

# A Phonetic Analysis of Korean EFL Learners' Production of English Reduced Vowel

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**Kwon, Harim. 2007. A Phonetic Analysis of Korean EFL Learners' Production of English Reduced Vowel.** *SNU Working Papers in English Linguistics and Language* 6, 1-13. This study investigates the phonetic properties of English reduced vowel of Korean EFL learners. Five native speakers of Korean (experimental group) and two native speakers of English (control group) participated in the study. While pronouncing English reduced vowels, Korean EFL learners were different from English native speakers in two acoustic features. Firstly, the learners' duration of the reduced vowels was significantly longer than that of the native speakers. Secondly, the vowel quality (first and second formant frequencies) of reduced vowels was also different between the learners and the native speakers. The formant frequencies of English reduced vowels of Korean EFL learners were more like those of native speakers' /ɜ/ or /ʊ/ rather than the reduced vowels. However, the learners were nativelike in having a lower fundamental frequency for the reduced vowels. The results are discussed in terms of the effect of the first language of the learners, especially the effect of phonological status of certain phonetic features.

**Keywords:** English reduced vowels, L1 effect, duration, pitch, formant frequencies

## 1. Introduction

English is a stress-timed language. English has both full and reduced vowels varying in duration and perceived prominence, which makes unstressed syllables less salient than stressed syllables (Crosswhite 2001). Thus, to speak more fluently and comprehensibly, L2 learners of English need to learn to produce English reduced vowels accurately.

The ability to accurately produce English reduced vowels might be affected by the learners' first language (L1). McAllister, Flege, and Piske (2002), in their feature hypothesis, proposed that L2 phonetic features that are not used to signal phonological contrasts in learners' L1 will be more difficult to acquire than those that are used. They also suggested

that their perceptual system is tuned only to phonologically meaningful features in their L1, and the phonetic features that are not phonologically meaningful will be underattended. This difficulty in perceiving phonetic features that are not phonologically meaningful will be reflected in low production accuracy of these features in the L2 (Flege 1995).

The aim of this study is to investigate the phonetic properties of Korean EFL learners' production of English reduced vowel. The phonetic properties of a reduced vowel can be summarized as shorter duration, lower pitch, lower intensity, and reduced formant, with more details of which will be dealt with later. Phonetic properties which are not phonologically meaningful in learners' L1 are difficult to acquire, and Korean does not have phonemic intensity, duration, pitch, or tenseness distinction in vowels. Therefore, Korean native speakers, in producing English reduced vowel, will show difference in the various phonetic properties in comparison with English native speakers. This study examines the phonetic properties of Korean EFL learners' production of English reduced vowel and defines the difference between Korean and English speakers in their production of English reduced vowel.

## **2. Literature review**

### **2.1 Phonetic properties of English reduced vowel**

The nature of English reduced vowels has been much considered. Any unstressed vowels of English are perceived as being reduced, which means lower in pitch, shorter in duration, less loud in intensity, and somewhat reduced in vowel quality (Fry 1955). Vowels without stress in any lexical words, or vowels in any function words are mostly reduced since they lack stress.

The production and perception of stress cannot be attributed to any one parameter. Therefore, the reduction of unstressed vowel should be interpreted in terms of the strength of the F0, duration, and intensity parameters. F0 is an acoustic correlate of pitch, which is decided by the shape and length of the speaker's vocal tract. Intensity is so easily influenced by the recording environment that cannot be meaningful unless used as a ratio between stressed and unstressed vowels. For the above reasons, it is common to use the ratio between stressed and

unstressed vowels. To use a ratio rather than an actual measure can have a merit in defining the prosody of a language, which means the contrastiveness between the stressed and unstressed syllables. However, the actual acoustic characteristics of any sound can be neglected, which is worth noticing for the English reduced vowel.

As for vowel quality, reduced vowels are more central than stressed ones. According to Hillenbrand, Getty, Clark, and Wheeler (1995), which investigated over a hundred English native speakers pronunciation of full vowels, suggested that the acoustic correlates of vowel qualities are the frequency values in harmonics of spectrogram, that is formant frequencies. Hillenbrand et al. measured the formant frequencies from F1 to F4, which include all the information of human voice, and among them, F1 and F2 are more significantly related to the vowel quality (Lindblom 1963, Ladefoged 1996).

## 2.2 Phonetic properties of Korean vowel

As one goal of this study is to investigate the effects of L1 on the production of English reduced vowel in Korean learners, some understanding of the phonetic properties of Korean vowels is needed.

Korean differs from English in its vowel inventory. Modern Seoul Korean does not have a length distinction or tense-lax vowel opposition (Kim & Han 1998). Duration, intensity, and vowel reduction have not been described as meaningfully contrastive in Korean vowels. Although vowel duration signals a phonemic contrast in some dialects of Korean, its phonemic function has completely disappeared in the modern standard Seoul dialect, which is the native dialect of the Korean participants of this study.

## 2.3 L2 learners' production of English reduced vowel

A few studies have investigated phonetic aspects of the production of English unstressed reduced vowels by L2 learners. Flege and Bohn (1989) examined stress placement and vowel reduction through the production in isolation of English word pairs derived from the same morpheme (e.g. *able* vs. *ability*) by seven English Native Speakers and seven Spanish Native Speakers. The difference between stressed and unstressed vowels

in duration and intensity was measured, and vowel quality was measured by the vertical distance of the tongue from the hard palate. Their findings indicated that Spanish Native Speakers were more nativelike in stress placement and implementation of the stressed versus unstressed contrast than in vowel reduction. More specifically, Spanish Native Speakers differentiated stressed and unstressed vowels in terms of duration and intensity in most cases. However, the Spanish learners of English showed much less vowel reduction in terms of tongue height than the English Native Speakers.

Another study on the L2 learners' phonetics of unstressed reduced vowel production, Lee, Guion, and Harada (2006) investigated the production of unstressed vowels in English by early and late Korean- and Japanese-English bilinguals. Their purpose is not to examine the phonetic features of reduced vowel production but to examine prosody of learners, and thus they are interested in the difference between the stressed and non-stressed vowels rather than the acoustic properties of reduced vowel. Therefore, instead of analyzing the measured values, they calculated the ratio between the measures of the stressed and unstressed vowels, for duration, intensity, pitch and formant.

In general, their findings support the effect of the phonological status of first language phonetic features and age of acquisition. All the experimental groups were nativelike in having a lower fundamental frequency for reduced vowels. Both Korean groups made less difference in both the intensity and the duration between unstressed and stressed vowels than the native speakers of English. The Japanese speakers, whose native language has a phonemic length distinction, produced more nativelike durational patterns. Finally, the vowel quality of reduced vowels was different from the native control group's for all the experimental group.

Their study surely contributes to showing the L1 effect in prosody, by calculating the ratio of reduced vowel's measures to the stressed ones, but leaves a gap for another related issue, the effect of L1 in the production of the reduced vowel itself, rather than prosodic features. In addition, a carrier phrase, "I said \_\_\_\_ this time." was used in their experiment, to ensure a constant prosodic environment for the target word production. This use of carrier phrase can be a weak point of their experiment, since it is too unnatural and arbitrary.

Here stands the need for this study. Rather than the prosodic features,

the acoustic properties of a reduced vowel itself can be affected by learners' L1. And by comparing the acoustic properties of EFL learners production to those of native speakers in a more natural condition, the L1 effect on phonetics can be demonstrated.

### 3. Research questions and hypotheses

The research question for this study is as follows.

- (1) Research Question: Are the acoustic characteristics of English reduced vowel produced by Korean EFL learners different from those spoken by English native speakers?

Based on the previous discussion of the feature hypothesis (McAllister, Flege & Piske 2002), which stated that the phonetic properties that are not phonologically meaningful in learners' L1 are difficult to acquire, and the findings of Lee, Guion and Harada (2006), the hypotheses for this study are as follows.

- (2) Hypotheses

Hypothesis 1: The acoustic characteristics of English reduced vowel produced by Korean EFL learners are different from those spoken by English native speakers in terms of duration. Korean EFL learners will have longer duration for reduced vowels than English native speakers.

Hypothesis 2: The acoustic characteristics of English reduced vowel produced by Korean EFL learners are different from those spoken by English native speakers in terms of pitch, which can be represented as the difference in F0 mean. Korean EFL learners will have higher F0 for reduced vowels than English native speakers.

Hypothesis 3: The acoustic characteristics of English reduced vowel produced by Korean EFL learners are different from those spoken by English native speakers in terms of vowel quality, represented by F1, F2 means.

All the hypotheses commonly assume that Korean EFL learners' production of English reduced vowel will be less reduced than that of

English native speakers. The intensity of the vowel is excluded, since this study will not analyze the ratio but the actual measures of the reduced vowel.

## 4. Method

### 4.1 Participants

Five native speakers of Korean participated in this experiment, and two English native speakers served as the control group. All of the participants are female in their 20~30s ( $n=7$ ,  $\text{mean}=26.71$ ,  $\text{s.d.}=2.50$ ). One of the main interests of this study is the frequencies, which is largely affected by the speakers' biological sex and age. Therefore, if the number of participants are not large enough to include both sexes and all the age ranges, it is better to control those factors. All the participants are graduate students, or working at university.

The Korean participants' level of English proficiency was strictly controlled to include only advanced learners. The participants' level of proficiency was objectively confirmed by standardized tests, TEPS. The TEPS scores of the participants are all above 900 ( $n=5$ ,  $\text{mean}=931.00$ ,  $\text{s.d.}=21.04$ ), and especially their scores of Listening Comprehension part are very high ( $\text{mean}=389.00$ ,  $\text{s.d.}=6.52$ ). According to the information provided by the Seoul National University Language Institute, which organizes and conducts the test, learners of holistic score above 901 (Listening Comprehension above 361) is described as having native level of communicative competence. By controlling the participants' level of English proficiency to include only advanced learners, the difference in acoustic measures can be attributed not to the lack of English competence, but to the effect of the learners' L1.

In addition, all of the nonnative participants have no experiences in any English-speaking country, if any, less than six months' experiences.

### 4.2 Materials and procedures

The test material is a passage of English containing 20 tokens of the 7 target form, such as *to*, *of*, *the*, *with*, *is*, *in*, and *a* (See Appendix for more information). All of the target items are prepositions and articles,

which are function words. English function words lack lexical stress, or do not carry sentential accent, which makes them the perfect target of vowel reduction. That is the reason why function words are chosen as the target item of this study. A constant prosodic environment for all the target words can be guaranteed. Unlike Lee, Guion and Harada (2006), using a carrier phrase to make the same prosodic environment, this study employs the function word as its target, eliminating the need for the carrier phrase.

Among the prepositions of the given passage, *for* and *are* are excluded from the analysis. In those words, the vowel is co-articulated with the following consonant *r*, which makes it impossible to distinguish a boundary between the vowel and the coda consonant.

For the production task, the passage were presented in a printed form. The participants were asked to read the passage aloud, after 5 minutes for familiarization. Their production was recorded in MP3 format.

### 4.3 Measurements and analysis

The recordings were analyzed using *Praat* (version 4.6.06). Duration (in milliseconds), and the frequencies (F0, F1, F2, in hertz) were measured for the reduced vowels of 20 function words in the passage. F1, F2 were measured on the assumption that they are the acoustic correlates of vowel quality. Fundamental frequency and formant values were sampled at the steady-state times.

There were four cases of non-applicable tokens. In the sequence of *to make*, the vowel of *to* reduced to nothing, and then the following /m/ became syllabic. 4 speakers (1 native, 3 nonnative) pronounced *to make* in that way, which were excluded in the analysis of this study. Therefore, the total number of the cases are 136, consisting of 39 cases of native group (2 speakers \* 20 tokens - 1 non-applicable token) and 97 cases of nonnative group (5 speakers \* 20 tokens - 3 non-applicable tokens). The above measures were then submitted to a *t*-test with two independent sample groups (NS vs. Korean native speakers).

## 5. Results and discussion

This section describes Korean EFL learners' production of English reduced vowel in terms of duration, pitch, and the first and second formant frequencies. Table 1 presents the descriptive statistics.

(3) Table 1. Descriptive Statistics

		N	Mean	Std. Deviation
Duration (ms)	NS	39	43.7713	11.65498
	NNS	97	56.3609	11.88970
Pitch (F0) (Hz)	NS	39	190.218	22.3847
	NNS	97	181.181	16.5571
F1 (Hz)	NS	39	482.772	73.1431
	NNS	97	431.878	71.6354
F2 (Hz)	NS	39	1807.097	277.8008
	NNS	97	1373.212	278.4605

A relatively large difference between native speakers (NS) and Korean EFL learners (NNS) are noticed in F2 mean. The F2 mean of Korean EFL learners is lower than the control group (English native speakers) by 433.8851 Hz.

To evaluate whether the mean difference between the groups is statistically significant, an independent samples *t*-test was implemented. Table 2 presents the results.

(4) Table 2. Independent Samples T-test

	T	df	Sig. (2-tailed)
Duration	-5.616	134	.000*
Pitch (F0)	2.590	134	.011*
F1	3.725	134	.000*
F2	8.223	134	.000*

The *t*-test results demonstrate that duration, F0 (pitch), F1, F2 mean



differences were significant between Korean EFL learners and English native speakers ( $p < .05$ ).

### 5.1 Hypothesis 1: duration

The first hypothesis expecting that Korean EFL learners will have longer duration for reduced vowels than English native speakers was supported. As for the duration of the reduced vowel, Korean EFL learners showed significantly longer duration than English native speakers, and the gap was 12.58965 milliseconds (ms).

Crosswhite (2001) investigated the pattern of vowel reduction cross-linguistically and suggested that the reduced vowels, existing only in stressed-timed languages, such as English, are morales. This lack of mora is represented as the extra-short duration of a vowel, and thus the minimum duration of reduced vowels is 0 ms (completely lost). Given that the durational range of vowels with one mora starts from 40 ms, morales reduced vowel's durational range can be from 0 to 50 (ms), with a 10 ms' overlap.

The result of this study is consistent with the view of Crosswhite, with native duration of 43.7713 ms, while Korean EFL learners, whose L1 is syllable-timed language without both the vowel reduction and morales vowel, show somewhat longer duration. Since whether the vowel is moraic or not is no longer phonologically meaningful in modern Seoul dialect of Korean, the learners have difficulty in perceiving and producing the extra short duration of reduced vowels accurately.

### 5.2 Hypothesis 2: pitch

The second hypothesis expecting that Korean EFL learners will have higher F0 for reduced vowels than English native speakers was rejected. As for the pitch of the reduced vowel, Korean EFL learners showed significantly lower rather than higher F0 than English native speakers, and the gap was 9.0365 Hertz (Hz).

This discrepancy between the results and the hypothesis may be due to the different attitudes of the participants. When recording the passage, all native participants were so confident and proud. Unlike the native speakers, however, Korean participants were very timid and diffident.

The researcher do not let the participants know about the purpose of recording in advance. When asked after the experiment, native speakers reported that they were thinking that the recording would be used as a teaching material so that they tried to be as accurate and clear as possible. However, the Korean participants said they were thinking that their recording would be analyzed in a way or another, so that they tried to as natural or nativelike as possible. Worrying that any weakpoint of their pronunciation would be revealed, Korean participants were far more nervous than the native speakers, which may result in the lower fundamental frequency. Another possibility is the individual difference.

In any cases, Korean EFL learners seem to be able to produce more reduced properties in terms of F0, since they did not show higher F0 but lower than native speakers. This result seem to be consistent with the results of Lee, Guion and Harada (2006). They also reported that all learners were the most nativelike in pitch of any other acoustic properties.

### 5.3 Hypothesis 3: vowel quality

The last hypothesis expecting that Korean EFL learners will different in F1, F2 for reduced vowels from English native speakers was supported. As for F1 of the reduced vowel, Korean EFL learners showed significantly lower F1 than English native speakers, and the gap was 50.8934 Hz. As for F2, Korean EFL learners was again significantly lower F2 than English native speakers, and the gap was 433.8851 Hz.

According to Hillenbrand et al. (1995), the first and second formant values for female adults 523-1588 is for the vowel /ɜ/ of *heard*, 519-1225 is for /ʊ/ of *hood*. Considering the gap between F1 and F2, Korean EFL learners production of reduced vowel is very similar to native speakers' /ɜ/ or /ʊ/ rather than the reduced vowel.

In sum, every aspect of English reduced vowels is troublesome to Korean learners, except pitch. They have difficulties in accurately perform English reduced vowel in terms of duration and vowel quality. Their understanding of English stress seems to be limited only to pitch excluding the quality or duration of the vowels. Korean learners seem to notice the lower pitch, the most salient acoustic feature of the reduced vowels but not the other features, such as duration or vowel quality.

## 6. Conclusion and limitation

This study investigated Korean EFL learners' production of English reduced vowel from the perspective of how the learners' L1 influence the performance of the learners. Previous studies of Korean speakers' acquisition of English reduced vowel have mainly been devoted to explaining the prosodic difference between stressed and unstressed vowels by examining the acoustic features. These previous studies are based on the assumption that as long as the unstressed vowels are contrastive from the stressed vowels, the phonetic properties of the unstressed vowel do not matter.

This study started from the curiosity about the phonetic properties of the reduced vowels themselves. Based on the assumption that Korean learners', especially in EFL settings, have great difficulties in acquiring the accurate phonetic properties of English reduced vowel, even though they can differentiate the stressed and unstressed vowel.

The findings of this study imply that almost every aspect of English reduced vowels is troublesome to Korean learners. They have difficulties in accurately perform English reduced vowel in terms of duration and vowel quality. Their understanding of English stress seems to be limited only to pitch excluding the quality or duration of the vowels.

There are some limitations in this study. First of all, this study used a passage reading rather than an authentic conversation as its material. Secondly, there are only 5 participants in experimental group, all of whom are female in their 20s. It would have been better if the number of participants are plenty enough to enable the between-group comparison. As a future study, analyzing the acoustic properties of function words in real authentic conversations of more various participants including both sexes and all the age range would be interesting. And, to see whether the difficulties of Korean learners in performing English reduced vowels is due to their inability to perceive the vowels or not, another experiment including a perception test, would be better. I leave these kinds of questions for future research.

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## Appendix

### Reading Passage

Phonetics is concerned with describing speech. There are many different reasons for wanting to describe speech, which means that there are many different kinds of phoneticians. Some are concerned with the sounds that occur in the languages of the world. Others are more concerned with helping people speak a particular form of English. Yet, others are looking for ways to make computers talk more intelligibly, or to recognize whatever is said to them. For all these purposes, phoneticians need to find out what people are doing when they are talking and how the sounds of speech can be described.