the stage of 'low-intermediate' of speaking proficiency as a learner can answer to the question in simple words; the stage of 'high-intermediate' as a learner can ask questions and answer in simple sentences with proper pronunciation.

2) The addresses of the websites are www.naver.com and www.daum.net.

2. Speech Materials

The speech materials consist of the target tense and lax vowels in high front/back vowels (i.e. /i, ɪ, u, ʊ/). For the selection of the speech materials, each syllable is controlled with CVC structure considering phonetic factors that might affect vowel durations. Specifically, I intentionally differentiate the following consonant with stop /t/ for phoneme pair of /i-ɪ/ while /d/ for /u-ʊ/ consist of stop /d/ due to its poor result in the previous perception tests by Korean dialect groups (Koo & Oh, 2001; Kim, 2006). The voiced stop /d/ was especially employed since it affects longer traces on the preceding vowel space and vowel length compare to the counterpart /t/ (Yang, 2009).

All of the speech materials for production test is taken from the elementary English textbooks that are familiar to the participants (See Table 1). Each participant is tested individually in a sound-treated booth with the researcher. The participants are asked to pronounce 4 words (for each pair with 2 tense/lax vowels) in a carrier sentence, "I say _____" twice apiece.

〈Table 1〉 Recording List with the target vowel

type	tense	lax
/i-ɪ/	seat	sit
/u-ʊ/	food	good ³⁾

3. Procedures

Since all of the 20 participants are the elementary school students who have not been trained for the correct pronunciation of the English tense and lax vowels, they repeat words twice after listening to the target words recorded by a female native speaker of American from the State of Illinois. Though this production test seems to be an imitation test, it can be regarded as reliable tests evidenced by the study of Kent (1979) with native English children and

3) Unlike phoneme pair of /i-ɪ/, proper minimal pair of /u-ʊ/ in Elementary vocabulary list was not available. So, considering the participants' age and familiarity of the test words, near-minimal pair with different onset was used in this experimental test.

adults and Lee (2011) with Korean English learners. By this procedure, the most similarly produced data are taken for the analysis except any abnormally recorded voice with extra noise or indistinct pronunciation.

All the productions of controlled participants of native speakers and the experimental participants of dialect speakers are recorded by Tascam recorder (DR-07MKII) at 44.1kHz and are saved as wave files for analysis in Praat program (version 6.0.40). They are recorded by the participants' normal speech speed. 24 data recorded (3speakers*4words*2 of repetition) by female native speakers are compared with 80 data recorded (10participants*4words*2) by Kyunggi dialect speakers and 80 data recorded (10participants*4words*2) by North Kyungsang dialect speakers. Thus, the total number of 184 data are acoustically analyzed to see the difference in voice duration and formants (F1 and F2) of vowels between dialectal groups of Korea. Each formant value is measured from the vowel steady state which is in the middle one-third portion of the total vowel duration.

For further investigation, the Euclidean distance measurement⁴⁾ is employed since the value of this method represents the acoustic distance between two contrastive vowels(i.e. the distance between /u/ and /ʊ/). This measurement is calculated based on the values of F1 and F2 which are closely relevant to the acoustic space of each vowel. Thus the calculated values could provide accurate information on how each dialect speaker distinctively pronounces contrastive vowels (Tsukada et al., 2005).

In order to examine whether there is any statistically significant difference between the means of the vowel distinction by dialectal groups, an independent t-test is carried out; the dependent variables are F1, F2, duration of vowels, the acoustic vowel distance of the lax and tense vowel pairs (i.e. /i vs. ɪ/, /u vs. ʊ/); the independent variables are established by "Kyunggi" and "North Kyungsang" speakers. For normalization, three native speakers' acoustic data are statistically analyzed with each group of dialect speakers respectively. Since the number of native group (3) is significantly lower than that of dialect groups (10), it is analyzed by Mann-Whitney u test of the non-parametric test.

4) The Euclidean distance formula is as following:
 $d(i, j) = \sqrt{(F2i-F2j)^2+(F1i-F1j)^2}$

III. Results

In this chapter, each acoustic feature of tense and lax vowels is summarized with the result of statistic analysis (t-test result from comparing dialectal groups and u-test from comparing each dialectal group with native speaker group respectively: native vs. KK and native vs. NKK).

1. Formants (F1 & F2)

In terms of the value of F1, which is relevant to the tongue height; higher value of F1 represents lower tongue height, shows no significant difference between two Korean dialect groups in any vowels (/i/: $p = .222$; /ɪ/: $p = .860$; /u/: $p = .450$; /ʊ/: $p = .096$). However, when comparing these values with the native speaker group, both dialectal groups report significant difference in tense vowels /i/ ($p = .043$) and /u/ (KK: $p = .011$; NKK: $p = .043$) (see table 2). In addition, as can be seen in table 2, the values of F1 of both Korean dialect groups show higher than those of native speakers in /i/ and /u/ phonemes which indicate that both Korean dialect speakers tend to further lower their jaw with the lower tongue height.

〈Table 2〉 Mean F1 values(Hz) of English tense and lax vowels across three groups

vowel	Native	KK (sd)	U-value	p-value	NKK (sd)	U-value	p-value
/i/	380.41 (21.43)	445.74 (46.28)	3.0	.043*	425.59 (19.88)	3.0	.043*
/ɪ/	569.70 (45.37)	520.04 (79.30)	9.0	.310	512.23 (112.99)	10.0	.398
/u/	378.20 (11.82)	486.60 (44.58)	.0	.011*	514.74 (113.50)	3.0	.043*
/ʊ/	514.95 (23.23)	465.53 (44.81)	5.0	.091	514.49 (75.47)	13.0	.735

* $p < .05$

On the contrary, for the value of F2, which stands for the tongue position; higher F2 values for more front position of the tongue and lower F2 for further

back position and rounder lips (protrudent lips), both dialect groups shows significant difference in lax vowel /ʊ/ comparing to the native speaker group (see table 3). Meanwhile, there is no big difference between Korean regional dialect groups in *t*-test (/i/: *p* = .129; /ɪ/: *p* = .813; /u/: *p* = .169; /ʊ/: *p* = .789).

〈Table 3〉 Mean F2 values(Hz) of English tense and lax vowels across three groups

vowel	Native	KK (sd)	<i>U</i> -value	<i>p</i> -value	NKK (sd)	<i>U</i> -value	<i>p</i> -value
/i/	2879.13 (139.00)	2730.29 (182.10)	7.0	.176	2605.11 (169.30)	4.0	.063
/ɪ/	2069.27 (212.91)	2275.16 (139.38)	8.0	.237	2255.03 (226.06)	8.0	.237
/u/	1301.35 (101.12)	1355.13 (243.26)	11.0	.499	1207.77 (171.97)	11.0	.499
/ʊ/	1707.03 (46.91)	1269.53 (172.55)	.0	.011*	1268.01 (145.16)	.0	.011*

**p* < .05

With regard to these results of vowel qualities (F1 and F2), both dialect groups show significant differences in /i/, /u/ and /ʊ/ compared to native speakers specifically in tongue position(F2) of /ʊ/ (*p* = .011) but no big difference is detected between regional dialects in any tense and lax vowels.

2. Vowel Duration

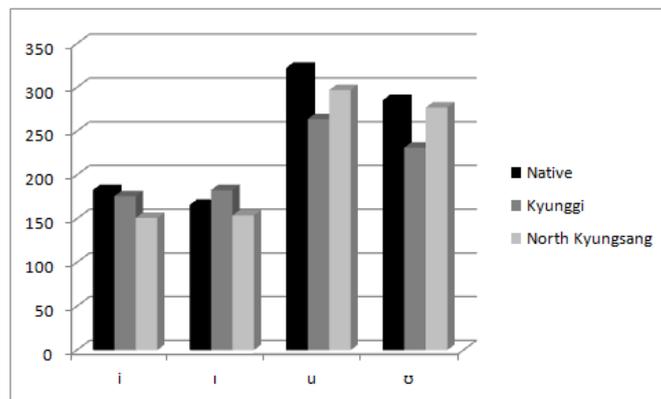
In terms of vowel duration, no significant differences are found in statistical analysis for each vowel by comparing native and dialect groups. However, it should be noticed that there are different patterns in /i/ - /ɪ/ for both dialectal groups compared to native speakers as shown in Figure 1. For instance, the mean vowel duration for /i/ (182.87 ms) produced by native speakers is longer than that of /ɪ/ (165.71 ms) while, those of KK and NKK are shown in vice versa [KK: /i/ (175.76 ms) < /ɪ/ (182.76 ms); NKK : /i/ (150.92 ms) < /ɪ/ (153.75 ms)] (see table 4). These findings suggest that young NKK, as well as young KK, might mismatch the different vowel lengths of this contrastive feature in their production of seat and sit.

Meanwhile, unlike the results of previous studies, vowel durations of /u/ - /ʊ/ by NKK is closer to those of native speakers than KK. This result might be attributed to their prosodic features that affect the discriminating length of vowels as Sohn (2015) remarks the relation of the tone and vowel duration in his production test of Daegu dialect speakers (a region of North Kyungsang province).

<Table 4> Mean vowel duration(ms) of English tense and lax vowels across three groups

vowel	Native	KK (sd)	<i>U</i> -value	<i>p</i> -value	NKK (sd)	<i>U</i> -value	<i>p</i> -value
/i/	182.87 (15.46)	175.76 (41.13)	11.0	.499	150.92 (39.56)	8.0	.237
/ɪ/	165.71 (28.02)	182.76 (43.03)	13.0	.735	153.75 (32.99)	11.0	.499
/u/	322.46 (58.70)	263.79 (78.13)	8.0	.237	296.98 (57.34)	13.0	.735
/ʊ/	285.51 (28.85)	231.29 (72.04)	7.0	.176	277.12 (83.83)	15.0	1.0

**p* < .05



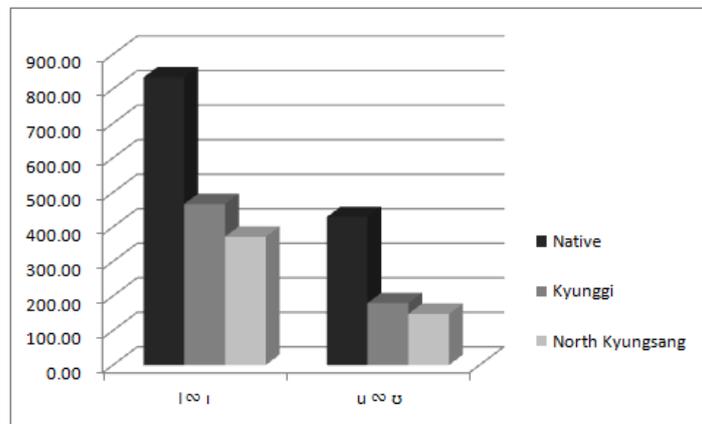
[Figure 1] Mean vowel duration of tense and lax vowels

3. Acoustic Vowel distance

With regard to the calculated vowel distance (Euclidean distance) between contrastive vowels (tense/lax; /i/ - /ɪ/), slight differences are shown between

the regional dialect groups (see figure 2). However, no significant differences between two dialect Korean groups are found in an independent t-test (/i/ ∼ /ɪ/ : $p = .349$; /u/ ∼ /ʊ/ : $p = .558$).

Whereas, it should be noted that only significant differences are revealed in the mean vowel distance of North Kyungsang dialect (/i/ ∼ /ɪ/, $p = .043$; /u/ ∼ /ʊ/, $p = .011$). This result can be detected in the comparative bar graphs demonstrate that NKK uses less vowel space than KK when distinguishing tense and lax vowels.



[Figure 2] Mean vowel distance of contrastive tense/lax vowel pairs by dialect speakers and native speakers

<Table 5> Mean vowel distance between contrastive vowels across three groups

vowel	Native	KK (sd)	U-value	p-value	NKK (sd)	U-value	p-value
/i/ ∼ /ɪ/	833.25 (328.46)	466.26 (203.50)	6.0	.128	371.47 (235.88)	3.0	.043*
/u/ ∼ /ʊ/	428.66 (86.11)	179.23 (139.09)	4.0	.063	147.89 (90.69)	.0	.011*

* $p < .05$

Through this analysis, it could be assumed that NKK shows more difficulty in discriminating vowel spaces when producing English tense and lax vowels than their counterpart KK, in particular for the back tense and lax vowels /u/ ∼ /ʊ/.

IV. General Discussion & Conclusion

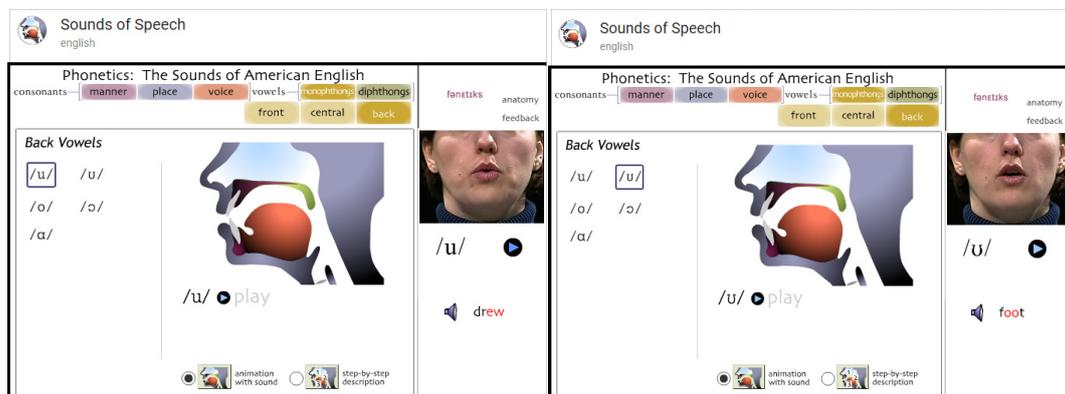
The present study is to investigate whether or not L1 regional dialect can affect young learners' acquisition of L2 sounds by analyzing the acoustic properties of high English tense and lax vowels pronounced by KK and NKK. In particular, the vowel distance is concerned to see if there is any difference in distinguishing contrastive vowels between those dialect groups. The overall findings from the statistical analysis show no differences between dialect speakers in vowel properties (F1, F2, and vowel durations) including vowel distances. Based on this result, it could be speculated that both dialect groups have similar patterns of producing English tense and lax vowels. However, results from the *t*-test comparing with native speakers suggest that both groups of Korean dialect show big differences in vowel formants for back vowels of /u/ and /ʊ/. For the tense vowel /u/, they tend to further lower their jaw which is also revealed in the front tense vowel /i/. On the contrary, for the lax vowel of /ʊ/, they produce this vowel in a more posterior position than native speakers. Concerning the vowel distance, it is only significantly different in the production by NKK for both vowel pairs compared to that of native speakers. These results indicate that NKK has more difficulty in differentiating vowel spaces than their counterpart KK which is consistent with previous studies (Koo & Oh, 2001; Kim, 2013).

In addition, distinguishing the vowel duration between contrastive vowels for both dialectal groups are poorly performed in high front vowels while fairly good in high back vowels. The result of the back vowels from this study shows differently from other previous studies which could be probably caused by the voiced stop /d/ following the target vowels with lengthened vowel duration. This inconsistent and unstable results in differentiating vowel duration might be caused by ongoing Korean vowel-length contrast merger in young NKK as well as young Seoul Korean speakers (Magen & Blumstein, 1993; Sohn 1999; Kang et al., 2015; Kim, 2018).

Despite differences in producing English tense and lax vowels compared to the native speakers, it can be assumed that undergoing sound changes under the influence of Seoul Korean also partly affects the sound acquisition by young NKK that is evidenced by no significant difference in between two dialect

groups. Besides, it could be also speculated that NKK uses acoustic cues similarly as KK but with a different or less accurate degree. The NKKs' rather poor production could be attributed to their poor perception of the target sounds (Kim, 2013). This assumption could be in the same vein as Flege's (1995) and Best's (1995) arguments that perceptual ability function as a prerequisite for production.

Concerning the results of the current study, both dialectal groups should be provided with explicit instructions that are articulatory-based training suggested by Catford and Pisoni (1970) such as teaching the correct acoustic information with providing adjustment of jaw movement (F1) and tongue position when teaching minimal pairs of vowels such as pool-pull or food-foot (see figure 3). In order to provide effective self-learning devices for this articulatory training, a phonetic software such as Sound Visualization Technique should be employed in pronunciation teaching (Pak & Min, 2008).



[Figure 3] Examples of visualized pronouncing practice
(excerpted from a website of Sounds of Speech in the University of Iowa)

Moreover, target-appropriate pronunciation could be improved by a substantial amount of various word structures (i.e., CV, CVC, VC, etc.) and various following codas (i.e., pull, pool, din, dean, etc.) presented in single words or minimal pairs for articulatory training as well as in sentential contexts. In addition, providing authentic L2 inputs with a wide range of pronunciation of native speakers are suggested by Logan et al. (1991) to improve L2 perceptual ability which also affects L2 learners' production. For instance, teachers provide

storybooks or rhymes that contain the target sounds and let students practice the sounds to fill the blanks with their recorded voices.

As a final remark, the limitation of the current study investigates only high tense and lax vowels with familiar words (seat-sit; food-good) for primary school students. Since one of them has different onset (food-good), the result of the acoustic features of the following vowels might be affected. Hence, in the future study, nonce words consist of the same adjacent phonemes in onsets and codas of the target vowels should be investigated. Furthermore, the perception and production performance by different L2 dialect learners with different English proficiency should be examined to get a comprehensive understanding of the regional dialect features on L2 acquisition.

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국문 초록

지역방언 어린이 화자들의 영어 긴장과 이완 모음 발화양상

임영신(한국폴리텍대학)

본 연구는 한국의 두 지역방언 화자들이 발화한 영어 긴장과 이완 모음의 음향적 속성에 차이점을 살펴보고자 하였다. 본 발화 실험에서는 4개의 음향적 변수를 (F1, F2, 모음 지속시간, 모음간의 거리) 사용하여 경기도와 경상북도 방언 화자들의 음향적 특징을 비교하였다. 발화 실험의 수집된 184개의 데이터는 고모음인 /i, ɪ, u:, ʊ/를 CVC의 형식으로 구성된 것으로 20명의 초등학생들의 (각 10명의 방언화자로 구성) 발화에서 취합하였다. 실험 결과 발화된 음향적 변수값에 대한 두 지역 방언 화자들 간의 유의한 차이점은 나타나지 않았는데 이것으로 두 그룹 간의 발화된 음향적 속성이 유사하게 나타난 것으로 볼 수 있다. 그러나 이러한 결과에도 불구하고 원어민 화자의 발화와 비교한 분석을 보면 경상북도 화자가 측정된 음향적 거리(유클리드 거리)를 통해서 상대적으로 좁은 모음 공간을 사용하는 것을 확인할 수 있다. 따라서 두 지역방언 화자들 간의 전반적인 음향적 속성에는 큰 차이가 나타나지 않았으나 원어민 화자와의 음성학적 비교를 통해서 경상북도 화자들에게 모음공간을 활용하여 소리를 구분하여 발화하는 것이 경기도 화자들보다 더 어려울 것이라고 볼 수 있다. 이러한 연구결과에 기반하여 효과적인 조음 훈련에 대한 교육적 제언이 제시되었다.

주제어: 영어 긴장 이완 모음, 음성 발화, 음향적 거리, 경상북도 방언화자, 경기도 방언화자

임영신

한국폴리텍대학 (안성) 교양영어 강사

(17550) 경기도 안성시 공도읍 송원길 41-12

Tel: (031) 650-7300

E-mail: ly224@naver.com

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