

Vowel production from Vietnamese learners of Korean: with reference to the elementary level*

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[한국어 초록]

베트남 여성 화자의 한국어 모음 산출: 한국어 초급 화자를 중심으로

본 연구는 한국어 초급 수준의 북부 베트남 여성 화자가 산출한 한국어 단모음의 특성에 대해 논의한다. 한국 여성 화자와는 다르게 모음 /e/ <에> 와 /ɛ/ <애>에 대한 포먼트 분석의 정량적 결과는 베트남 학습자의 모음 산출에서 F1 값 ($p < 0.05$)과 F2 값 ($p < 0.05$)이 통계적으로 유의한 차이가 있음을 보여준다. 한국어 모음 체계에서 음성학적으로 합류된 모음 /e/ <에> 와 /ɛ/ <애>를 한국인 모어 화자가 대립성 없이 산출하는 것과는 다르게 한국어를 목표어로 배우는 베트남인 초급 학습자는 두 모음 /e/ <에> 와 /ɛ/ <애>를 변별하여 산출하였다. 이것은 베트남어의 모음 체계 내에서 /e/ 와 /ɛ/를 변별하여 발화하는 베트남 화자의 모어의 영향이 목표어인 한국어의 산출에 영향을 주었음을 시사한다. 또한, 베트남인 여성 한국어 학습자의 후설원순모음 /u/ <우>와 /o/ <오>는 F1과 F2 값 모두에서 통계적으로 유의한 차이를 보였다 ($p < 0.05$). 따라서 베트남 여성 학습자의 한국어 모음 /u/ <우>와 /o/ <오>의 산출은 혀의 높이 (F1)와 혀의 위치 (F2) 모두에서 변별된다. 두 후설원순모음 /u/ <우>와 /o/ <오>는 한국 여성 화자의 경우 혀의 높이를 반영하는 F1 값의 차이가 통계적으로 유의하지 않으며 단지 혀의 위치 (F2) 차이로만 대조되었다. 따라서 베트남 여성 화자가 산출한 모든 한국어 단모음의 쌍은 통계적으로 모두 유의미한 대립을 하지만, 한국인 여성 화자는 /e/ <에>와 /ɛ/ <애>가 합류되어 7모음 체계를 이루며, 기존의 다수의 연구에서 보고되었듯이 /u/ <우>와 /o/ <오>의 산출에서 혀의 높이 차이가 더 이상 유지되지 못함을 알 수 있었다. 두 집단에서 산출한 한국어 모음 체계 내에서 각 모음 간의 유클리드 거리를 파악한 결과 베트남 여성 화자가 산출한 한국어 단모음 /u/ <우>와 /o/ <오> 사이의 유클리드 거리는 88.4로 한국 여성 화자가 산출한 /u/와 /o/의 유클리드 거리인 146.5 보다 더 짧았다. 따라서 베트남 여성 학습자가 산출한 한국어 모음 /u/와 /o/는 한국 화자보다 구강 내에서 매우 가까운 거리에서 산출되는 음성적 특징이 있으며 이

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런 까닭으로 베트남인 화자가 산출한 두 모음의 발음이 서로 혼동되거나 오류로 이어질 가능성이 있다.

주제어 : 음성학, 포먼트, 한국어 모음, 산출, 베트남인, 초급 학습자, 여성

1. Introduction

This paper discusses the acoustic and phonetic characteristics of Korean monophthong vowels produced by northern Vietnamese female learners of Korean at the elementary level, and we identify how they differ from those of Korean female speakers. Previous studies related to the production of Korean monophthong vowels by Vietnamese speakers were mainly discussed in a way in which the researcher verifies errors through the auditory judgment of native Korean speakers (Shin 2005, Kang 2009, Min 2010, Do 2015, Kim 2016, Yun 2018).

The characteristics of these studies are the overall discussion of Korean pronunciation, including the phonological contrast between Korean and Vietnamese. In part, studies on some Korean vowels have been conducted, but acoustic phonetic discussions have not been conducted on all Korean monophthong vowels.

Recently, acoustic phonetic studies related to monophthong Korean vowels produced by Vietnamese speakers include those of Park and Kim (2017), Jung and Lee (2017), Jang (2018), Kwon (2018), Ryu (2019), Park and Ryu (2019), Kim (2020) and Lee (2023). These studies mainly discussed the characteristics of Korean monophthong vowels produced by Vietnamese speakers from the perspective of Korean language acquisition.

Park and Kim (2017) examined an acoustic phonetic analysis of Vietnamese monophthong vowels produced by Vietnamese speakers and monophthong vowels produced by native Korean speakers. They discussed the similarity scale of the corresponding vowels in the two groups. Jung and Lee (2017) compared Korean short vowels produced by Vietnamese speakers at the elementary level with monophthong vowels

produced by native Korean speakers for acoustic phonetic analysis and statistical analysis of vowels produced by the two groups.

Kwon (2018) presented contrastiveness between Vietnamese monophthong vowels and Korean monophthong vowels produced by Vietnamese learners at the elementary level and Korean monophthong vowels of native Korean speakers. She presented a hierarchy of difficulty from the perspective of Korean language acquisition.

Jang (2018) analyzed the formants of Korean monophthong vowels and Vietnamese monophthong vowels produced by advanced Vietnamese speakers and compared them with Korean monophthong vowels of native Korean speakers to discuss acoustic phonetic differences.

Park and Ryu (2019) and Ryu (2019) discussed Vietnamese monophthong vowels of Vietnamese speakers who have no experience learning Korean, and Korean monophthong vowels of Korean speakers were analyzed through phonetic analysis and cognitive experiments to find Korean monophthong vowels with which Vietnamese speakers have cognitive difficulties.

Kim (2020) divided Vietnamese Korean language learners into elementary and advanced levels and discussed the acoustic phonetic characteristics of Korean monophthong vowels produced at different levels. Recently, Lee (2023) discussed the acoustic phonetic characteristics of Korean monophthong vowels produced by Vietnamese speakers at an advanced level.

Let us discuss Vietnamese vowels. Since Vietnam has a long topography from north to south, the pronunciation of vowels varies across the north, central, and south; therefore, the experiment was conducted based on northern dialect speakers. The monophthong vowels of Vietnamese are nine in the northern

Hanoi dialect, which is considered to be standard (Han 1966, Kirby 2011, Đào and Nguyễn 2018).

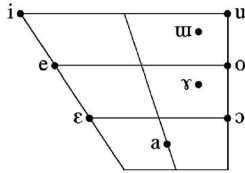


Figure 1. Vietnam monophthong vowels (Kirby 2011: 384)

Kirby (2011) presents a vowel diagram represented by F1 and F2 values through acoustic and phonetic analyses of Vietnamese monophthong vowels. Vietnamese vowels between /e/ and /ε/ are distinguishable, while Korean forms a seven-vowel system (/i, e, u, ʌ, a, u, o/) that is based on the current spoken language due to the merger of /e/ and /ε/ (Yoon and Kang 2014, Lee et al. 2016, Kang and Kong 2016). Moreover, vowels like /u/ and /ʌ/ were classified as middle vowels in Đào and Nguyễn (2018), but they are located more posteriorly than /a/ in Figure 1.

2. Methods

2.1 Participants

A total of 22 subjects participated in the experiment: 12 Vietnamese female learners of Korean (elementary level: less than 6 months of learning experience; average age: 21.4) from the northern part of Vietnam, including Hanoi. All of them attended a Korean language school at universities in Seoul. Ten Korean female speakers (average age: 21.1) who indicated their

birthplaces and residences were in Seoul and Gyeonggi. All of them are students attending universities in Seoul. A predetermined honorarium was paid to all subjects.

2.2 Procedure

The words used in the experiment were 24 nonce words in Korean with two syllables composed of eight monophthong vowels. Due to the merger of /e/ <ㅓ> and /ɛ/ <ㅕ>, the monophthong vowels of Seoul Korean form a seven-vowel system based on the production level (Yoon and Kang 2014, Lee et al. 2016, Kang and Kong 2016, and many others). However, we included nonce words with eight vowels to examine how Vietnamese speakers pronounce the Korean vowels /e/ and /ɛ/ and how it differs from that of Korean native speakers. The nonce words in Table 1 are in the form of “V1+CV2” so that eight monophthong vowels (V1) are the word-initial position, while the following consonants are the Korean plosives /p, t, k/.

Table 1. Nonce words.

	<u>ka</u>	<u>ta</u>	<u>pa</u>
i	ika	ita	ipa
e	eka	eta	epa
ɛ	ɛka	ɛta	ɛpa
u	uka	uta	upa
ʌ	ʌka	ʌta	ʌpa
a	aka	ata	apa
u	uka	uta	upa
o	oka	ota	opa

The experiment was conducted in a manner that the subjects repeatedly read the 24 nonce words presented in Table 1 three

times, and the words were read with the carrier sentence 'This is ____'. In this way, 72 pieces of data were collected per subject, and the total number of data obtained through each group of Korean (10 people \times 24 words \times 3 repetitions) and Vietnamese (12 people \times 24 words \times 3 repetitions) was 1,584. The recording was performed using an LG Gram laptop, which is included in the public software Praat version 6.2.23. A SONY ECM-LV1 pin microphone was attached to the upper body of the subject and connected to the laptop. The recording took place in a quiet space on campus without noise.

For the data analysis, using Praat version 6.2.23, we checked the spectrogram of all vowels and set the section with the least variation in formant as the stable section. Since all the subjects were women, the maximum formant value was set to 5,500 Hz, the number of formants was set to five, and the window was set to 25 ms. The measurement of the formant value was calculated by finding the midpoints of the stable section found in the collection. All the formant values were summarized using Excel, and statistical analysis was performed using IBM's statistical analysis program SPSS 26 to judge the statistical significance.

3. Results

3.1 Production

To discuss the acoustic phonetic characteristics of Korean monophthong vowels produced by Korean and Vietnamese female speakers, the statistical results of F1 and F2 of vowels measured for each group were obtained through repeated measures ANOVA (Hence, RM ANOVA), and the variable

between each subject was set as 8 groups.

For statistically significant variables among eight groups, a post-hoc test was conducted for precise judgment. To adjust for the increase in error due to multiple comparisons during the post-hoc test, the statistical significance of each vowel within the Korean monophthong vowel system realized by each group was determined through Bonferroni correction. Let us discuss the acoustic and phonetic characteristics of Korean monophthong vowels produced by Korean female speakers, and we present the formant values in Table 2.¹⁾

Table 2. Korean female speakers' F1 and F2 values (Hz)

Vowel (F1)	Estimated mean	Standard errors	95% Confidence interval	
			Minimum	Maximum
i	433.5	7.1	419.5	447.5
e	611.1	4.0	603.3	619.0
ɛ	618.8	4.1	610.6	627.0
u	449.2	5.5	438.3	460.1
ʌ	603.1	5.8	591.5	614.7
a	931.0	6.8	917.6	944.4
u	420.0	4.8	410.5	429.5
o	418.0	4.7	408.6	427.4
Vowel (F2)	Estimated mean	Standard errors	95 % confidence interval	
			Minimum	Maximum
i	2759.7	61.9	2636.8	2882.6
e	2210.9	44.0	2123.7	2298.2
ɛ	2229.6	43.1	2144.0	2315.2
u	1565.5	29.7	1506.5	1624.4
ʌ	932.3	11.1	910.3	954.3

1) The formant data of Korean female speakers used here is also used as the same control group in Lee (2023). In this paper, we are using Korean vowel formants for the purpose of comparison with Vietnamese learners of Korean at the “elementary level,” while Lee (2023) was focusing on a comparison group with Vietnamese speakers at the “academic (advanced) level.”

a	1424.0	14.6	1395.0	1453.0
u	854.2	15.7	822.9	885.4
o	715.2	11.8	691.8	738.6

Sphericity, by Mauchly's test, was verified to test the within-subject effect on the F1 values of the eight groups (= /i, e, ε, ʉ, ʌ, a, u, o/). Since the sphericity of the F1 values of the eight groups was rejected ($p < 0.05$), there is a significant difference between the F1 values produced from the eight groups. Based on this, a post-hoc analysis was conducted through Bonferroni correction to determine the effect on each individual.

As a result, the vowel /i/ is for /ʉ/; /u/, /o/ and /e/ are for /ε/; /ʌ/ is for /e/ and /ε/; /u/ is for /o/, there was no statistically significant difference for each ($p > 0.05$). Therefore, it can be seen that these pairs have no statistically significant difference with respect to the F1 value related to tongue height. Especially, as shown in Table 2, as a result of vowel merger, there is no significant difference between /e/ and /ε/ in F1 ($p > 0.05$). Furthermore, the quantitative analysis also reveals that the position of the tongue is no more contrastive between /u/ and /o/ in Korean ($p > 0.05$).

For F2 values, sphericity was also tested in the same way to determine whether the F2 values were homogeneous. Through Mauchly's test, sphericity was rejected for the F2 values of the eight groups ($p < 0.05$), and then a post-hoc analysis was conducted through Bonferroni correction to determine the effect on each individual. As a result, the vowel /e/ did not show a significant difference in mean for the F2 estimate for /ε/ ($p > 0.05$), but all monophthong vowels except this pair had a significant difference ($p < 0.05$) from all their corresponding

monophthong vowels.

Thus, it can be seen that only a pair of /e/ and /ɛ/ form a homogeneous subset of the mean difference for the F2 estimated mean value. Based on the estimated mean in Table 2, we present the Korean female speakers' vowel production in Figure 2. As discussed in Yoon and Kang (2014), Lee et al. (2016), Kang and Kong (2016), and many others, the vowel diagram in Figure 2 shows that the phonetic contrast only exists as 7 vowel category by the Korean production of Korean female speakers.

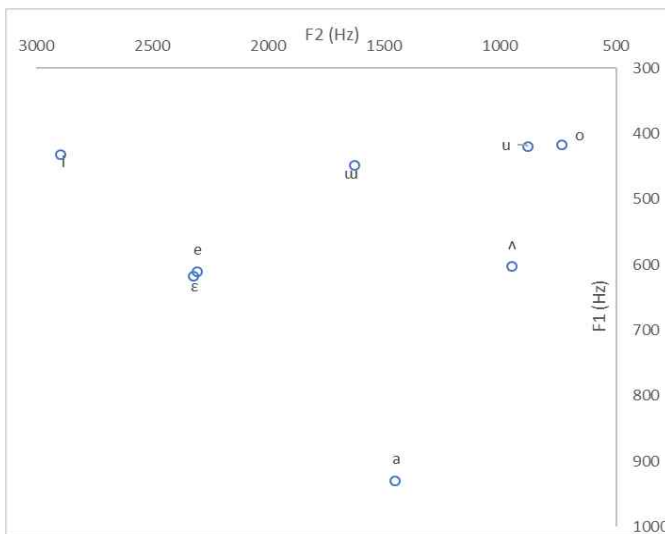


Figure 2. Korean female speakers' Korean vowel production (Hz)

However, unlike in Korean, the Vietnamese vowel system distinguishes front vowels between /e/ and /ɛ/, as shown in Figure 1. In Figure 2, considering the vowel merger between /e/ and /ɛ/ in Korean, it is not clear whether Vietnamese female speakers pronounce these two Korean vowels differently as they do in Vietnamese or simply merge them in the same way as

Korean speakers.

Thus, we investigated the acoustic and phonetic characteristics of Korean monophthong vowels produced by Vietnamese female learners of Korean at the elementary level. Let us consider quantitative formant data from Vietnamese female learners of Korean in Table 3. As a result of the RM ANOVA, for F1 and F2 values by Vietnamese vowel production, the sphericity test to determine the homogeneity of the F1 and F2 values of the 8 groups was rejected ($p < 0.05$), so a post-hoc analysis was performed with Bonferroni correction to determine the effect within each subject.

Table 3. Vietnam female speakers (elementary level) F1/ F2 values (Hz)

Vowel (F1)	Estimated mean	Standard errors	95 % confidence interval	
			Minimal	Maximum
i	425.6	5.8	414.0	437.1
e	524.4	7.9	508.7	540.0
ɛ	573.8	9.1	555.8	591.8
u	446.5	6.2	434.3	458.7
ʌ	708.7	11.6	685.7	731.7
a	912.7	9.5	893.9	931.5
u	404.5	5.8	393.0	416.0
o	480.4	8.5	463.6	497.2
Vowel (F2)	Estimated mean	Standard errors	95 % confidence interval	
			Minimal	Maximum
i	2875.0	14.5	2846.1	2903.8
e	2569.7	18.6	2532.7	2606.6
ɛ	2618.3	18.4	2581.8	2654.8
u	1565.6	15.6	1534.6	1596.6
ʌ	1179.0	9.501	1160.2	1197.9
a	1665.3	12.0	1641.4	1689.1
u	814.1	9.7	794.9	833.3
o	859.5	8.4	842.8	876.2

As a result of multiple comparisons to determine the effect within each subject, the average difference in monophthong vowels uttered by Vietnamese female speakers showed statistically significant differences for all corresponding monophthong vowels ($p < 0.05$). Unlike Korean female speakers' vowel production, the results of the quantitative analysis of the F1 and F2 values in Table 3 show that all eight vowels are categorically significant in F1 and F2 values ($p < 0.05$). This means that Vietnamese female speakers maintained differences in formant values related to tongue height (F1) and tongue position (F2) for all vowels. Based on the estimated mean in Table 3, we present a diagram of Korean vowel production of Vietnamese female learners.

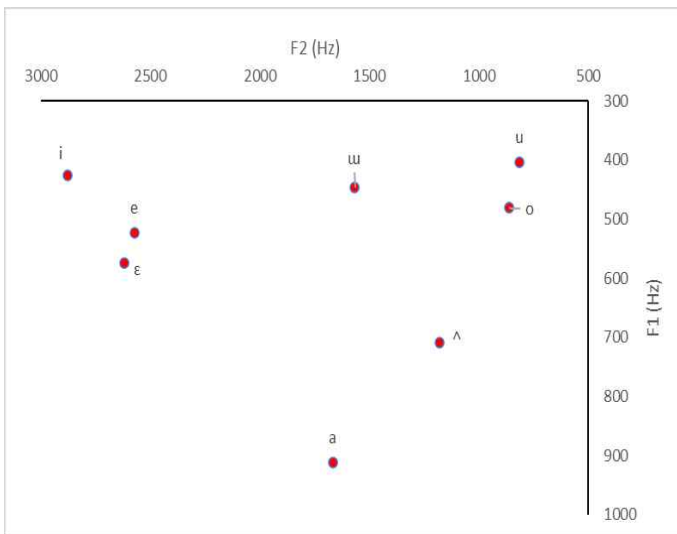


Figure 3. Korean vowel production of Vietnamese female learners (elementary level) (Hz)

In Figure 3, the distance between each vowel is statistically contrastive among Vietnamese female speakers ($p < 0.05$). Specifically, Korean vowel production of Vietnamese female speakers shows the phonetic contrast between /e/ and /ɛ/. Moreover, they maintain the difference of height of the tongue (F1) between /u/ and /o/ while Korean speakers only maintain the position of the tongue (F2). As can be seen in the Vietnamese vowel diagram by Kirby (2011), /u/ and /o/, which correspond in the Vietnamese vowel system, maintain the difference in tongue height better than in Korean. It can be seen that this has had a direct impact on the production of the Korean back vowels /u/ and /o/ by Vietnamese speakers.

Therefore, we argue that the native (Vietnamese, L1) phonological category, as shown in Figure 1, is reflected in the production of the target language (Korean, L2) in the early stage of L2 acquisition.

3.2 Euclidean distance

In the Korean vowel diagram (Figure 2, Korean speaker's production, and Figure 3, Vietnamese speaker's production), we shall measure the physical distance among all pairs of Korean vowels, since the pairs of /e : ɛ/ and /u : o/ are relatively close in multiple comparisons in both groups. Based on the formant analysis of the F1 and F2 values, the distance between the two points corresponding to each vowel was obtained by applying the formula to determine mathematically the distance between the vowels.²⁾ By applying the Euclidean distance formula, the

2) Euclidean distance is a technique for calculating the distance between two points, and when two points have coordinates of (P1, P2, P3...Pn) and (Q1, Q2, Q3...Qn), the distance between two points is expressed by the

Euclidean distance between two vowels is shown in Table 4.

Table 4. Korean female (KF) vs. Vietnamese female (VF, elementary level):
Euclidean distance (ED) for Korean monophthong vowels

KF	ΔF1	ΔF2	ED	VF	ΔF1	ΔF2	ED
i-e	170.5	589.7	613.9	i-e	98.4	305.0	320.5
e-ε	7.7	18.2	19.8	e-ε	49.8	48.3	69.4
ε-a	338.9	872.1	926.0	ε-a	338.9	953.0	1011.5
i-ɯ	15.7	1267.7	1267.8	i-ɯ	20.9	1309.4	1309.6
ɯ-u	29.2	746.7	747.3	ɯ-u	42.0	751.5	752.7
ɯ-o	31.2	893.2	893.7	ɯ-o	33.9	706.1	999.2
ɯ-ʌ	153.9	676.4	693.7	ɯ-ʌ	262.2	386.6	467.1
ɯ-a	175.9	481.8	512.9	ɯ-a	466.2	99.7	457.2
u-o	2.0	146.5	146.5	u-o	75.9	45.4	88.4
o-ʌ	185.1	216.8	285.1	o-ʌ	228.3	319.5	392.7
ʌ-a	327.9	500.5	598.3	ʌ-a	204.0	486.3	527.4

In Korean speaker's production, the Euclidean distance between the vowels /e/ and /ε/ was shorter (/e : ε/; 19.8) than Vietnamese speaker's production (/e : ε/; 69.4). The difference in tongue height (F1) between these vowels was not significant for Korean female speakers ($p > 0.05$), while these two vowel categories were statistically contrastive in Vietnamese learners' production ($p < 0.05$).

For the case of the rounded back vowel /u/ and /o/, Korean production of these vowels' distance is short in F1 (/u : o/; 2.0) but the distance was maintained in F2 (/u : o/; 146.5). Thus, the Euclidean distance between /u/ and /o/ is calculated as 146.5 by Korean speakers. However, the Euclidean distance between /u/

Euclidean distance formula as follows.

$$d(p, q) = \sqrt{(q_1 - p_1)^2 + (q_2 - p_2)^2}$$

and /o/ in Vietnamese speakers' production was 88.4, which is shorter than the Korean speaker's Euclidean distance between /u/ and /o/.

Hence, the Euclidean distance between the two merged /e/ and /ɛ/, which had no statistically significant difference, was the shortest in Korean speaker's vowel production. It was also confirmed that the distance between /u/ and /o/ is close among all vowel pairs, corresponding to their physical distance.

However, for the Korean vowels /u/ and /o/ produced by Vietnamese female speakers, the formant values related to tongue height (F1) and tongue position (F2) are statistically significant, but the Euclidean distance between /u/ and /o/ is only 88.4, which is the second shortest one within the realized Korean vowel system. Thus, it can be seen that the production of Vietnamese realization of the two vowels /u/ and /o/ are physically closest among Korean vowels.³⁾ Let us consider the following diagram, which presents Korean vowel production from both groups.

3) The information available through the value of the Euclidean distance only presents the physical distance between each other through multiple comparisons within the vowel system. In addition, it is not possible to directly judge the similarity of pronunciation or the ease and difficulty of perception through the distance and proximity of Euclidean distance.

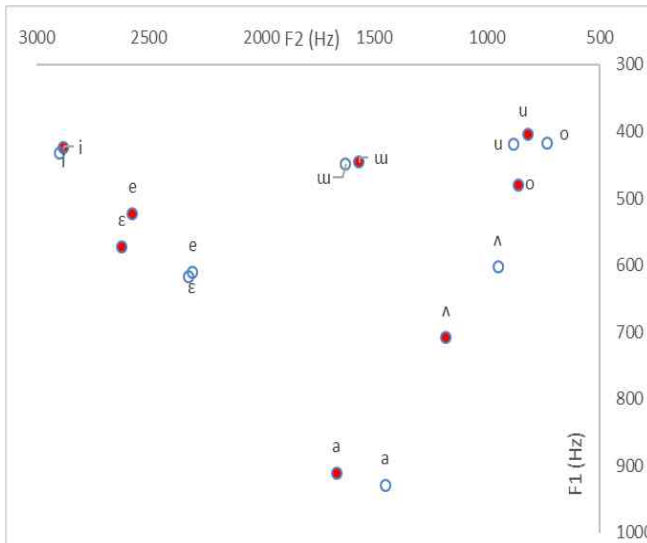


Figure 4. Korean monophthong vowels produced by KF (white dot) and VF (elementary level)

In Figure 4, the distance between the vowels produced in the two groups is visually presented. However, we have not discussed vowels' similarity or dissimilarity in either groups. Thus, for the following section, the Korean monophthong vowels produced by Korean and Vietnamese female speakers are compared independently.

To examine the similarity or dissimilarity among this pair of vowels, we shall conduct a paired T-test for both groups and discuss the differences between the vowels produced by the two groups.

3.3 Discussion

We compare the acoustic phonetic information of each vowel

produced by Vietnamese and Korean female speakers to identify the acoustic phonetic differences of monophthong vowels produced by both groups. To this end, a paired T-test was conducted on the F1 and F2 values of all vowels produced in the two groups. Let us first consider the statistical results of the F1 difference.

Table 5. Paired T-test of F1 values produced by Korean and Vietnamese (elementary level) female speakers

paired F1 difference						t	degrees of freedom	significance probability (Two-tailed)
95 % confidence interval of the difference								
Pair K: V	mean	standardization deviation	Standard error mean	minimum	maximum			
i	-5.733	87.865	9.262	-24.136	12.670	-0.619	89	0.537
e	-88.422	94.749	9.987	-108.267	-68.577	-8.853	89	0.000
ɛ	-45.967	119.256	12.571	-70.944	-20.989	-3.657	89	0.000
ʊ	-0.811	97.088	10.234	-21.146	19.524	-0.079	89	0.937
ʌ	101.044	138.529	14.602	72.030	130.059	6.920	89	0.000
a	-30.489	124.244	13.097	-56.511	-4.466	-2.328	89	0.022
u	-6.222	80.730	8.510	-23.131	10.686	-0.731	89	0.467
o	71.422	111.605	11.764	48.047	94.797	6.071	89	0.000

Table 5 presents the results of the paired T-test of each vowel from the two groups. The F1 values were significantly different in all paired vowels except for the case of /i/, /ʊ/, and /u/ ($p > 0.05$). This results show that only the paired vowel /i/, /ʊ/ and /u/ were similar in tongue height (F1) from both groups, but other pairs of vowels are statistically different ($p < 0.05$). Let us move on to discuss the difference in each vowel for the F2 values of the two groups in Table 6.

Table 6. Paired T-test of F2 values produced by Korean and Vietnamese (elementary level) female speakers.

paired F2 difference						t	degrees of freedom	significance probability (Two-tailed)
95 % confidence interval of the difference								
Pair K: V	mean	standardization deviation	Standard error mean	minimum	maximum			
i	18.156	195.341	20.591	-22.758	59.069	0.882	89	0.380
e	-261.811	282.878	29.818	-321.059	-202.563	-8.780	89	0.000
ɛ	-293.278	252.090	26.573	-346.077	-240.479	-11.037	89	0.000
u	53.344	233.618	24.626	4.414	102.275	2.166	89	0.033
ʌ	-238.678	140.107	14.769	-268.023	-209.333	-16.161	89	0.000
a	-216.267	146.315	15.423	-246.912	-185.622	-14.022	89	0.000
u	62.800	170.218	17.943	27.149	98.451	3.500	89	0.001
o	-138.100	136.797	14.420	-166.752	-109.448	-9.577	89	0.000

In Table 6, the difference in correspondence to the position of the tongue (F2) was significant in all vowels ($p < 0.05$), but there was no significant difference in the position of the tongue in the case of vowel /i/ ($p > 0.05$). Thus, there is an acoustic similarity for the production of vowel /i/ from both groups since this vowel's F1 and F2 values are not statistically significant with each other. However, all other paired vowels in the F2 values are significantly different.

4. Conclusion

This study discusses the characteristics of Korean monophthong vowels produced by female speakers in northern Vietnam at the elementary level. Unlike Korean female speakers, the quantitative results of the formant analysis for vowels /e/ <에> and /ɛ/ <애> show that there is a statistically significant difference between the F1 value ($p < 0.05$) and the F2 value ($p <$

0.05) in the production of Vietnamese learners of Korean. Unlike the phonetically merged vowels /e/ <에> and /ɛ/ <애> produced by Korean female native speakers, Vietnamese elementary learners who study Korean as target the language distinguished the two vowels /e/ <에> and /ɛ/ <애>. This suggests that the influences of the Vietnamese female speaker's mother tongue, which distinguishes /e/ and /ɛ/ within the Vietnamese vowel system, influenced the production of the target Korean vowels.

In addition, the rounded vowel /u/ <우> and /o/ <오> from Vietnamese female learners of Korean showed statistically significant differences in both F1 and F2 values ($p < 0.05$) compared with Korean female speakers. In other words, the production of the Korean vowels /u/ <우> and /o/ <오> by Vietnamese female learners is distinguished in both the height of the tongue (F1) and the position of the tongue (F2). However, among Korean female speakers, the difference between the vowels /u/ <우> and /o/ <오> in F1 values reflecting the height of the tongue was not statistically significant, and the only difference exists in the positioning of the tongue (F2).

Furthermore, as a result of the statistical analysis, RM ANOVA, all pairs of Korean monophthong vowels produced by Vietnamese female speakers have a statistically significant opposition, but Korean female speakers merge /e/ <에> and /ɛ/ <애> to form a seven vowel system. Moreover, the Euclidean distance between /u/ <우> and /o/ <오> by Vietnamese female speakers was 88.4, which was shorter than the Euclidean distance between /u/ <우> and /o/ <오> by Korean female speakers, which resulted in 146.5.

Therefore, the Korean vowels /u/ and /o/ produced by Vietnamese female learners may have an error pattern since these two vowels are closer in distance within the oral cavity

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than Korean speakers. For this reason, the pronunciation of these two vowels produced by Vietnamese speakers may lead to pronunciation errors.

[Abstract]

Vowel production from Vietnamese learners of Korean: with reference to the elementary level

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This paper discusses the phonetic characteristics of Korean monophthong vowels produced by Vietnamese female speakers at the elementary level. Unlike Korean female speakers, the quantitative results for /e/ and /ɛ/ show that there was a statistically significant difference in F1 values ($p < 0.05$) as well as F2 values ($p < 0.05$) in the production of vowels by Vietnamese learners of Korean. Therefore, the difference in height between the two vowels was contrastive by Vietnamese learners of Korean differently from native Korean female speakers. On the other hand, the back vowels /u/ and /o/ produced by female Vietnamese learners of Korean had a statistically significant difference in both F1 and F2 values ($p < 0.05$). Therefore, female Vietnamese learners' pronunciation was contrastive by the difference in tongue height (F1) as well as the position of the tongue (F2) in the production of Korean rounded back vowels /u/ and /o/, whereas these two vowels were contrastive only by the difference in tongue position (F2) in native Korean female speakers. Therefore, all pairs of monophthong vowels produced by Vietnamese female speakers formed in opposition to each other, while Korean native speakers

formed a seven-vowel system due to the merger of /e/ and /ɛ/. Moreover, Vietnamese female speaker's Euclidean distance between /u/ and /o/ was shorter (88.4) than Korean female speaker's (146.5). Thus, it can be also argued that the pronunciation of the Korean vowels /u/ and /o/ produced by Vietnamese female learners of Korean are considerably different to the production of Korean rounded back vowels.

Key words : phonetics, formants, Korean vowels, learner, Vietnamese, female, beginner

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