

Effects of Experience on the Production of English Unstressed Vowels*

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<Abstract>

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This study examined the effect of English-language experience on Korean- and Japanese-English late learners' production of English unstressed vowels in terms of four acoustic phonetic features: F0, duration, intensity and vowel reduction. The learners manifested some improvement with experience. The native-like attainment of a phonetic feature, however, was related to the phonological status of that feature in the speakers' native language. The results suggest that the extent to which the non-native speakers' production of English unstressed vowels improved with English-language experience varied as a function of their native language background.

* Keywords: English stress, L2 experience, Duration, F0, Intensity, Vowel quality reduction.

* This study was supported by Wonkwang University in 2005.

1. Introduction

Non-native speakers' accuracy in producing the prosodic features of a second language (L2) is considered a major contributor to perceived foreign accent. Studies have indicated that foreign accent and intelligibility could be more greatly influenced by prosodic than segmental factors [1][2][3][4]. English, as a stress-timed language, uses specific acoustic cues to signal unstressed vowels. Unstressed vowels in general are perceived to be lower in pitch, shorter in duration ('duration' in this study refers to vowel length) and less loud in intensity than stressed vowels [5]. Furthermore, unstressed English vowels tend to be reduced in terms of vowel quality: Unstressed vowels tend to be centralized in terms of first and second formant frequencies [6].

Native language (L1) interference in L2 acquisition has long received a lot of attention. The feature hypothesis was proposed in [7], which states that L2 phonetic features not used to signal phonological contrasts in L1 will be more difficult to acquire than those that are used to signal phonological contrasts in the L1. Along with [8], it was reasoned that the difficulty in perceiving phonetic features that are not phonologically meaningful will result in low accuracy of these features in second language production [7]. In a recent study, the production of English unstressed vowels focusing on age of acquisition (AOA) was investigated [9]. The study used highly proficient Korean and Japanese speakers of English, and divided each group into early and late groups. The early learners had their first massive exposure to an English-speaking environment (AOA) before the age of 6 and the late learners after the age of 15. They found that first language effects could be found for both early and late learners, and that, at the same time, both early and late learners showed some sensitivity to novel second language phonetic cues. The results also indicated that late learners were less likely to become native-like in their production in certain domains, specifically, in the centralized production of reduced vowels.

The present study was designed as a follow-up study to [9] to investigate the effect of amount of experience with English on the acquisition of the English unstressed vowel in late learners. Following previous research, experience is defined as the length of residence (LOR) in the target country, here the United States (see [10] for a review). The role of experience in adults' L2 acquisition has focused on consonants and full vowels [11][12]. Recently, the effect of experience on adults' L2 acquisition has considered prosodic aspects as well [10]. Converging results indicate that there is a rapid improvement in L2 perception and production in the early stages, but that additional improvement requires substantial experience with the L2, often over

7 years of residence in the target country [12][13][14].

The purpose of the current study is to further investigate the effect of experience on the acquisition of L2 production in adult learners. Specifically, the production of English unstressed vowels by learners with varying LOR in the US (4 months vs. 10 years) will be studied. Additionally, the influence of the L1 background on the acquisition of English unstressed vowels will be investigated by including groups of learners from Korean and Japanese language backgrounds who arrived in the US after the age of 15.

The organization of this paper is as follows. Section 2 will review the theoretical backgrounds on the topics that are covered in this study. The detailed results of the production experiment of English unstressed vowels by the learners will be presented in section 3. Section 4 will provide the general discussion on the results and present the conclusion of the study.

2. Theoretical Backgrounds

2.1. English unstressed vowels

An unstressed vowel is less prominent than a stressed vowel and is usually characterized by three acoustic parameters: lower fundamental frequency (perceived subjectively as lower pitch), shorter duration and weaker intensity. It is generally agreed that the production and perception of stressed syllables cannot be attributed to any one of the parameters [15]. Another important factor is to do with vowel quality: unstressed vowels in English tend to be reduced to a centralized vowel which corresponds to midrange first formant (F1) and second formant (F2) frequencies.

Relatively less attention has been paid to the effect of vowel quality in relation to perception of stress. [16] investigated the relation between the degree of vowel reduction and the perception of stress when other parameters such as fundamental frequency (F0 hereafter), intensity and duration were held constant and reported that the lack of spectral reduction was a cue for perceived stress in this condition. In a corpus study of everyday English, it was found that the difference in word-stress location in the majority of orthographically identical word pairs was signaled by vowel reduction as a manipulation of quality as well as acoustic differences of F0, intensity and duration [17].

2.2. Korean and Japanese prosody

Korean and Japanese have prosodic systems distinct from that of English in that they are not stress-based. Korean is described as having a phrase-level pitch system in which tones, realized as F0 patterns, are assigned to specific syllables within a prosodic domain that might be larger than a lexical word [18]. As far as phonetic features are concerned, there is consensus among researchers that F0 patterns play an important role in Korean prosody. Duration, intensity, and vowel reduction have not been analyzed as part of the phonetic realization of prosody in Korean. Whereas in some dialects of Korean vowel duration still signals a phonemic contrast, its phonemic function has completely disappeared in modern standard Seoul dialect [19].¹⁾

It is generally accepted that Japanese has a word-level pitch accent system where F0 patterns are the primary realization of Japanese pitch accent [20][21]. However, there have been arguments suggesting that intensity is at least a secondary acoustic cue in identifying Japanese accent [22][23][24]. The other features of English stress, namely duration or vowel reduction, are not part of the phonetic realization of pitch accent in Japanese. The phonetic property of duration, however, is used to realize the rhythm of Japanese. Japanese is described as a mora-timed rhythmic language which exhibits phonetic properties that differentiate it from stress-timed or syllable-timed language [25]. Short segments are analyzed as consisting of one mora, whereas long segments are analyzed as consisting of two moras [26]. To summarize, Japanese prosody utilizes the acoustic cues of duration, F0 and intensity.

2.3. Previous research

The majority of previous work on second language acquisition of English stress has focused on the acquisition of stress placement patterns. Late learners have been found to show incomplete acquisition of the English stress patterns based on syllable structure, and learners from non-stress language backgrounds showed little or no acquisition [27][28][29][30][31][32]. However, both early and late learners from a variety of language backgrounds demonstrate knowledge of English stress patterns by lexical class [31][33][34].

Perhaps less well studied is the implementation of stressed and unstressed vowels

¹⁾ The average age of the Korean participants in this study was 31, and the oldest participant was in the mid forties. None of the participants reported that they were distinguishing the Korean vowel length phonemically.

at the phonetic level. It has been claimed that prosodic errors are more closely related to the perception of foreign accent than segmental errors. It has also been accepted that the use of full instead of reduced vowels in unstressed syllables plays an important role in foreign accent. It was noted that this phenomenon is extremely typical in Spanish-accented English [35]. It was also reported that second language learners of English made errors of incorrectly producing unstressed vowels by using full vowels in the place of reduced vowels [36]. [37] examined stress placement and vowel reduction through the production of English word pairs in isolation derived from the same morpheme (e.g., able/ability) by seven English native speakers and seven Spanish native speakers. The findings in [37] indicated that native Spanish speakers differentiated stressed and unstressed vowels in terms of duration and intensity in most cases, but that the Spanish learners of English showed much less vowel reduction than the native English speakers.

There have been studies investigating patterns of English stress placement by Korean speakers. It was found that late Korean learners of English demonstrated only partial knowledge of English stress placement patterns and that stress placement was not influenced by grammatical category [38]. On the other hand, early Korean learners of English were found to have near-native knowledge of English stress patterns. Stress placement was observed to be influenced by grammatical category.

A few studies have also investigated the phonetic implementation of stress. In a study on English word and sentence prosody produced by Korean learners of English, [39] used acoustic measurements and auditory judgments and reported that Korean learners' word prosody was more similar to that of English native speakers than sentence prosody, and that the rhythmic pattern turned out to be the most serious problem in the Korean learners' sentence prosody production. [40] examined the durational patterns of the English inter-stress interval using nonnative-speakers of English from three Asian languages (Chinese, Japanese and Korean). It was found that the utterances of all groups of nonnative English speakers differed significantly from the native speaking group in both total speaking time and total number of stresses. It was reported that Japanese speakers showed significantly longer inter-stress intervals than the native English speakers.

In a study on stress placement for two-syllable nonwords in English, [41] found that early Japanese English learners showed effects of grammatical category (nouns vs. verbs) and syllable structure on both perception and production of stress, whereas late Japanese English learners demonstrated knowledge of stress differences across grammatical category only in the production task and did not show an effect of

syllable structure.

The production of unstressed vowels in English was acoustically analyzed in [9] by early and late Korean-English and Japanese-English learners with long lengths of residence in the US. The results showed that all four learner groups were native-like in having a lower fundamental frequency for unstressed than stressed vowels. The early and late Korean groups made less intensity differences between unstressed and stressed vowels than the native English speakers. The Korean groups, especially the late learners, made less difference in duration between the two vowels than the native English speakers. The Japanese speakers, whose native language has phonemic length distinction, produced more native-like durational patterns. On the other hand, the quality (F1 and F2) of the unstressed vowels of all four learner groups was different from the native English group's. The difference was most pronounced in the late Japanese learners for whom unstressed vowels were widely dispersed in the vowel space according to their orthographic representations, probably due to no central vowels in Japanese.

2.4. Research questions

The current study was designed as a follow-up study of [9] in order to investigate the role of experience on the acquisition of the English unstressed vowel. Much research has examined the role of experience on adults' L2 acquisition and has found that lengths of residence in the target country exceeding 7 years may positively affect the production of the target language [12][14][15]. [12] examined the effect of English language experience on non-native speakers' production and perception of English full vowels. The results supported the view that adults who learn an L2 become able to produce and perceive certain L2 vowels more accurately as they gain experience in an L2. [12] also found that not only the non-natives' degree of accuracy in producing and perceiving the English vowels but the extent to which their performance improved with experience in English varied as a function of L1 background. Recently, they have also found a positive effect of experience on the production of the prosodic characteristics of English stress timing in late learners [11].

In the current study, inexperienced and experienced late learners were compared. Based on the findings of the previous research, late learners in the current study with longer lengths of residence (10 years on average) are expected to demonstrate more accurate production of the English unstressed vowel than late learners with shorter lengths of residence (4 months on average). The inexperienced late learners were

recruited for this study and compared to the experienced late learners whose data were previously published in [9].

In the present study, the L1 background is also considered. Late learners from two different L1 backgrounds, Korean and Japanese, were compared. The summary of the two L1 backgrounds is presented in Table 1.

<Table 1> Phonological status of the phonetic features used to realize the English unstressed vowel in Korean and Japanese.

Phonetic feature	Korean	Japanese
F0	Yes	Yes
Duration	No	Yes
Intensity	No	Yes?
Vowel quality reduction	No	No

As provided in the above table, Korean and Japanese vary in the phonological status of the phonetic features used to realize the English unstressed vowel. Korean uses F0 in its phonology and Japanese uses F0, duration, and possibly intensity in its phonology. Neither language uses vowel quality reduction. In the case where a phonetic feature is used in the phonology of the L1, it is predicted that the learners will be better able to acquire and effectively use this feature in English production than a phonetic feature not used in the L1 phonology. That is, native-like production is predicted to be more likely in phonetic features that are also used in the learners' L1 phonology than in phonetic features that are not used in the learners' L1 phonology. Additionally, the ability to use a specific phonetic feature is predicted to be improved by experience with English.

3. Experiment

3.1. Method

Five groups of 10 each participated as paid subjects: native English speakers to serve as controls, experienced Korean learners of English, inexperienced Korean learners of English), experienced Japanese learners of English, and inexperienced Japanese learners of English. All participants were recruited from Eugene, Oregon in the US, and all of them reported normal hearing. The native English group spoke no

other language in their childhood and had never lived abroad for more than 3 months, although many had studied a foreign language in high school or college. All of the learners had their first massive exposure to an English-speaking environment after the age of 15, so called late learners. The learners were divided by the length of residence in the US to test the effect of amount of L2 experience, which is defined in this study as length of residence in the English speaking environment. At the time of testing, the experienced ('exp.' in the table) learners had resided in the US for an average of approximately 10 years as opposed to an average of 4 months for the inexperienced ('inexp.' in the table) groups. Table 2 summarizes the information on each group's background. All experienced learners were highly proficient in English as measured by standardized tests [42]. There were no significant differences between the two experienced learner groups for the scores of the tests. On the other hand, most of the inexperienced learners (7 and 9 each out of 10 in Korean- and Japanese-English groups respectively) were students of the American English Institute at the University of Oregon, and all of them were in the similar level classes (on average, level 4 out of 7).

<Table 2> Information on the subjects

Group	Sex (F/M)	AOA ^a	LOR ^b	Age ^c	Educ. ^d
Native English	5/5	0.0	24.9	24.9	14.8
inexp. Korean	7/3	29.0	0.3	29.1	16.8
exp. Korean	7/3	21.4	11.0	33.6	17.3
inexp. Japanese	6/4	21.6	0.3	21.6	16.0
exp. Japanese	6/4	21.0	10.4	32.0	17.7

^a AOA = Mean age of English acquisition as defined by the time of first massive exposure to an English speaking environment, i.e., when the participants came to the US (in years).

^b LOR = Mean length of residence in the US (in years).

^c Age = Mean age at time of testing (in years).

^d Educ. = Mean years of education. A high school degree was counted as 12 years, a Bachelor's degree as 16 years, a Master's Degree as 18 years, and a PhD was counted as 20 years. Partial years studying toward a degree were counted up to the maximum for that degree.

The subjects were asked to read once real English words containing unstressed vowels in a carrier frame, "I said _____, too." A total of 21 unstressed vowel targets were elicited by the stimulus words in Table 3. The total number of tokens to be analyzed was 630 (21 unstressed vowels x 30 subjects). The unstressed vowels

used in the study are indicated in boldface and main stress is indicated with an accent. The words were chosen to collect a fairly representative sample of unstressed vowels with respect to position within the word (initial, medial or final) and orthographic representation. For example, the target word ‘manage’ contained an unstressed vowel spelled as ‘a’ in the second syllable and ‘medium’ contained an unstressed vowel spelled as ‘u’ in the final syllable.

<Table 3> List of English words used in the experiment

agénda	eléven	médiu m
ágent	giráffe	ó ri gin
banána	índicate	possé s
básk e t	introdú c e	potáto
cá l endar	kangaróo	spaghé t ti
có m pensate	machí n e	
descé n t	mána g e	

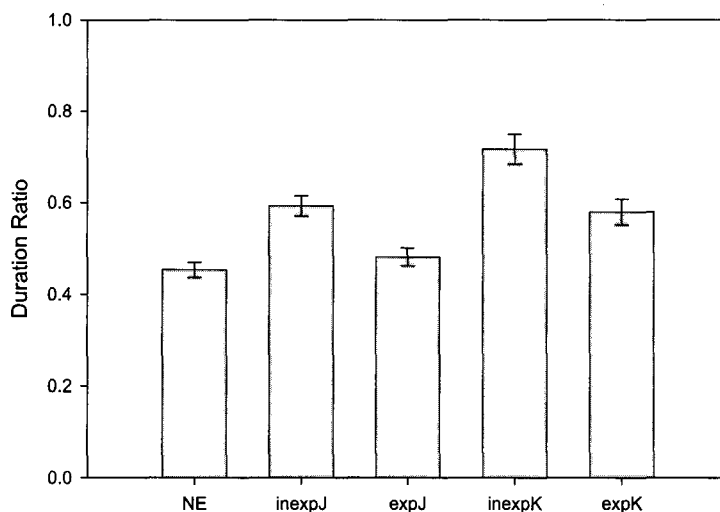
Incorrect productions, either due to wrong stress placement or simply a wrong pronunciation, were all excluded from the analysis. Several acoustic measures were made of the unstressed and primary stressed vowels in the test words using PCQuirer 6.3: fundamental frequency (in Hz), intensity (in dB), both measured at the peak, and duration (in ms). The first and second formant frequencies (in Hz) at temporal vowel midpoint were also measured for the unstressed vowels, as the first and second formants (F1 and F2) are acoustic correlates of vowel quality.

3.2. Results

The ratio of the unstressed to the stressed vowel in a given word was calculated for the duration, fundamental frequency, and intensity measures. The F1 and F2 were normalized to allow for comparison across the subjects. Then, the mean ratio of unstressed vowels to stressed vowels for the duration and fundamental frequency, the log ratio calculated from the mean differences between them for the intensity, and both the vowel plots of normalized F1 and F2 frequencies of the unstressed vowels were obtained. The differences between the five groups, native English group (NE), inexperienced Japanese group (inexpJ), experienced Japanese group (expJ), inexperienced Korean group (inexpK), and experienced Korean group (expK), are presented below.

Figure 1 presents the mean ratio of the duration of unstressed to stressed vowels produced by the five groups. Lower bars indicate relatively shorter duration of the unstressed vowel. All of the groups produced unstressed vowels with shorter duration. The English native speakers produced unstressed vowels with roughly half the duration of the stressed vowels (the ratio = .45). An ANOVA investigating the effect of group on the ratio of the duration of the unstressed to stressed vowels showed a significant effect [$F(4,912)=18,666, p<.01$]. Tukey's pair-wise comparisons ($p<.05$) revealed that the experienced Japanese group was not significantly different from the native English group. All the other learner groups produced the unstressed vowels with relatively longer durations compared with the NE group.

Significant differences between inexperienced and experienced adult learners were found to exist in duration differences between the stressed and the unstressed vowels. Both language groups showed significant improvement in durational control with L2 experience measured by the length of residence in the US. However, the Korean-English learners, even the experienced speakers, did not manipulate duration in a native-like way. They still made significantly less difference in duration between stressed and unstressed vowels than the English native speakers. On the other hand, the experienced Japanese-English learners demonstrated native-like manipulation of duration in unstressed syllables. This difference may be due to characteristics of the first language, i.e., Japanese has a phonemic vowel length contrast, whereas Korean does not. The phonemic length contrast in Japanese may have sensitized the Japanese learners to durational differences in English and aided their acquisition of this correlate of English stress with increased experience with English. It may also be suggested that the production of a phonetic feature in L2 irrespectively of its phonological status in the learner's L1 can become more accurate (or native-like) with experience but that only the feature that is used to signal a phonological difference in L1 can be produced native-like.



<Figure 1> The mean ratio (+/- one standard error) of the duration of unstressed vowels to stressed vowels for the five groups. Lower bars indicate relatively shorter duration of the unstressed vowel.

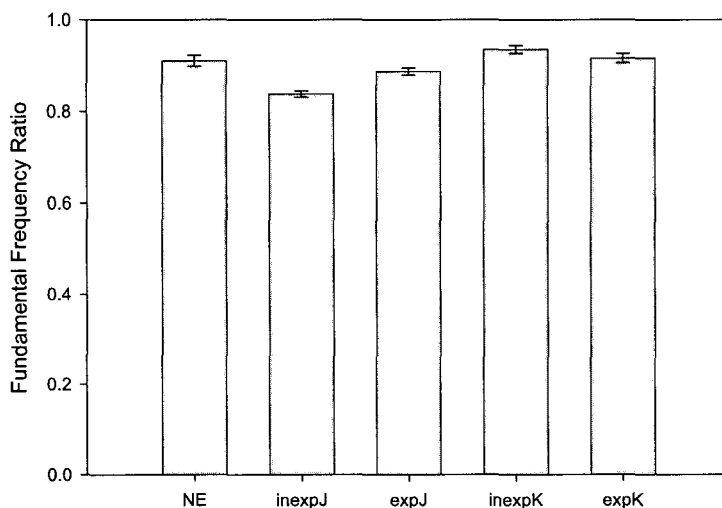
Figure 2 presents the mean ratio of the fundamental frequency of unstressed to stressed vowels for the five groups under investigation. All of the groups produced the unstressed vowels with lower F₀ than the stressed vowels. However, in terms of native-likeness, the Japanese learner groups, once again, documented improvement from non-native-like to native-like with experience. Specifically, the inexperienced Japanese group used bigger F₀ difference between the stressed and unstressed vowels than the native English group.

An ANOVA investigating the effect of group on the ratio of the F₀ of the unstressed to stressed vowels showed a significant effect [$F(4,827)=14,617, p<.01$]. Tukey's pair-wise comparisons ($p<.05$) revealed that all of the learner groups except the inexperienced Japanese group were not significantly different from the native English group. The inexperienced Japanese group produced the unstressed vowels with relatively lower F₀. The experienced group, however, produced native-like F₀ patterns, to support improvement with experience. This means that this group used F₀ differences to signal English stress more extensively than any other groups, although it cannot be readily answered why they have done so. Further research and replication of this finding will be needed before a meaningful interpretation can be made.

On the other hand, neither Korean group was significantly different from the native

English group in F0 manipulations, which means that the inexperienced Korean group also showed a native-like performance. Though not significant, however, the inexperienced Korean group (F0 ratio: 0.94) was farther apart from the native English group (F0 ratio: 0.91) than the experienced Korean group (F0 ratio: 0.92) was. This means that the inexperienced Korean group used a slightly higher F0 for the unstressed vowels than the native English group did.

The overall ease of acquisition of fundamental frequency as a correlate of prosodic prominence may be explained by its use in the prosodic systems of both Japanese and Korean. Japanese has pitch pattern at the lexical level, and Korean has pitch patterns at the phrasal level.

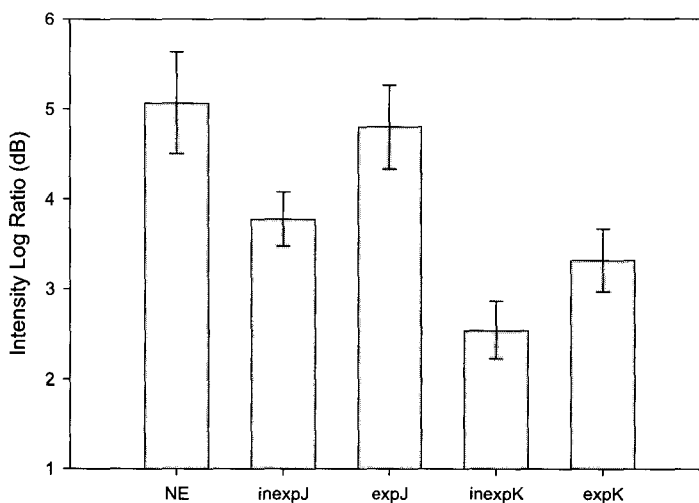


<Figure 2> The mean ratio (+/- one standard error) of the fundamental frequency of unstressed vowels to stressed vowels for the five groups. Lower bars indicate relatively lower fundamental frequency of the unstressed vowel.

Figure 3 presents the log ratio of the intensity for the stressed to unstressed vowels, calculated by subtracting the intensity (in dB) of the unstressed vowel from that of the stressed vowel. Higher bars represent a greater intensity difference between the stressed and unstressed vowels. An ANOVA investigating the effect of group on the log ratio of the intensity of the stressed to unstressed vowels showed a significant effect [$F(4,928)=5.899$, $p<.01$]. Tukey's pair-wise comparisons ($p<.05$) revealed that neither the inexperienced nor the experienced Japanese groups were significantly

different from the native English group but that both the inexperienced and the experienced Korean groups were significantly different from the native English group. Although the Korean groups made some differences in intensity between stressed and unstressed vowels, they used a significantly smaller difference than either the native English speakers or the Japanese learners.

For intensity differences also, both learner groups display a non-significant trend to become more native-like with experience, but the Korean groups remain significantly different from the native English group. This difference in intensity performance between the two language groups might be accounted for if the view is accepted that intensity is at least a secondary acoustic cue in identifying Japanese accent [22][23][24]. In other words, if intensity is indeed a secondary, but important cue to pitch accent in Japanese, familiarity with this acoustic feature might suggest that Japanese-English learners were able to more easily acquire the phonetic feature of intensity in English than were Korean-English learners.

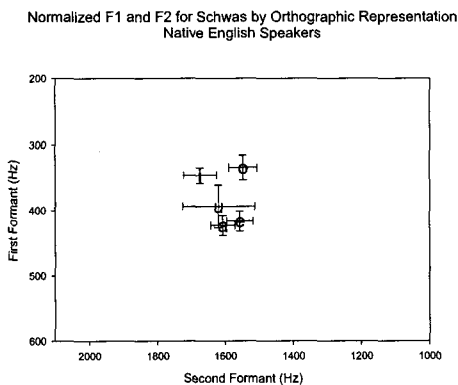


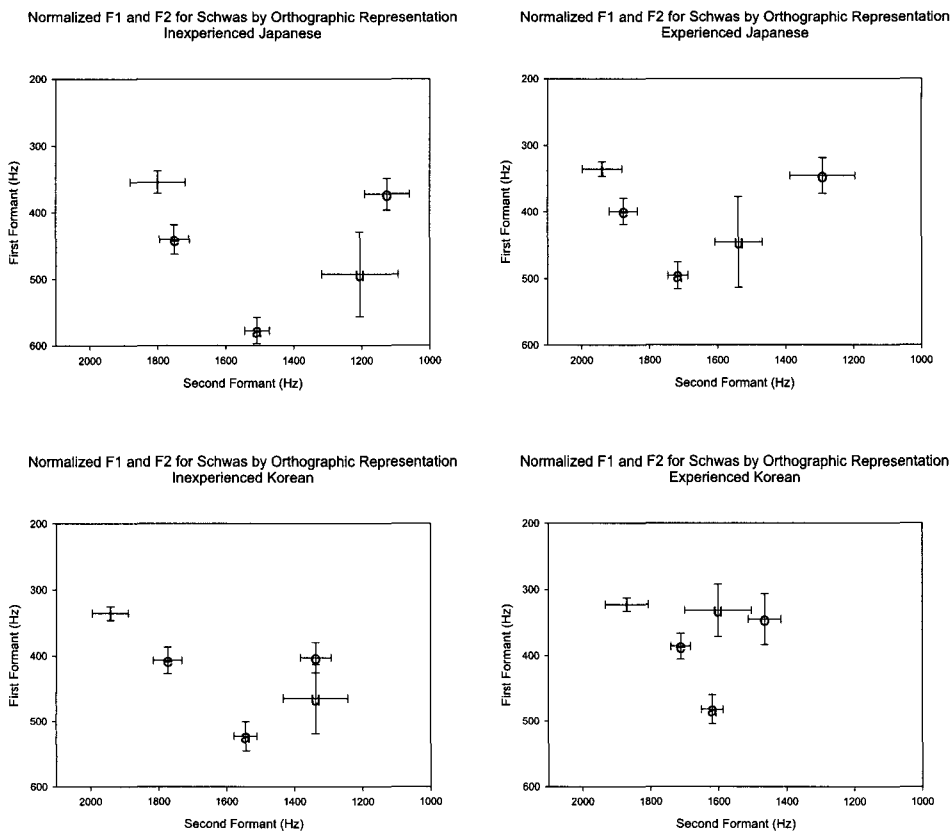
<Figure 3> The log ratio (+/- one standard error) of the intensity of the stressed to unstressed vowel calculated by subtracting the intensity (in decibels) of the unstressed vowel from that of the stressed vowel. Higher bars indicate relatively greater intensity of the stressed vowel.

Figure 4 presents normalized F1 and F2 for unstressed vowels (in Hz) produced by the five groups. The productions are presented separately for each orthographic spelling of the unstressed vowel.

All five different spellings for the unstressed vowel tended to converge in the native English group, whereas the unstressed vowels diverged by orthographic representation in all of the learner groups. In other words, all learner groups were non-native-like in their production of the English unstressed vowels. Instead of mid-central values of the formants, the learners produced vowels that were more dispersed in the vowel space. In general, the English unstressed vowels were produced with formant frequencies similar to full vowels with the same orthographic representation. For example, English unstressed vowels spelled “i” were produced in a high front [i] location. Thus, none of the learner groups seem to have acquired the reduced, i.e., centralized production of English unstressed vowels.

A comparison between inexperienced with experienced learner groups reveals that the inexperienced groups display even greater dispersion of the unstressed English vowels. This may suggest that the production of reduced vowel in English is a feature that can be improved with experience but that the native-like production may not be achieved, even after roughly 10 years of immersion experience in English. On the other hand, the relatively smaller dispersion found for the experienced Korean learners compared to the experienced Japanese learners might be accounted for by the Koreans’ sporadic use of their native central vowel targets, namely [i] or [ə]. The fact that Japanese has only peripheral vowels may explain the Japanese speakers’ consistently greater dispersion than their corresponding Korean groups.





<Figure 4> Normalized F1 and F2 for unstressed vowels
by orthographic representation for the five groups

4. General Discussion and Conclusion

This study specifically investigated the production of the English unstressed reduced vowels by the inexperienced and experienced Korean-English and Japanese-English learners. The acoustic correlates of the unstressed reduced vowels as opposed to the stressed vowels, i.e., duration, F0, intensity and vowel reduction, were analyzed. Table 4 summarizes the results of the study. The four phonetic features used to produce unstressed vowels in English are listed. The status of these phonetic features as relevant to the phonology of Korean and Japanese prosody is also indicated in the column labelled L1 (see also Table 1). In Table 4, *NL* indicates native-like performance and *NNL* indicates non native-like performance for a specific phonetic feature by either the inexperienced or experienced groups. In the column labelled *imp*, the improvement between the inexperienced and experienced groups is indicated. A indicates a significant improvement and a indicates a non significant trend towards

improvement.

<Table 4> Summary of the findings for the phonetic features used to realize the English unstressed vowel in inexperienced and experienced Korean and Japanese learners

	Korean				Japanese			
	L1	inexp	exp	imp	L1	inexp	exp	imp
Duration	No	NNL	NNL	☑	Yes	NNL	NL	☑
F0	Yes	NL	NL	✓	Yes	NNL	NL	☑
Intensity	No	NNL	NNL	✓	Yes?	NL	NL	✓
Reduction	No	NNL	NNL	✓	No	NNL	NNL	✓

As can be seen in Table 4, phonetic features used to realize English unstressed vowels that were also used in the L1 were produced in a native-like manner. It was either the case that both inexperienced and experienced groups produced the feature in a native-like manner, or that the only the experienced group produced the feature in a native-like way, demonstrating learning of that feature during the long length of residence in the US. Specifically, for the Korean learners, both groups produced F0 in a native-like manner. For the Japanese groups, both groups produced the feature of intensity in a native-like manner and the experienced group produced the features of duration and F0 in a native-like way. Thus, it seems that some L1 features are more readily transferable to the L2 and are used in a native-like way, even with short lengths of residence in the US. Perhaps the predominance of F0 in Korean prosody produced a high sensitivity to the use of F0 in a second language among the Korean learners. Note that the Korean learners only achieved native-like production for unstressed vowels in the domain of F0. The other features were produced in a non native-like manner, even by the experienced learners. Therefore, it seems that F0 is the primary and most accessible cue for prosody in the Korean language and may be transferred by learners at an early stage of L2 acquisition. However, the native-like use of intensity among the inexperienced Japanese learners can not be explained in similar fashion. Even if intensity is feature used in producing Japanese accent, it is not considered by any account to be a primary feature. Thus, this finding remains unexpected and may need verified in further studies before it can be fully accepted.

Features that were not used phonologically in the native language were not produced in a native-like way. However, experience with English did affect the production of these features to a certain degree. In most cases, there was a non-significant trend toward native-like production and, in one case, there was a significant improvement with experience. Specifically, the Korean groups exhibited a non significant trend toward native-like production for intensity and vowel reduction and a significant trend toward native-like production for the

feature of duration. The Japanese groups exhibited a non significant trend toward native-like production for vowel reduction, which is the only phonetic feature of unstressed English vowels that is not used in the Japanese prosody.

From the results, we may conclude that experience can affect the acquisition of L2 phonetic features that are not in the L1 to only a small degree, with the exception of duration in Korean learners. Although native-like production in vowel duration was not attained even with the experienced Korean learners, a significant improvement was observed compared with the inexperienced Korean learners, hence a \checkmark . It may be that vowel duration is a particularly perceptually salient and even when it is not used phonemically in the L1, duration may be relatively more easily acquired in the L2 than the other non-phonemic features in the L1, intensity and vowel reduction in this study (see, e.g., [43]).

In conclusion, the results of this study supported the view that adults who learn an L2 will come to produce the L2 phonetic features more accurately as they gain experience in the L2. The overall results also suggest that the extent to which a non-native speakers' production of the English unstressed vowel improved with experience in English varied as a function of L1 background.

References

- [1] J. Anderson-Hsieh, R. Johnson, K. Kochler, "The relationship between native speaker judgments of nonnative pronunciation and deviance in segmentals, prosody and syllable structure", *Language Learning*, Vol. 42, pp. 529-555, 1992.
- [2] A. Moyer, "Ultimate attainment in L2 phonology: The critical factors of age, motivation, and instruction", *Studies in Second Language Acquisition*, Vol. 21, pp. 81-108, 1999.
- [3] M. J. Munro, T. M. Derwing, "Foreign accent, comprehensibility, and intelligibility in the speech of second language learners", *Language Learning*, Vol. 49, pp. 285-310, 1999.
- [4] M. Pennington, J. Richards, "Pronunciation revisited", *TESOL Quarterly*, Vol. 20, pp. 207-225, 1986.
- [5] D. B. Fry, "Duration and intensity as physical correlates of linguistic stress". *Journal of the Acoustical Society of America*, Vol. 27, pp. 765-768, 1955.
- [6] T. Gay, "Physiological and acoustic correlates of perceived stress", *Language and Speech*, Vol. 21, pp. 347-353. 1978.
- [7] R. McAllister, J. E. Flege, T. Piske, "The influence of L1 on the acquisition of Swedish quantity by native speakers of Spanish, English and Estonian", *Journal of Phonetics*, Vol. 30, pp. 229-258, 2002.
- [8] J. Flege, "Second-language speech learning: Theory, findings, and problems", In W. Strange (Ed.), *Speech perception and linguistic experience: Issues in cross-language research* (pp. 233-277), Timonium, MD: York Press, 1995.

- [9] B. Lee, S. G. Guion, T. Harada, "Acoustic analysis of the production of unstressed English vowels by early and late Korean and Japanese learners", *Studies in Second Language Acquisition*, Vol. 28, pp. 487-513, 2006.
- [10] P. Trofimovich, W. Baker, "Learning second language suprasegmentals: Effect of L2 experience on prosody and fluency characteristics of L2 speech", *Studies in Second Language Acquisition*, Vol. 28, pp. 1-30, 2006.
- [11] J. Flege, I. MacKay, "Perceiving vowels in a second language", *Studies in Second Language Acquisition*, Vol. 26, pp. 1-34, 2004.
- [12] J. Flege, O-S. Bohn, S. Jang, "Effects of experience on non-native speakers' production and perception of English vowels", *Journal of Phonetics*, Vol. 25, pp. 437-470, 1997.
- [13] W. Baker, P. Trofimovich, M. Mack, J. Flege, "The effect of perceived phonetic similarity on non-native sound learning by children and adults", In B. Skarabela, S. Fish, A.H.-J. Do (Eds.), *Proceedings of the Annual Boston University Conference in Language Development*, Boston: Cascadilla Press, pp. 36-47, 2001.
- [14] J. Flege, N. Takagi, V. Mann, "Japanese adults can learn to produce English /t/ and /l/ accurately", *Language and Speech*, Vol. 38, 25-5, 1995.
- [15] D. Crystal, *Prosodic systems and intonation in English*, Cambridge: Cambridge University Press, 1969.
- [16] A. C. M. Rietveld, F. J. Koopmans-van Beinum, "Vowel reduction and stress", *Speech Communication*, Vol. 6, pp. 217-229, 1987.
- [17] F. W. Householder, *Linguistic Speculations*, Cambridge: Cambridge University Press, 1971.
- [18] S-A. Jun, *The phonetics and phonology of Korean prosody*, Doctoral dissertation, Ohio State University, 1993.
- [19] H-S. Kim, J-I. Han, "Vowel length in modern Korean: An acoustic analysis", In B-S Park and J. H. Yoon (Eds.), *Proceedings of the 11th International Conference on Korean Linguistics* (pp. 412-418), Seoul: Hanshin, 1998.
- [20] M. Sugito, "Akusento, intoneshon no hikaku [Comparison of accent and intonation]", In T. Kunihiro (Ed.), *Nichieigo hikaku koza: Onsei to keitai [Series of Japanese and English contrastive linguistics: Phonology and morphology]* Tokyo: Taishukan, pp. 107-183, 1980.
- [21] M. E. Beckman, *Stress and non-stress accent*, Dordrecht, Netherlands: Foris, 1986.
- [22] J. V. Neustupny, "Nihongo no akusento wa kootee akusento ka [Is the Japanese accent a pitch accent?]", *Bulletin of the Phonetic Society of Japan*, pp. 121, 1-7, 1966.
- [23] Y. Homma, "Visicorder de mita Kyoto hogen no akusento [Pitch accent in Kyoto speech through a visicorder",] *Bulletin of the Phonetic Society of Japan*, Vol. 137, pp. 11-15, 6, 1971.
- [24] R. Glen, *Japanese lexically specified accent: A word-level prominence system with both pitch and loudness as components*, Doctoral dissertation, Indiana University, 2003.
- [25] F. Ramus, M. Nespou, J. Mehler, "Correlates of linguistic rhythm in the speech signal", *Cognition*, Vol. 73, pp. 265-292, 1999.
- [26] N. Tsujimura, *An introduction to Japanese linguistics*, Malden, MA: Blackwell, 1996.
- [27] J. Archibald, "Transfer of L1 parameter settings: some empirical evidence from Polish metrics", *Canadian Journal of Linguistics*, Vol. 37, pp. 301-339, 1992.
- [28] J. Archibald, "The learnability of English metrical parameters by adult Spanish speakers", *International Review of Applied Linguistics and Language Teaching*, Vol. 31/32, 129-142,

1993.

- [29] J. Archibald, "The acquisition of English stress by speakers of nonaccentual languages: lexical storage versus computation of stress", *Linguistics*, Vol. 35, pp. 167-181, 1997.
- [30] P. H. Erdmann, "Patterns of stress-transfer in English and German", *International Review of Applied Linguistics*, Vol. 11, pp. 229-241, 1973.
- [31] S. G. Guion, T. Harada, J. J. Clark, "Early and late Spanish-English learners' acquisition of English word stress patterns", *Bilingualism Language and Cognition*, Vol. 7, pp. 207-226, 2004.
- [32] J. L. Mairs, "Stress assignment in interlanguage phonology: An analysis of the stress system of Spanish speakers learning English", In S. M. Gass & J. Schachter (Eds.), *Linguistic perspectives on second language acquisition*, Cambridge: Cambridge University Press, pp. 260-283, 1989.
- [33] J. Arciuli, L. Cupples, "Effects of stress typicality during spoken wordrecognition by native and nonnative speakers of English: Evidence from onset gating", *Memory and Cognition*, Vol. 32, pp. 21-30, 2004.
- [34] S. M. Davis, M. H. Kelly, "Knowledge of the English noun-verb stress difference by native and nonnative speakers", *Journal of Memory and Language*, 36, pp. 445-460, 1997.
- [35] R. H. Hammond, "Error analysis and the natural approach to teaching foreign languages", *Lenguas Modernas*, Vol. 13, pp. 129-139, 1986.
- [36] J. Fokes, Z. S. Bond, M. Steinberg, "Patterns of English word stress by native and non-native speakers", In M. P. R. van den Broecke & A. Cohen (Eds.), *Proceedings of the Tenth International Congress of Phonetic Sciences*, Dordrecht: Foris, pp. 682-686, 1984.
- [37] J. Flege, O.-S. Bohn, "An instrumental study of vowel reduction and stress placement in Spanish-accented English", *Studies in Second Language Acquisition*, Vol. 11, pp. 35-62, 1989.
- [38] S. G. Guion, "Knowledge of English word stress patterns in early and late Korean-English learners", *Studies in Second Language Acquisition*, Vol. 27, pp. 503-533, 2005.
- [39] H.-S. Koo, "Umhyang chukjungkwa jikak pandane uihan hankukin yeongeoui unyul yeongu [A study using acoustic measurements and perceptual judgment to identify prosodic characteristics of English as spoken by Koreans]", *Speech Sciences*, Vol. 2, pp. 95-108, 1997.
- [40] P. J. Anderson, *The interstress interval as an indicator of perceived intelligibility among nonnative speakers of English*. Doctoral dissertation, Wichita State University, 1993.
- [41] T. Harada, "Age of acquisition effects on English stress in Japanese-English learners", Paper presented at the 2004 AAAL Conference, Portland, OR, 2004.
- [42] D. D. Hammill, V. L. Brown, S. C. Larsen, J. L. Weiderholt, *Test of Adolescent and Adult Language* [3rd ed.], Austin, Texas: Pro-ed, 1994.
- [43] O.-S. Bohn, "Cross language speech perception in adults: first language transfer doesn't tell it all", In *Speech Perception and Linguistic Experience: Issues in Cross Language Research* (Edited by W. Strange), Timonium, MD: York Press, pp. 279-304, 1995.

접수일자: 2006년 11월 10일

게재결정: 2006년 12월 20일

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