



The Journal of Asia TEFL

<http://journal.asiatefl.org/>

e-ISSN 2466-1511 © 2004 AsiaTEFL.org. All rights reserved.



Korean Learners' Production of English Sound Contrast: Focusing on Word-Final /ʃ/ and /ʃi/*

Jayeon Lim**

University of Seoul, Korea

Misun Seo

Hannam University, Korea

This study examines Korean L2 learners' production of English sound contrast not attested in their L1, focusing on word-final /ʃ/ and /ʃi/. L2 pronunciation error patterns such as vowel deletion and epenthesis were more frequently found in the low group than in the high group. Acoustic properties of lexical and epenthetic vowels were also different according to learners' proficiency levels. The low group's epenthetic and lexical vowels showed similar acoustic properties with respect to friction and vowel ratio and F1 and F2 midpoint values. On the other hand, the high group's epenthetic vowels exhibited longer friction ratio, shorter vowel ratio, higher F1 and lower F2 than lexical vowels. While the low group did not distinguish epenthetic vowels from lexical vowels, the high group pronounced epenthetic vowels differently from lexical vowels, possibly as transitional vowels. As for word-final [ʃ] from /ʃ/ or /ʃi/, both groups showed longer friction ratio for [ʃ] from /ʃi/ than for [ʃ] from /ʃ/. The findings suggest the use of production strategies by L2 learners is different from native speakers and is mediated by their proficiency levels.

Keywords: L2 pronunciation, vowel epenthesis, vowel deletion, English proficiency

Introduction

Acquisition of L2 sound contrasts has received not only theoretical but also pedagogical attention due to the learning difficulties of L2 learners (Flege, 1999). For instance, English speakers are known to show difficulties in differentiating Hindi retroflexes and dental stops (Pruitt, Jenkins, & Strange, 2006) and

* This work has been supported by the 2015 Hannam University Research Fund.

** First author: Jayeon Lim, Correspondent author: Misun Seo

Japanese and Korean speakers in differentiating English liquids (Hattori & Iverson, 2009; Iverson, Hazan, & Bannister, 2005, among others). By examining the source and locus of difficulties in language development, previous studies have come up with some partial answers to how L2 learners acquire their phonological system. Often, learners' L1, language aptitude, age of onset, as well as phonological features of L2 such as voicing and place and manner of articulation were found to influence their acquisition (Seo & Lim, 2008). Pedagogically speaking, understanding how L2 speakers process their phonetic features can help their teachers better understand the general learning process and be better prepared to teach L2 pronunciation.

In L2 pronunciation, there are often an extensive number of different variables involved. Ultimate attainment of L2 learners is one of the most controversial of these variables. Previous studies have made different claims regarding this matter: For instance, some have argued that adult L2 learners would have reached a plateau-stage after the first few years of exposure to the target language when it comes to their pronunciation (Larson-Hall, 2006). The claim is in line with 'fossilization' or 'stabilization' (Han & Odlin, 2006; Selinker & Han, 2001), or the critical period hypothesis in L2 pronunciation (Scovel, 1988). For those who fail to reach native-like pronunciation, the age of onset (i.e., age of arrival to the L2 speaking environment) was found to be the most prominent factor in the acquisition of L2 pronunciation. Thus, the age of onset is robustly linked to the limit in ultimate attainment for adult L2 speakers in EFL environments (Flege, 1995; Long, 1990).

Some studies, however, have argued that adult L2 learners, even after their early exposure, still retain their ability to learn new sounds. The quality and quantity of L2 input are thought to determine the continuous learning (Flege, 1999; Flege, Takagi, & Mann, 1995). Continuous learning seems to be possible with a large amount of L2 input (Bongaerts, van Summeren, Planken, & Schils, 1997), in a learning context that promotes input enhancement through instruction (Ioup, 1994), with the presence of explicit knowledge of the L2 phonetic system (Kashiwagi, Snyder, & Craig, 2005). It can also be dependent on whether learners retain their L1 ability (Flege, 1995). In the field of L2 pedagogy, different teaching methods have made different claims about whether the development of L2 pronunciation in classroom settings is possible (Rajadurai, 2007). Thus, certain learner characteristics or environmental factors seem to influence accuracy in L2 pronunciation.

At this point, it still remains to be seen whether the proficiency level of learners, along with other variables such as cognitive abilities or the amount of input, can be significantly correlated to L2 pronunciation. Understanding L2 speech production of learners at different proficiency levels will provide a better picture for both language teachers and researchers in looking at the learning process. Additionally, only a few previous studies have focused on how L2 phonological development occurs in actual instructed settings, resulting in a lack of research-based practice in L2 classrooms (Saito, 2011). Since most of the current instructed L2 studies have investigated L2 morphosyntactic development, further study exclusively on L2 phonological development in instructed settings will be a useful contribution to the development of research-based L2 classroom pedagogy.

The present study aims to examine the production of English words with word-final /f/ or /fi/ by Korean learners at two different proficiency levels in English. In Korean, fricatives (and affricates) are not allowed in word-final (syllable-final) position and realized as the unreleased alveolar stop [t̚], as in /nas/ → [nat̚] 'sickle'. In addition, the palato-alveolar fricative /ʃ/ does not belong to the Korean phoneme inventory and the alveo-palatal fricative [ç], not [ʃ], occurs as an allophone of /s/ before /i/ or /j/, as in /sin/ → [çin] 'shoes' (Lee, 1996; Shin, 2003). Based on such Korean phonology, it can be predicted that Korean learners of English will have difficulty in discriminating English /f/ vs. /fi/ in word-final position.¹

¹ According to Korean phonology, Korean learners of English are also expected to have difficulty in the discrimination of word-final English /tʃ/ vs. /tʃi/ and /dʒ/ vs. /dʒi/. Since these contrasts include affricates whose acoustic properties are different from those of the fricative /ʃ/, we leave this issue for future research.

One goal of the present study is to investigate Korean L2 learners' production of the contrast /ʃ/ vs. /ʃi/ in word-final position. First of all, production patterns of word-final /ʃ/ vs. /ʃi/ by Korean learners at two different English proficiency levels will be examined, focusing on L2 pronunciation error patterns used by Korean learners of English on the segment level. Then, acoustic properties of lexical vs. epenthetic vowels will be investigated to see whether Korean learners at two different English proficiency levels show the same or different acoustic properties with respect to lexical and epenthetic vowels.

As for the phonetic properties of lexical vs. epenthetic vowels, Gouskova and Hall (2009), Susman (1943) and Miner (1979) argued that epenthetic vowels are shorter in duration than lexical vowels in Lebanese Arabic and Winnebago. Davidson (2006) also found that inserted schwas are acoustically different from lexical schwas by having shorter duration and lower F1 and F2 midpoint values through an experiment with native speakers of English pronouncing pseudo-Czech word-initial clusters. In addition, Davidson and Stone (2003) showed through an ultrasound study that lexical and epenthetic schwas in English were pronounced in different tongue positions with the latter produced as a transitional sound. On the other hand, Michelson (1989) claims that epenthetic vowels are acoustically identical to lexical vowels based on Mohawk data. According to Kim and Kochetov (2011), acoustic properties of epenthetic vowels in Korean loanwords from English were similar to those of Korean native vowels with respect to duration and vowel quality measured as F1 and F2.

In the present study, the acoustic properties of an epenthetic vowel observed in Korean learners' mispronunciation of English words will be compared to those of a lexical vowel found in Korean learners' correct pronunciation of English words. By doing this, it will be examined whether English learners at two different English proficiency levels exhibit the same or different properties with respect to the two types of vowels. In addition, acoustic properties of [ʃ] produced by Korean learners at two different English proficiency levels from the two different target forms /ʃ/ and /ʃi/ will be examined.

Additionally, word frequency may possibly be a factor influencing L2 pronunciation. With respect to frequency, many studies have measured its effect across different linguistic domains (Bybee, 2002; Vais, Lewandowski, & Walsh, 2015). Specifically in speech production, an increased amount of input and practice by L2 speakers may possibly lead to decreased variability (Bybee, 2006) and hence increase accuracy. Despite an ample number of recent studies investigating the role of frequency in the acquisition of grammar and vocabulary (Bybee, 2006; Nation, 2001), only a few have examined the interaction effect of frequency and proficiency of L2 learners in L2 speech. What has been found so far is that the effects of frequency may not be identical across all speakers (Cardoso & Liakin, 2009; Vais et al., 2015). The present study is interested in examining whether frequency of the target words interacts with proficiency in influencing the accuracy of L2 speech production.

Based on the above, the present study intends to examine whether higher-level L2 learners will show quantitative and qualitative differences from lower-level L2 learners. Additionally, L2 learners' data will be compared to data from native speakers'. Finally, correlations between word frequency of target words and accuracy in production will be examined. The present study focuses on the following research questions. In answering these questions, the study will investigate whether L2 proficiency levels will influence the production.

- (1) What are the production patterns of Korean L2 learners' English sound contrast (i.e., word-final /ʃ/ vs. /ʃi/)?
- (2) Do Korean L2 learners attest differences regarding the acoustic properties of lexical vs. epenthetic vowels?
- (3) Do Korean L2 learners attest differences regarding the acoustic properties of word-final [ʃ] from two different target forms (i.e., /ʃ/ and /ʃi/)?

Method

Participants

For the production experiment, 20 Korean learners of English were recruited from two different universities in Korea. Of the participants, 10 (five males and five females) were low in English proficiency and the other 10 (five females and five males) were high. The English proficiency level of the participants was determined by considering their TOEIC scores. Nine of the low group learners had TOEIC scores in the 500s and 1 of them in the 600s. The high group learners' TOEIC scores were in the 900s. All the participants were in their 20s and were paid for their participation. Additionally, for native speaker base-line data, four native speakers of English (two males and two females) participated in the same experiment. They were university students in their 20s recruited from a university in the USA and were paid for their participation.

Stimuli

For the production experiment, 10 pairs of words (20 words total) with the contrast of /f/ vs. /fi/ were chosen. Table 1 illustrates a full list of words used in the production experiment.

TABLE 1
Words for the Production Experiment

/f/ vs. /fi/				
fish – fishy	mush – mushy	dash – dashy	mesh – meshy	bush – bushy
ash – ashly	push – pushy	wash – washy	marsh – marshy	dish – dishy

Procedure

The task for the participants was to read the 20 words put in a carrier sentence (i.e., Please say _____.) at their natural speaking rate. The order of the 20 words was randomized for each participant. The recordings were made in a quiet room by the 20 Korean learners of English and in a sound-attenuated room by the 4 native speakers of English and digitized at a 44,100 Hz sampling rate and 16 bit quantization.

Analysis

From the production experiment, 480 tokens (24 subjects × 20 words) were obtained and acoustic analysis was performed using Praat. The analysis involved measurements of word, friction and vowel duration. In measuring word duration, a word-initial consonant was excluded since the stimuli employed in the experiment had various types of word-initial consonants and initial vowels. Measurements of friction duration were made from the onset of friction (i.e., aperiodic noise) to the offset by referring to the waveform and spectrogram. Vowel duration measurements were performed from the onset of vowel to the offset. The first and last full glottal pulses were considered as the onset and offset of the vowel, respectively. Then, the ratio of friction and vowel duration within the word duration was calculated. For the tokens with either an epenthetic or lexical vowel after a palato-alveolar sibilant, the first two formants (i.e., F1 and F2) were also measured at the midpoint of the vowel.

For a statistical analysis, the 480 tokens were categorized into four types based on their target and produced forms, as shown in Table 2.

TABLE 2
Realization Types of the Tokens

Type	Target Form	Produced Form
1	/ʃi/	[ʃi]
2	/ʃ/	[ʃi]
3	/ʃi/	[ʃ]
4	/ʃ/	[ʃ]

If the target form /ʃi/ was produced as [ʃi], it was categorized as Type 1. When a token ending in /ʃ/ was produced with the word-final epenthetic [i], it was classified as Type 2. Type 3 refers to a token pronounced with word-final vowel /i/ deleted. Finally, a token whose word-final palato-alveolar fricative was produced without any modification, thus accurately, was categorized as Type 4.

Results

The present study set out to investigate whether Korean L2 learners of English exhibit differences in producing epenthetic vowels and lexical vowels in word-final position. That is, the acoustic properties of epenthetic vowels after a word-final palato-alveolar fricative (i.e., [i] of *ash* which was produced as [æʃi]) were compared to those of lexical vowels occurring after a palato-alveolar fricative (i.e. [i] of *ashy* [æʃi]). Further, vowel deletion may occur in the production of Korean L2 learners with /ʃi/, producing word-final [ʃ] (i.e., *ashy* as [æʃ] instead of [æʃi]). The paper intended to investigate whether word-final [ʃ] from two different target forms (i.e., *ash* pronounced as [æʃ] vs. *ashy* pronounced as [æʃ]), despite their identically produced forms, exhibits differences by measuring the acoustic properties.

Production Patterns

The 400 tokens with the palato-alveolar fricative /ʃ/ (i.e., 200 with word-final /ʃ/ and the other 200 with word-final /ʃi/) produced by 20 Korean learners at two different proficiency levels showed the following patterns regarding realization types. Table 3 below displays the findings in percentages, with raw numbers in parentheses.

TABLE 3
Realization Types of the Tokens with /ʃ/ or /ʃi/

Type	low	high
1 (/ʃi/ → [ʃi])	24 % (48)	35 % (70)
2 (/ʃ/ → [ʃi])	15 % (30)	2 % (4)
3 (/ʃi/ → [ʃ])	26 % (52)	15 % (30)
4 (/ʃ/ → [ʃ])	35 % (70)	48 % (96)

Of the 200 tokens produced by the low group learners, Type 4 (/ʃ/ as [ʃ]) was the most frequent one, followed by Type 3 (/ʃi/ as [ʃ]) and Type 1 (/ʃi/ as [ʃi]). Type 2 (/ʃ/ as [ʃi]) was attested in 30 tokens. Of the 200 tokens produced by the high group learners, Type 4 was the most frequent one followed by Type 1 and Type 3. Type 2 with an epenthetic vowel was found only in 4 tokens. As for the 80 tokens produced by 4 native speakers of English, all the 40 tokens with /ʃi/ belonged to Type 1 and all the other 40 with /ʃ/ to Type 2. It can be seen from Table 3 that correct native-like pronunciation (i.e., Type 1 and 4) was found more

frequently in the high group learners' production than in the low group learners'. In addition, within both groups, Type 3 with vowel deletion was more frequently found than Type 2 with vowel epenthesis.

Acoustic Analysis

For the statistical analysis of the 400 tokens produced by Korean learners of English at two different proficiency levels and the 80 tokens produced by native speakers of English, a multivariate analysis of variance (MANOVA) was performed. In the analysis, subjects' group (low vs. high vs. native) and realization type (Type 1 vs. 2 vs. 3 vs. 4) were independent variables. The ratio of friction and final vowel, F1 and F2 were dependent variables. A significant interaction effect of subjects' group * realization type was found with friction ratio ($F(4, 467) = 4.558, p < .05$), vowel ratio ($F(4, 467) = 35.861, p < .05$), F1 ($F(4, 467) = 51.906, p < .05$) and F2 ($F(4, 467) = 10.404, p < .05$). Figure 1 illustrates the interaction effect of subjects' group * realization type with friction ratio. Since vowel epenthesis or deletion was not attested with the native English group's pronunciation, only Type 1 and 4 were represented for the native English group in Figure 1.

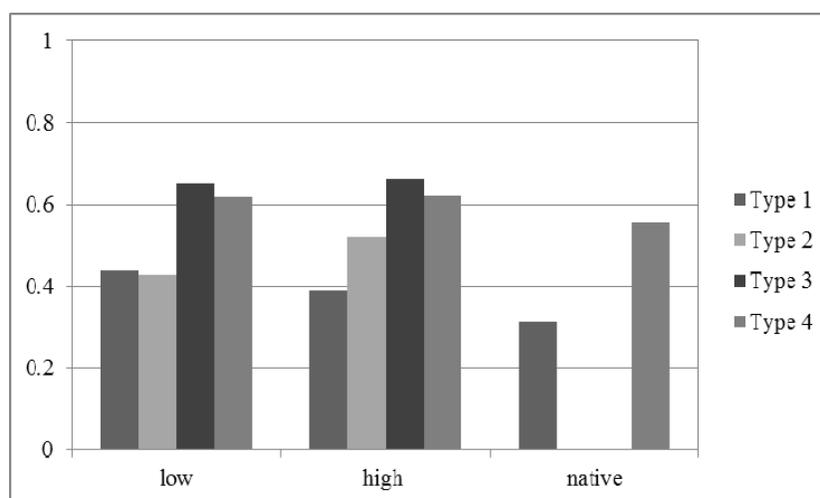


Figure 1. Friction Ratio of [j] for Group * Realization Type

To see if significant differences existed among realization types within the low group, an analysis of variance (ANOVA) was performed with friction ratio as a dependent variable and realization type as an independent variable. There were significant differences in friction ratio among realization types within the low group ($F(3, 196) = 78.829, p < .05$). According to a post-hoc analysis of LSD, there was no significant difference of friction ratio between Type 1 (/j/ → [ji]) at .437 and Type 2 (/j/ → [ji]) at .430 ($p = .718$) while the difference between Type 3 (/j/ → [j]) at .652 and Type 4 (/j/ → [j]) at .617 was significant ($p < .05$).

ANOVA revealed significant differences in friction ratio among realization types within the high group ($F(3, 196) = 200.917, p < .05$). A post-hoc analysis of LSD revealed a significant difference between Type 1 (.389) and Type 2 (.521) and between Type 3 (.662) and Type 4 (.620) ($p < .05$). Thus, the high group learners distinguished Type 1 and Type 2 by producing longer friction duration for Type 2 than for Type 1 while the low group learners did not make a significant distinction between the two. As for Type 3 and Type 4, both groups made a distinction by producing longer friction duration for Type 3 than for Type 4.

Within the native English group, as can be seen from Figure 1, Type 4 exhibited higher friction ratio than Type 1. ANOVA revealed a significant main effect of realization type with friction ratio ($F(1, 78) = 294.623, p < .05$). Thus, native English speakers exhibited longer friction ratio when pronouncing tokens with word-final /j/ (.554)

than the ones with word-final /j/ (.314). According to a series of ANOVAs, there were significant differences among the three groups regarding friction ratio of Type 1 ($F(2, 155) = 38.248, p < .05$) and Type 4 ($F(2, 203) = 10.823, p < .05$). Friction ratio of Type 1 was .438 for low, .389 for high and .314 for native. A post-hoc analysis of LSD showed significant differences for low vs. high, high vs. native, and low vs. native ($p < .05$). For Type 4, low exhibited friction ratio at .617, high at .620, and native at .554. According to a post-hoc analysis of LSD, there were significant differences for low vs. native and high vs. native ($p < .05$) while no significant difference was found for low vs. high.

In addition, it was examined whether friction ratio of Korean learners' Type 2 with an epenthetic vowel was different from that of the native's Type 1 with a lexical vowel. According to ANOVA, there were significant differences ($F(2, 71) = 37.781, p < .05$). A post-hoc analysis of LSD revealed significant differences for low vs. high, high vs. native and low vs. native ($p < .05$). Thus, friction ratio of Type 2 with an epenthetic vowel was significantly longer within the high group at .521 than within the low group at .430, both of which were significantly longer than that of Type 1 within the native English group at .314.

To see if there were significant differences of friction ratio between the low and high groups' Type 3 produced with vowel deletion and the native English group's Type 4 (/j/ → [j]), ANOVA was conducted and significant differences were found among the three groups ($F(2, 119) = 21.042, p < .05$). According to a post-hoc analysis of LSD, there were significant differences for low vs. native and high vs. native ($p < .05$) but not for low vs. high. Thus, friction ratio of Type 3 within the low and high groups was significantly longer than the native English group's friction ratio of Type 4.

Figure 2 illustrates the interaction effect of subjects' group * realization type with vowel ratio. Type 3 and Type 4 were produced with word-final /j/ and thus were not shown in Figure 2.

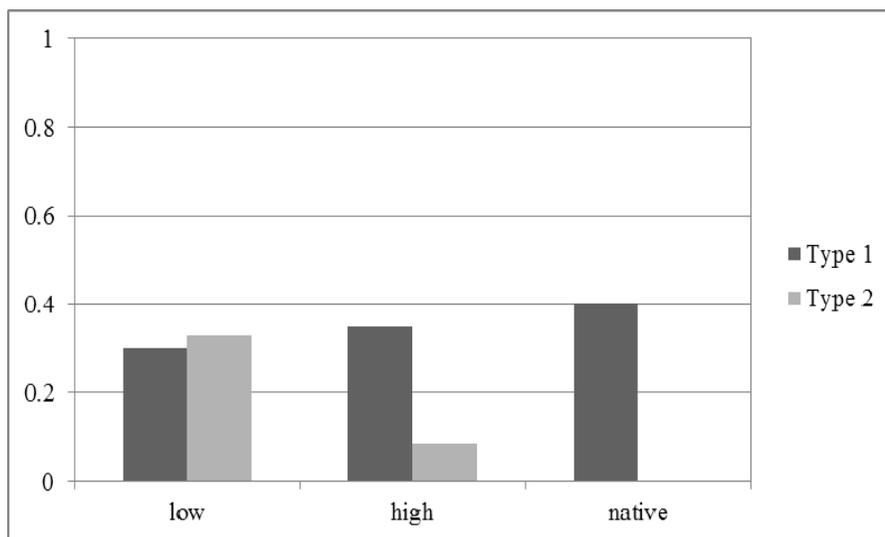


Figure 2. Ratio of the Final Vowel after [j] for Group * Realization Type

According to a series of t-tests, there was no significant difference in vowel ratio between Type 1 and Type 2 within the low group ($p = .173$) while the difference was significant within the high group ($t = 7.160, p < .05$). Thus, vowel ratio of a lexical vowel (.302) and that of an epenthetic vowel (.331) were not significantly different within the low group. However, within the high group, vowel ratio of an epenthetic vowel (.088) was significantly shorter than that of a lexical vowel (.349). To see if there were significant differences among the three groups regarding vowel ratio of Type 1, ANOVA was run. According to the analysis, significant differences were found ($F(2, 155) = 18.946, p < .05$). A post-hoc analysis of LSD revealed significant differences for low vs.

high, high vs. native and low vs. native ($p < .05$). Vowel ratio was the highest for the native English group (.400) followed by the high (.349) and low groups (.302). In addition, ANOVA showed that significant differences existed between the low and high groups' vowel ratio of Type 2 with an epenthetic vowel and the native English group's vowel ratio of Type 1 with a lexical vowel ($F(2, 17) = 32.954, p < .05$). According to a post-hoc analysis of LSD, there were significant differences for low vs. high, high vs. native and low vs. native ($p < .05$). Vowel ratio of a lexical vowel by the native English group (.400) was significantly longer than those of an epenthetic vowel by the low (.331) and high groups (.088). It is notable that the high group's vowel ratio of an epenthetic vowel was significantly shorter than the low and native English groups'.

Figure 3 illustrates the interaction effect of subjects' group * realization type with F1. Since Type 3 and Type 4 were not produced with a word-final vowel, they were not shown in Figure 3. A series of t-tests revealed no significant difference of F1 between Type 1 and Type 2 within the low group ($p = .989$) while a significant difference was exhibited within the high group ($t = -7.414, p < .05$). Thus, F1 values of epenthetic and lexical vowels were not significantly different within the low group. On the other hand, within the high group, F1 of epenthetic vowels was significantly higher than that of lexical vowels. According to ANOVA, within Type 1, there were no significant differences of F1 among the three groups. F1 of epenthetic vowels (i.e., Type 2) within the low and high groups and that of lexical vowels (i.e., Type 1) within the native English group were significantly different according to ANOVA ($F(2, 71) = 26.432, p < .05$). A post-hoc analysis of LSD showed significant differences for low vs. high and high vs. native ($p < .05$). Thus, the high group's F1 of epenthetic vowels was significantly higher than the low group's F1 of epenthetic vowels and the native English group's F1 of lexical vowels.

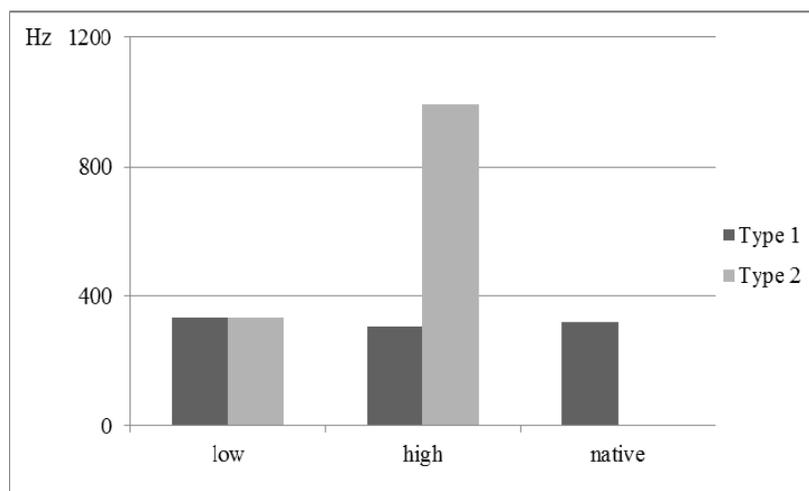


Figure 3. F1 of Final Vowel for Group * Realization Type

Figure 4 shows the interaction effect of subjects' group * realization type with F2. Type 3 and Type 4 were not shown in Figure 4 since they were not produced with a word-final vowel. According to a series of t-tests, there was no significant difference of F2 between Type 1 and Type 2 within the low group ($t = .205, p = .838$) while a significant difference was attested within the high group ($t = 2.412, p < .05$). The high group's F2 was significantly higher for lexical vowels (i.e., Type 1) than for epenthetic vowels (i.e., Type 2). ANOVA revealed that F2 of Type 1 was significantly different among the three groups ($F(2, 155) = 10.284, p < .05$). According to a post-hoc analysis of LSD, there were significant differences for low vs. high and high vs. native ($p < .05$). The high group's F2 of lexical vowels was significantly higher than the low and native. According to ANOVA, F2 of Type 2 within the low and high groups was not significantly different from that of Type 1 within the native English group.

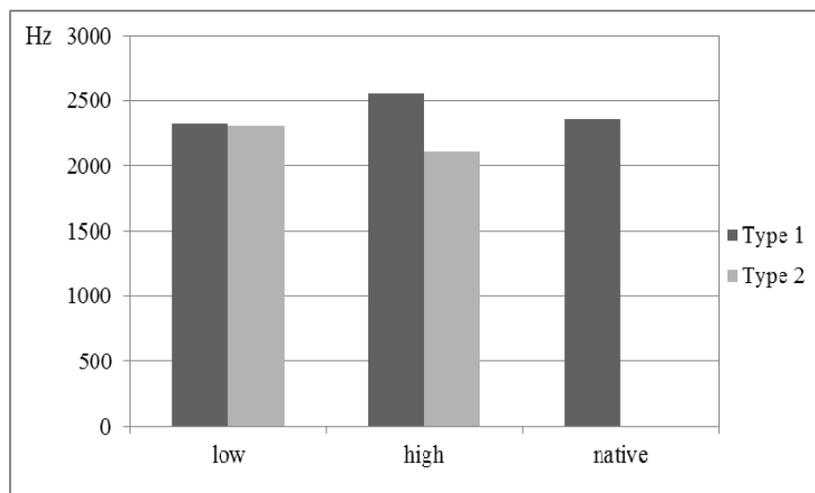


Figure 4. F2 of Final Vowel after [j] for Group * Realization Type

Relationship to Word Frequency

In order to examine whether word frequency influenced the accuracy of production, word frequencies of the target words were collected from the BNC/COCA database. Table 4 below displays the word frequencies of the target words. The accuracy for each production was then correlated with the frequencies. In the production data, Type 1 and 4 were accurate pronunciation and thus given a score of 1. Since Type 2 and 3 were inaccurate, they were given a score of 0. The high and low groups' correlation coefficients were separately calculated. Since the native group exhibited no inaccurate productions, their correlation was not calculated.

The results revealed a significant correlation of accuracy and word frequency within the high group ($r^2 = .159, p < .05$). Within the high group, it was shown that the target words with higher word frequencies exhibited higher accuracies. However, no significant correlation was found within the low group ($r^2 = .127, p = .073$). Thus, for the low group learners, target words with higher word frequencies did not yield higher accuracies.

TABLE 4

Word Frequencies of the Target Words

Word	Frequency	Word	Frequency
ash	4,942	ashy	178
bush	106,042	bushy	722
dash	4,006	dashy	0
dish	11,902	dishy	49
fish	50,179	fishy	519
marsh	4,344	marshy	295
mesh	2,678	meshy	2
mush	616	mushy	563
push	24,778	pushy	459
wash	12,560	washy	18

Discussion

With respect to the production patterns of word-final /f/ vs. /fi/, more errors were found within the low group than within the high group. Out of the 200 target words produced by the low group, vowel epenthesis forms (i.e. Type 2 with [fi] from the target form /f/) were found in 15% while they were attested in 2% produced by the high group. In addition, vowel deleted forms (i.e. Type 3 with [f] from the target form /fi/) were found in 26% of the data produced by the low group while 15% of the data exhibited the pattern within the high group. Thus, production patterns of word-final /f/ and /fi/ differed according to Korean learners' proficiency levels in English. While the high group exhibited more accurate production than the low group, both groups showed the same pattern in that vowel deleted forms were attested more frequently than vowel epenthesis forms. Both groups also pronounced word-final /f/ more correctly than word-final /fi/. The stimuli used in the present study attest higher frequency for the words with final /f/ than the ones with final /fi/. According to the results of the BNC/COCA database, the two categories exhibit vastly different frequencies per 4 million words (i.e., 'fish' 50179 vs. 'fishy' 519). It seems that the production of vowel deletion is related to the frequency of the words.²

The low and high groups showed different patterns regarding the acoustic properties of lexical and epenthetic vowels. Within the low group, the target words with lexical vowels (i.e., Type 1) and those with epenthetic vowels (i.e., Type 2) were not significantly different regarding friction ratio of the palaeoalveolar fricative preceding the vowels, ratio of the final vowel, and midpoint F1 and F2 values. Thus, the low group did not discriminate the two types of the target words at all in their pronunciation. On the other hand, within the high group, significantly different patterns were attested with respect to all of the four acoustic properties. That is, the high group showed longer friction ratio, shorter vowel ratio, higher F1 and lower F2 for the target words with epenthetic vowels. The high group tried to discriminate the target words with lexical vowels from those with epenthetic vowels in terms of vowel and friction duration and vowel quality. Although the high group learners' pronunciation deviates from that of native speakers in that they showed some inaccurate realization of the target forms /f/ as [fi], epenthetic vowels were discriminated from lexical vowels with respect to the acoustic properties such as friction and vowel ratio and F1 and F2 values. The results show that the high group learners were employing production strategies to discriminate the contrast, yet still deviating from native speakers. The low group learners were different from both the high group learners and the native speakers in that they did not employ any strategies discriminating epenthetic and lexical vowels. This indicates that the high group's pronunciation is qualitatively different from that of the low group.

Regarding the target words with lexical vowels (i.e., Type 1), the friction and vowel ratio of the high group were closer to that of the native group than the low group. However, when comparing Korean learners' target words with epenthetic vowels (i.e., Type 2) to native speakers' target words with lexical vowels (i.e., Type 1), the friction and vowel ratio of the low group were closer to that of the native group since the high group exhibited longer friction ratio and shorter vowel ratio than the low and native groups. With respect to F1 of lexical vowels (i.e., Type 1), the three groups did not show any significant difference. However, the high group's F1 of epenthetic vowels (i.e., Type 2) was significantly higher than that of the low and native groups. In addition, the high group's F2 of lexical

² One reviewer commented that this preference of /f/ over /fi/ could be due to overcorrection, noting that the reviewer heard a few advanced Korean learners of English produce 'energy' as a two-syllable word. To substantiate this argument, the study would need to look into the nature of input provided to the learners in the present study, which is beyond the scope of the present study. Future studies examining the relationship between learners' input and their error patterns may provide answers to this interesting speculation.

vowels was higher than both other groups while that of epenthetic vowels was not significantly different from the two groups. From the results, it can be seen that the high group's pronunciation of the target forms with epenthetic vowels was different from those with lexical vowels. On the other hand, the low group did not differentiate epenthetic vowels from lexical ones.

Previous phonetic studies on epenthetic vowels have mainly focused on phonetic specifications. That is, the issue was whether they are targetless transitional vowels distinct from lexical vowels (David, 2006; Davidson & Stone, 2003; Gouskova & Hall, 2009; Miner, 1979; Susman, 1943) or the same type of vowels as lexical vowels sharing exactly the same acoustic properties (Kim & Kochetov, 2011; Michelson, 1989). The results of the present study show that epenthetic vowels observed in L2 pronunciation exhibit different acoustic properties depending on learners' proficiency levels in L2. The low group's epenthetic vowels were the same as their lexical vowels as well as those of native speakers as evidenced by acoustic properties. Thus, the low group produced epenthetic vowels as 'full-fledged' segments, supporting Kim and Kochetov (2011) and Michelson (1989).

On the other hand, the high group showed a clear distinction between lexical and epenthetic vowels as evidenced by their shorter vowel ratio, higher F1 and lower F2 than lexical vowels. Epenthetic vowels produced by the high group also differed from lexical vowels produced by the native English group by exhibiting shorter vowel ratio and higher F1. Thus, the high group produced epenthetic vowels differently from lexical vowels, possibly as transitional vowels (David, 2006; Davidson & Stone, 2003; Gouskova & Hall, 2009; Miner, 1979; Susman, 1943) for a strategy to pronounce word-final /ʃ/ unattested in their L1.

As for word-final [ʃ] from the two different target forms /ʃi/ (i.e., Type 3 with [ʃ] from the target form /ʃi/) and /ʃ/ (i.e., Type 4 with [ʃ] from the target form /ʃ/), both low and high groups showed longer friction ratio for Type 3 than for Type 4. That is, of the two types of target words with word-final [ʃ], vowel deleted forms exhibited longer friction ratio within both low and high groups. Both Korean learner groups' Type 3 (i.e., with [ʃ] produced from the target form /ʃi/) also showed significantly longer friction ratio than the native group's Type 4. Thus, in some tokens, both Korean learner groups tried to discriminate the contrast of /ʃ/ vs. /ʃi/ in terms of different friction ratio, not in terms of the presence or absence of the vowel /i/ as a native English speaker did. Possibly, Korean learners were aware of the difference between word-final /ʃ/ and /ʃi/ but they devised their own strategy to differentiate the contrast in production, failing to produce the contrast like native English speakers.

Regarding the correlation between word frequency and accuracy, Korean learners exhibited different patterns according to their proficiency levels in English. The high group showed a significant correlation of word frequency and accuracy while the low group did not. That is, within the high group, higher accuracies were observed in production for the target words with higher word frequencies. However, for low group learners, the target words with higher word frequencies did not yield higher accuracies. The present study showed a result similar to Vais et al. (2015) which reported that frequency played a role in L2 production for talented speakers, but not for less talented speakers. According to Exemplar Theory (Pierrehumbert, 2001), linguistic stimuli are stored as highly detailed episodes with acoustic and contextual information which are employed in speech production and perception. The high group L2 learners would hold more exemplars than the low group L2 learners in their memory where L2 words with higher frequencies would be represented by more exemplars than those with lower frequencies. Thus, the results from the present study support the theory which predicts that the high group is more likely to be influenced by word frequency in production than the low group.

Conclusion

In the present study, Korean L2 learners' production of the contrast /f/ vs. /fi/ in word-final position was investigated. Vowel epenthesis and deleted pronunciations were attested in their production of the contrast and such L2 pronunciation error patterns were more frequently found within the low group than within the high group, suggesting a role of proficiency levels in L2 production. According to the acoustic analysis of epenthetic and lexical vowels, the high group exhibited significant differences regarding the acoustic properties of the two types of vowels. These differences were in the friction and vowel ratio and F1 and F2 midpoint values, producing epenthetic vowels as transitional vowels. On the other hand, the low group did not differentiate the two types of vowels, producing epenthetic vowels like lexical vowels. As for [ʃ] from /f/ or /fi/, both the low and high groups exhibited longer friction ratio for [ʃ] from /fi/ than for [ʃ] from /f/. The findings suggest the use of production strategies by L2 learners differs from native speakers. Although both low and high group learners exhibited longer friction ratio for vowel deleted forms, high group learners in general employed more effective strategies for distinction of the contrast.

The findings from the present study have pedagogical implications in L2 settings. In many Asian countries, including Korea, where the number of ESL/EFL learners is increasing at a fast rate, the demand for teachers and researchers is increasing as well. Thus, insights into variability in interlanguage are vital for them. Especially when it comes to pronunciation, the degree of pronunciation accuracy varies considerably depending on learners. In order to fully understand the L2 sound system, it is necessary to consider biological, learner-related and environment-related factors. Indeed, the finding suggests that the variability amongst learners at different proficiency levels exist, with high levels showing higher accuracy. It further implicates that input provided through EFL settings turns out to be useful at least to some extent in promoting accuracy of L2 pronunciation. It remains to be seen in future studies whether these high group learners, who have devised their own strategy of discriminating the L2 contrast, will continue to show progress that is in par with native speakers.

The Authors

Jayeon Lim is a professor in the Dept. of English Language and Literature of University of Seoul in Seoul. Her research interests include L2 acquisition and learning, specifically grammar development and speech perception for EFL learners. Her recent publications include a study on the influence of L1 constraints on L2 sound perception and a study on word-nonword phonological memory and L2 proficiency with M. Seo (2015).

Department of English Language and Literature
College of Humanities
University of Seoul
Seoul, 02504, Korea
Tel: +82 264902521
Fax: +82 264902514
Email: limjy@uos.ac.kr

Misun Seo is an associate professor in the Dept. of English Language and Literature of Hannam University in Daejeon. Her research interests include speech perception and production both in L1 and L2. Her recent publications include a study on gender difference in the affricate productions of young Seoul Korean speakers with E. J. Kong and S. Kang (2014) and a study on the influence of L1 constraints on L2 sound perception with J. Lim (2015).

Department of English Language and Literature
College of Liberal Arts
Hannam University
Daejeon, 34430, Korea
Tel: +82 426298461
Fax: +82 426297321
Email: misunseo@hnu.kr

References

- Bongaerts, T., van Summeren, C., Planken, B., & Schils, E. (1997). Age and ultimate attainment in the pronunciation of a foreign language. *Studies in Second Language Acquisition*, 19, 447-465.
- Bybee, J. (2002). Word frequency and context of use in the lexical diffusion of phonetically conditioned sound change. *Language Variation and Change*, 14, 261-290.
- Bybee, J. (2006). From usage to grammar: The minds response to repetition. *Language*, 82, 711-733.
- Cardoso, W., & Liakin, D. (2009). When input frequency patterns fail to drive learning: Evidence from Brazilian Portuguese English. In B. Baptista, A. Rauber, & M. Watkins (Eds.), *Recent research in second language phonetics/phonology: Perception and production* (pp. 174-202). New Castle Upon Tyne: Cambridge Scholars.
- Davidson, L. (2006). Phonology, phonetics, or frequency: Influences on the production of non-native sequences. *Journal of Phonetics*, 34, 104-137.
- Davidson, L., & Stone, M. (2003). Epenthesis versus gestural mistiming in consonant cluster production: An ultrasound study. In G. Garding & M. Tsujimura (Eds.), *Proceedings of the 22nd West Coast Conference on Formal Linguistics* (pp. 165-178). Somerville, MA: Cascadilla Press.
- Flege, J. E. (1995). Second language speech learning: Theory, findings, and problems. In W. Strange (Ed.), *Speech perception and linguistic experience* (pp. 233-277). Timonium, MD: York Press.
- Flege, J. E. (1999). Age of learning and second language speech. In D. Birdsong (ed.), *Second language acquisition and the Critical Period Hypothesis* (pp. 101-131). Mahwah, NJ: Lawrence Erlbaum Publishers.
- Flege, J. E., Takagi, N., & Mann, V. (1995). Japanese adults can learn to produce English /ɪ/ and /l/ accurately. *Language and Speech*, 38, 25-56.
- Gouskova, M., & Hall, N. (2009). Acoustics of epenthetic vowels in Lebanese Arabic. In S. Parker (Ed.), *Phonological argumentation: Essays on evidence and motivation* (pp. 203-225). London: Equinox.
- Han, Z.-H., & Odlin, T. (2006). Introduction. In Z.-H. Han & T. Odlin (Eds.), *Studies of fossilization in second language acquisition* (pp. 1-20). Clevedon, UK: Multilingual Matters.
- Hattori, K., & Iverson, P. (2009). English /r/-/l/ category assimilation by Japanese adults: Individual differences and the link to identification accuracy. *Journal of Acoustical Society of America*, 125,

469-479.

- Ioup, G. (1994). Evaluating the need for input enhancement in post-critical period language acquisition. In D. Singleton & Z. Lengyel (Eds.), *The age factor in second language acquisition* (pp. 95-123). Clevedon, UK: Multilingual Matters.
- Iverson, P., Hazan, V., & Bannister, K. (2005). Phonetic training with acoustic cue manipulations: A comparison of methods for teaching English /r/-/l/ to Japanese adults. *Journal of Acoustical Society of America*, 118, 3267-3278.
- Kashiwagi, A., Snyder, M., & Craig, J. (2005). The role of explicit instruction in the development of L2 phonology. *The Journal of Asia TEFL*, 2, 63-87.
- Kim, K., & Kochetov, A. (2011). Phonology and phonetics of epenthetic vowels in loanwords: Experimental evidence from Korean. *Lingua*, 121, 511-532.
- Larson-Hall, J. (2006). What does more time buy you? Another look at the effects of long-term residence of production accuracy of English /r/ and /l/ by Japanese speakers. *Language and Speech*, 49, 521-548.
- Lee, H. (1996). *Gukeo eumseonghak (Korean phonetics)*. Seoul: Taehaksa.
- Long, M. H. (1990). Maturational constraints on language development. *Studies in Second Language Acquisition*, 12, 251-285.
- Michelson, K. (1989). Invisibility: Vowels without a timing slot in Mohawk. In D. Gerds & K. Michelson (Eds.), *Theoretical perspectives on Native American languages* (pp. 38-69). New York: SUNY Press.
- Miner, K. L. (1979). Dorsey's law in Winnebago-Chiwere and Winnebago accent. *International Journal of American Linguistics*, 45, 25-33.
- Nation, I. S. P. (2001). *Learning vocabulary in another language*. Cambridge: Cambridge University Press.
- Pierrehumbert, J. (2001). Exemplar dynamics: Word frequency, lenition, and contrast. In J. Bybee & P. Hopper (Eds.), *Frequency effects and the emergence of lexical structure* (pp. 137-157). Amsterdam: John Benjamins.
- Pruitt, J. S., Jenkins, J. J., & Strange, W. (2006). Training the perception of Hindi dental and retroflex stops by native speakers of American English and Japanese. *Journal of Acoustical Society of America*, 119, 1684-1696.
- Rajadurai, J. (2007). Intelligible pronunciation: Focus on the proficient L2 speaker. *The Journal of Asia TEFL*, 4, 1-25.
- Saito, K. (2011). Differential effects of phonological and lexicogrammatical errors on NS and NNS listeners' perceptions of comprehensibility: An exploratory study. *The Journal of Asia TEFL*, 8, 39-61.
- Scovel, T. (1988). *A time to speak: A psycholinguistic inquiry into the critical period for human speech*. Rowley, MA: Newbury House.
- Selinker, L., & Han, Z. H. (2001). Fossilization: Moving the concept into empirical longitudinal study. In C. Elder, A. Brown, E. Grove, K. Hill, N. Iwashita, T. Lumley, T. McNamara, & K. O'Loughlin (Eds.), *Studies in language testing: Experimenting with uncertainty* (pp. 276-291). Cambridge: Cambridge University Press.
- Seo, M., & Lim, J. (2008). Perceptual discrimination of sibilants by adult Korean learners of English. *Korean Journal of Applied Linguistics*, 24, 219-238.
- Shin, J. (2003). *Malsoriuy ihae (Understanding speech sounds)*. Seoul: Hankookmunhwasa.
- Susman, A. L. (1943). *The accentual system of Winnebago*. Unpublished doctoral dissertation, Columbia University, NY.

- Vais, J., Lewandowski, N., & Walsh, M. (2015). Investigating frequency of occurrence effects in L2 speakers: Talent matters. In The Scottish Consortium for ICPHS 2015 (Ed.), *Proceedings of the 18th International Congress of Phonetic Sciences*. Glasgow, UK: the University of Glasgow. ISBN 978-0-85261-941-4. Paper number 0723.1-5 retrieved from <https://www.internationalphoneticassociation.org/icphs-proceedings/ICPhS2015/Papers/ICPHS0723.pdf>