Influence of Prosody on Korean Word Production by Non-heritage Learners

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1. Introduction

The challenge for learners of a non-heritage language extends beyond learning new sounds (phonemes), vocabulary or syntax. The learner must also acquire prosody, which refers collectively to variations in pitch, amplitude, tempo, rhythm, and intonation of speech. Prosody can be examined at the word, phrasal or whole utterance level, and thus is considered a "suprasegmental" feature in that it extends beyond a single phoneme (segment). It contains information that is both linguistically-relevant and relevant to the particular speaker.

Word prosody can be described in terms of tone, stress, length (duration), and pitch-accent. The pattern of variation of these qualities and their linguistic significance is language-specific, e.g. in Mandarin, which is a tone language, pitch variation can change the meaning of a word. In English, which is a stress-timed language, stressed syllables recur at fixed intervals, and are produced with higher pitch, longer duration, and greater amplitude than unstressed syllables. In Japanese, which is a pitch-accent language, accent is placed on a particular syllable and is often invariable (Ladefoged 2006). In these ways, suprasegmental variation is confounded with variation at the segmental level, as phonemic distinctions can also be signaled by differences in pitch and duration.

For non-heritage learners, it is important to become proficient at producing the correct prosody of their new language. Incorrectly produced, native speakers can easily identify foreign accent. Shin (2005) demonstrated that prosodic structure and intonational pattern (variation in pitch) heavily influence listeners' judgments of foreign accent. Shin (2005) reported that native speakers could detect foreign accent based solely on intonation, without segmental information. Additionally, learning new prosodic patterns may be confounded by patterns of segmental and suprasegmental variation from the native language. In previous work, we have demonstrated cross-language interference in production at the segmental level for native English speakers learning Korean (Kim & Lotto 2002, see also Lotto, Sato & Diehl 2004, for an example with Japanese and English). In the present work, we examine segmental and suprasegmental interference.

2. Korean Suprasegmental and Segmental Variation

During the Middle Korean period, from the early 10th until the end of the 16th century, tone (pitch) varied lexically, i.e. distinguished word meaning in Korean. This phenomenon can be explained by contact with the Chinese of the period, and subsequent influx of Chinese-derived vocabulary into Korean. Middle Korean tone could be described as either high or low, or rising (which was the combination of a low and high tone within a syllable). In modern Korean, tone differences are perceived only in a few nonstandard dialects, such as that of Kyengsang or Hamkyeng. But in the standard dialect, in lieu of variation in tone, we find differences in vowel length. That is, long vowels replace rising tones, and short vowels replace high or low tones. Finally, while we can generalize, it is important to bear in mind that there are some dialects, viz. that of Ceycwu and those from isolated areas in North Korea, that show neither tone nor vowel length contrasts (Sohn 1999).

2.1. Vowel Length Differences

There are ten vowel phonemes in Korean, shown in Table 1 below. The vowels are represented in both Yale Romanization and IPA (International Phonetic Alphabet) symbols, which appear in square brackets.

Table 1. Korean Vowel Phonemes

	Front		Central	Back
	Unrounded	Rounded		
High	i [i]	wi [y]	u [ɨ]	wu [u]
Mid	ey [e]	oy [ø]	e [ə]	o [o]
Low	ay [ɛ]		a [a]	

All ten vowels have long and short variants. The long vowels are pronounced about 1.5 times to 2 times longer than their short counterparts. Although vowel length is phonemic, this variation is not indicated in Korean orthography. Table 2 shows monosyllabic noun pairs varying contrastively in vowel length. For convenience, a long vowel in the following examples is represented by a colon, customary of Yale Romanization.

Table 2. Korean Minimal Pairs with Vowel Length Difference

Short Vowel	Glossary	Long Vowel	Glossary
mal	horse	ma:l	speech
nwun	eye	nwu:n	snow
pam	night	pa:m	chestnut

Vowel length variation as a contrastive feature is also found in disyllabic words, such as pwu:ca 'rich' , pwuca 'father & son'; ce:k-ta 'small amount', cek-ta 'to write'. In addition, some Korean words are simply pronounced with long vowels and do not have short vowel counterparts, such as sa:lam 'person', se:m 'island', and sa:l-ta 'to live'. Other Korean words are likewise pronounced with short vowels, and do not have long vowel counterparts, such as tal-ta 'sweet', sim-ta 'to plant', and salm-ta 'to boil'. Finally, for some sino-Korean morphemes, a vowel is produced as either long or short (Kim 2006).

However, vowel length is a contrastive feature only in word-initial syllables. That is, if a monosyllabic word containing a long vowel appears in a non-initial position in a compound word, the long vowel is shortened, e.g. nwu:n 'snow' becomes nwun in huynnwun (huyn 'white' + nwun 'snow'). We have also observed that a long vowel in a root morpheme remains long only if the morpheme is attached to a suffix beginning with a consonant, as in wu:s-ta 'to laugh' and wu:s-ko 'laugh and'. But when the same morpheme is attached to a suffix beginning with a vowel, the long vowel is shortened, as in wus-ess-ta 'laughed'.

Such complicated phonological rules yield inconsistent production, especially in words that do not have minimal pairs based on vowel length. Older speakers of standard Korean preserve length differences clearly; younger speakers do not (Sohn 1999; Lee & Ramsey 2000). Park (1994) has also reported that in a perception experiment, many native speakers of Korean fail to distinguish vowel length contrastively.

But in spite of these inconsistencies, Korean language textbooks indicate that vowel length variation is important to clear communication in modern Korean, and therefore should be taught and learned well (Kim 1992; Lee 2002; Kim 2006).

2.2. Tonal Differences

Tonal difference is still distinctive in the dialects of Kyengsang (located in the southeastern part of the Korean peninsula) and Hamkyeng (located in the northeastern area). Although these dialects preserve tonal patterns, they differ from those of Middle Korean. With considerable variation in tonal patterns among dialects, and even within the same dialect, tone is nevertheless generally represented

as high (H), mid (M), and low (L). A low tone is also produced as a rising tone in some dialects. Table 3 shows Korean words differing in tone.

Table 3. Korean Minimal Triplets with Tone Difference

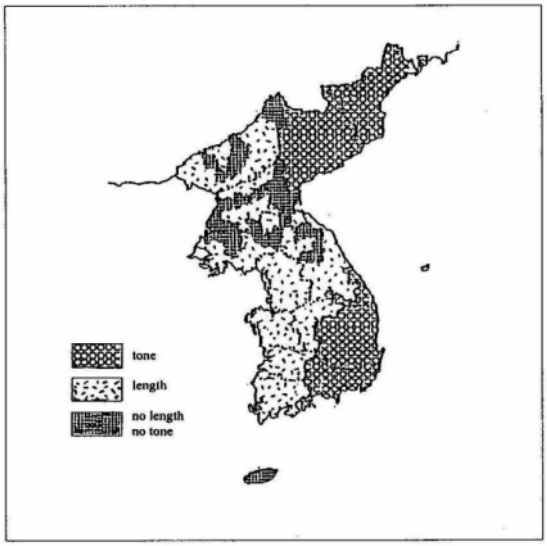
	High Tone	Mid Tone	Low Tone
	Glossary	Glossary	Glossary
mal	horse	measuring unit	speech
pay	pear	ship or belly	double
son	guest	hand	loss

Here we examine three dialects based on prosody (see Figure 1 below). The first pattern indicates the areas with tone contrasts; the second, those with length contrasts; the third, those with neither tone contrasts nor length contrasts.

The purpose of this study is to examine the influence of the prosodic properties of English on learning Korean (as a non-heritage language). In particular, we examine whether native speakers of English can produce vowel length differences in Korean words presented in the standard dialect. The potential for interference between the segmental and suprasegmental structures of the two languages is of particular interest. While English does have variation in vowel length, vowel length differences are inherent to the vowels themselves, and are not distinguished phonemically on the basis of length alone. For example, the vowel in "beat" is typically produced longer than the vowel in "bit." We may predict, therefore, since vowel length does not vary independently from vowel identity in English, learners will have difficulty with vowel length distinction in Korean. We test this by examining whether the duration of Korean vowels produced by non-native speakers vary systematically as a function of phonemic vowel length. The fundamental frequency (f0, voice pitch) and amplitude of the vowels are also measured to determine whether these variables are used to distinguish words in lieu of duration variation.

One might expect non-native speakers to try to enforce their English stress patterns onto the production of Korean words. These patterns consist of increased duration, amplitude and f0 placed on syllables with primary stress. This is over-learned behavior for English speakers. In the present experiment, these stress patterns may show up as variation in measured properties, and would be a function of the number of syllables (a suprasegmental feature) as opposed to vowel length (a segmental feature). Given the inconsistency of length contrast in learners' input, one might further expect substantial native language interference with the perception and production of this contrast.

Figure 1. Dialect Areas of Word Prosody in Korean



Note. From *The Korean Language* (p. 61), by Ho-Min Sohn, 1999, Cambridge, UK: Cambridge University Press.
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3. Experiment

3.1. Subjects

Twelve non-heritage learners of Korean participated in this experiment. Six were male and six were female. All were native speakers of English, 20-25 years old, and were students enrolled in an intermediate Korean class at the University of Georgia. They had previously taken two introductory Korean courses. The subjects were taught vowel length distinction in standard Korean words.

3.2. Stimuli

Each subject was asked to read a list of words and sentences that contained 18 tokens: six monosyllabic words, six disyllabic words, and six trisyllabic words. The 13 nouns were listed in isolation, while the two adjectives and three verbs were placed in sentences in order to clarify their meanings. Among the minimal pairs, the words with which the subjects were more familiar were selected. Since vowel length

is not represented in Korean orthography, alongside the Korean, the tokens were presented with their English meanings.

3.3. Procedure

Recordings were made from a noise-canceling Shure SM48-LC microphone and a Sony Digital Audio Tape recorder at a sampling rate of 48-kHz. The microphone was placed roughly four inches from the subjects' mouths. The recordings were made in a quiet classroom at the University of Georgia. Each subject was given a reading list and instructed to read the words and sentences as naturally as possible. Subjects were also asked to speak at a constant speed. The list of words and sentences was read three times, each recording lasting about four minutes. The 18 tokens are listed in Table 4. Long vowels are indicated by colons.

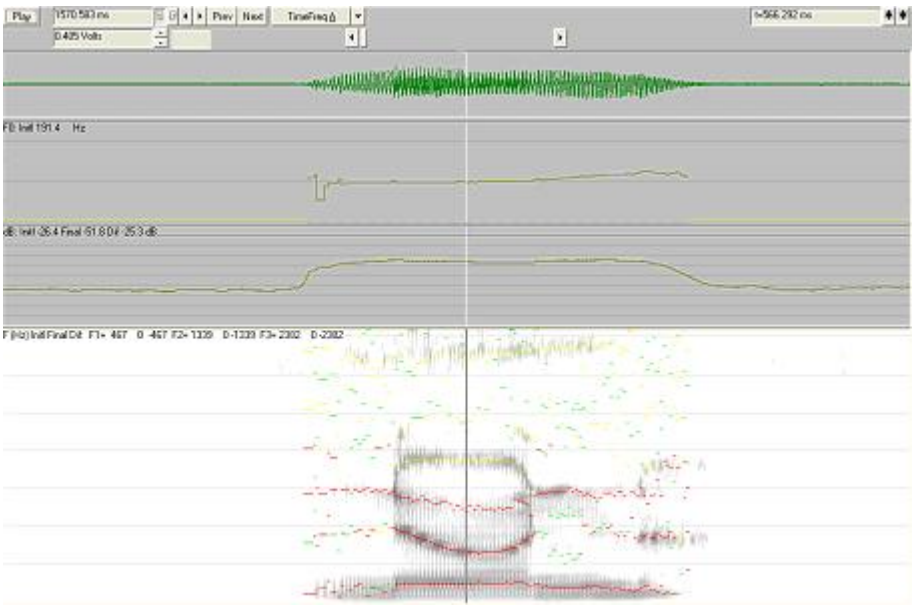
Table 4. List of Korean Words

Short Vowels		Long Vowels	
Korean Word	Glossary	Korean Word	Glossary
nwun	eye	nwu:n	snow
pam	night	pa:m	chestnut
pay	pear	say:	bird
sakwa	apple	sa:lam	people
isa	moving	pwu:ca	rich
ippal	tooth	ywu:myeng	famous
nwunwusum	smiling eyes	nwu:nsalam	snowman
cekta	write	se:mmaul	island village
simta	plant	wu:lta	cry

3.4. Acoustic Analysis

All recorded data were digitized at a sampling rate of 22 kHz. In total, 648 tokens (18 words x 12 subjects x 3 repetitions) were acoustically analyzed from the spectrographic and wave form display of the TF32 program implemented in CSpeech SP (Milenkovic & Read 2000). Figure 2 shows the waveform, pitch analysis, amplitude analysis, and spectrogram of nwun 'eye'.

Figure 2. Waveform and Spectrogram of ‘nwun’



[n u n]

In order to obtain pitch, fundamental frequency (f0) was measured at the center of the vowel segment using the pitch trace function. For volume, amplitude was measured at the center of the vowel segment using the RMS trace function. TF32 provides 0 dB as a maximum amplitude sine wave (a 7.07-volt peak, 5-volt RMS sine wave on the 20-volt PP scale), values below which are negative relative to the arbitrary zero. For vowel length, duration was measured from the beginning to the end of the vowel segment.

3.5. Statistical Analysis

A mixed-model ANOVA was computed for each dependent variable (f0, duration, amplitude) with vowel length (long vs. short) and syllable number (1 vs. 2 vs. 3) taken as variables particular to each subject. The sex of a subject was an independent variable between male and female subjects. A significance level of .05 was used for all analyses.

3.6. Results

3.6.1. Vowel Length

The means and standard errors (s.e.) for each dependent variable are presented in Table 5 as a function of phonemic vowel length.

Table 5. Vowel Length Results (Means with s.e. in parentheses)

Vowel Length	f0 (Hz)	Duration (ms)	Amplitude
Short Vowel	146.61 (7.88)	138.31 (10.30)	-22.84 (0.48)
Long Vowel	147.21 (7.90)	136.45 (10.41)	-23.10 (1.01)
Average	146.91 (5.54)	137.38 (7.27)	-22.97 (0.55)

None of the measured variables varied as a function of phonemic vowel length, i.e. there was no significant change in f0, duration or amplitude (all main effect Fs less than 1.0). It appears the subjects had considerable difficulty producing the vowel length distinction, which does not exist phonemically in English.

3.6.2. Syllable Number

The means and standard errors (s.e.) for each dependent variable are presented in Table 6 as a function of syllable number.

Table 6. Syllable Number Results (Means with s.e. in parentheses)

Syllable Number	f0 (Hz)	Duration (ms)	Amplitude
1	144.83 (9.53)	210.01 (9.40)	-21.90 (0.57)
2	147.28 (9.74)	112.43 (5.06)	-22.86 (0.61)
3	148.62 (9.92)	89.71 (4.49)	-24.15 (1.42)

There was a significant increase in vowel f0 with a corresponding increase in syllable number ($F(1,20) = 7.27$, $p < .005$). Vowel duration, on the other hand, decreased with the increase in syllable number ($F(1,20) = 108.28$, $p < .001$), and amplitude seemed unaffected ($F(1,20) = 1.60$, $p = .23$). The changes in f0 and duration are examples of suprasegmental variation. The increase in f0 could be the result of an attempt to add primary stress to a syllable in multi-syllabic words, though we do not find the same expected increase in duration and amplitude.

3.6.3. Sex of Subjects

The means and standard errors for each dependent variable are presented in Table 7 as a function of the sex of the subject.

Table 7. Sex of Subject Results (Means with s.e. in parentheses)

Sex	f0 (Hz)	Duration (ms)	Amplitude
Male	101.13 (1.36)	132.24 (8.97)	-22.93 (1.03)
Female	192.70 (1.72)	142.52 (11.51)	-23.01 (0.42)

As expected, due to anatomical differences, there was a significant disparity in f0 between male and female subjects ($F(1,10) = 294.81$, $p < .001$). However, there was no significant variation in duration or amplitude (Fs < 1.0).

4. Discussion

We predicted that native English speakers would have difficulty producing the Korean vowel length distinction because vowel length is determined by vowel identity and stress patterns in English, but is phonemic in Korean. The results of the experiment support this prediction. The subjects produced no duration distinctions to contrast short and long vowels, nor did their speech vary in f0 or amplitude as a function of phonemic vowel length. In other words, there is no evidence to indicate that these speakers produced any distinction between long and short vowels. Given the importance of vowel length in distinguishing word meaning, this is a significant deficiency that demonstrates once again the problem of native language interference on second language learning.

The subjects' speech did, however, vary in vowel f0 and duration systematically as a function of syllable number, increasing in f0 and decreasing in duration for greater numbers of syllables. These variations occurred independently of vowel length distinctions and are heard as accented speech by native speakers of Korean.

Furthermore, these results demonstrate the interference, on both the segmental and suprasegmental levels, of native language phonetics and phonology in second language acquisition. Unfortunately, even for native speakers of Korean, both perceiving and producing vowel length distinction is not an easy task. As a result, the context of a sentence may be required, for both learners and native speakers, to discern the meaning of a word.

Although rules and patterns in the native language at either level (e.g., the suprasegmental use of f0 and duration in English) can interfere with learning conflicting or novel rules in the second language (e.g., segmental use of duration in Korean), vowel length distinctions in Korean cannot be overemphasized. An

acoustic analysis of speech sounds can serve as an excellent diagnostic tool in Korean-as-a-foreign-language (KFL) classes. Based on precise physical measurements and visual representations of speech sounds, in lieu of (or perhaps in addition to) subjective and impressionistic diagnoses, KFL teachers can detect problematic areas more precisely and provide more efficient guidance to their students, both in their production and in their perception of Korean.

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