Modern English Education, Vol. 12, No.1, Spring 2011

Phonetic Declination Patterns of Korean English learners' Intonation*

Seokhan Kang, Hyunkee Ahn†
(Kyunghee University, Seoul National University)

Kang, Seokhan & Ahn, Hyunkee. (2011). Phonetic declination patterns of Korean English learners' intonation. *Modern English Education, 12* (1), 20-34.

This paper reported the declination slopes of English intonation of Korean learners of English in both declarative and interrogative sentences, comparing them with those of native English speakers. Twenty native English speakers and Korean learners of English in a university took part in the experiments. The findings were that Korean learners of English showed a slower declination tilt in declarative sentences: a narrower range in fundamental frequency, slower speech rate, and shorter duration and higher F0 in the final syllable. In the interrogative sentences, they showed a positive declination tilt: a higher pitch level in the initial segment than in the final segment. On the contrary, native English speakers showed steeper declination tilt in declarative sentences: a wider range in fundamental frequency, faster speech rate, and longer duration and lower F0 in the final syllable. In case of interrogative sentences, they showed a negative declination slope: a higher pitch level in the final segment than in the initial segment. This incorrect production of intonation by Korean learners of English might lead to foreign-accent to some degree.

**[intonation/second language acquisition/suprasegmental factor/prosody/
억양/제2언어습득/초분절 요소/운율]**

I. INTRODUCTION

English is a stress-timed language, in which the suprasegmental features such as stress, rhythm, intonation, and length are as important as segmental factors in both speaking and listening. On the contrary, Korean is a syllable-timed language which relatively focuses more on the segmental factors. Considering fundamental differences between two languages, it is a quite reasonable prediction that Korean learners of English may

* We really appreciate three anonymous reviewers and editors. The remaining errors, however, are of ours.

† Seokhan Kang: first author; Hyunkee Ahn: correspondent author.

implement particular intonational patterns in speaking English different from native English speakers. That is, their distinguishable production has some influences on the incorrect "intelligible" intonation.

Recently, the educational goal of English as a second/foreign language on "perfect native-like pronunciation" has been moved to decide on what is "comfortably intelligible" or "near-native accent" pronunciation (Chun, 2002). This movement is based on the result of the studies that intelligibility is more important than fluency and the prosody is more important factor in producing "intelligible pronunciation" (Anderson-Hsieh & Koehler, 1988; Tajima, Port & Dalby, 1997). In this respect, intonation is thought of an important aspect of prosody affecting intelligibility in L2 speech production (e.g., Laures & Weismer 1999; Mennen, 2006).

Intonation as a suprasegmental factor refers to pitch output realized on the utterance, in which its fundamental frequency contour typically declines across clauses or their comparable units. Some researchers (e.g., Sorensen & Cooper, 1980; Thorsen, 1978, 1985) have made claim that languages universally have decline of a F0 contour. That is, regardless of the language types, the tendency of the voice is to begin on a moderate pitch, moves to a higher pitch, and then lower the pitch line during the sentence (Maeda, 1976). However, the degree of the intonation could be different depending on native languages.

Generally, the declination f0 in a sentence could be related with second language learners' background language (e.g., Chun, 2002; Seokhan Kang, Guion, Seokchae Rhee, & Hyunkee Ahn, 2010). Delattre (1963) claims that speakers tend to impose their native intonation patterns on their second language. In his study, a French native speaking English could be different from a native English speaker because English intonation would carry his native French. Seokhan Kang et al. (2010) report that native English speakers have steeper declination tilt of F0 than Korean native speakers and that the more advanced Korean learners of English show similar slopes of f0 declination as native English speakers'. It implies that the effect of the background language has some influences on the acquisition of L2 intonation.

Some Korean researchers have studied the effect of intonational factors—f0 range, duration, pitch contour, boundary tones, etc.—on Korean learners of English' speaking. Seo Chae Rhee, Cheol Hyun Cho, and Sonyoung Moon (2003) reported that Korean learners of English implement half as much pitch fluctuation as the native as the native speakers with the achievement rate of, on an average, 47%. Jookyung Lee (2008), on the experiment of pitch accent distribution, high and low pitch accent values, pitch ranges, and edge tones, reported that Korean learners of English did not show a correct production of pitch accents, which implies that they do not successfully perform tonal strategies for communication, ignoring contextual meaning and informative weight of words. Seokhan Kang and Hyunkee Ahn (2010a) in the study on pitch range, speech rate, and pause

duration using PRAAT scripts exhibit that Korean learners of English are realized differently from those by native English speakers: narrower pitch range, slower speech rate, and longer pause duration.

This paper focuses on how Korean learners of English produce intonation from the theory of the declination tilt. Until now, comparatively little research has been carried out on overall intonational variation from the acoustic phonetics for Korean learners of English. In details, phonetic approach, checking the cues of intonation slope such as F0 range, length, and boundary pitch and duration in the final syllable, would induce foreign-like intonational problems of Korean learners of English. For the purpose, we checked major phonetic patterns of declination, including F0 range and duration as well as local patterns of F0 distribution and length in the final syllable.

II. EXPERIMENT

1. Subjects

Ten native male speakers of English and ten native male speakers of Korean learning English as a foreign language took part in the experiment. The native speakers of English were English instructors of a university in Korea, and their average age was 27.1 at the time of experiment. They have been staying in Korea for around 11 months as a mean length of residence. Korean learners were sophomores or juniors at the same university, majoring in English, Economics, or International Relationships, who enrolled a class of the advanced English conversation. Even though they had no experience in studying or staying in English-speaking countries, they would have comparatively good English ability because overall mean values of TOEIC score taken in 2009 were 802 out of 1000. All the subjects had no history of speech disorders and no problems in pronunciation.

2. Procedure

Recording was done in a sound-proof broadcasting booth at a university. Sounds were recorded by SONY DAT recorder (TASCOM DA 20 AMK II) with a Shure 10A microphone. Recorded sounds were digitalized at a sampling rate of 44,100 Hz and a quantization rate of 16 bits. All the subjects were required to read a total of 30 sentences which were classified into two types of sentences: 15 declarative sentences and 15 Yes-No interrogative sentences. They were allowed to practice reading before their recording. The sentences were chosen based on the general observation that the speaking rate might be similar on comparatively same amounts of content words that contained stressed syllables.

All sentences were randomly distributed and given to the subjects.

(1) The declarative sentences

a. My sister is coming on Tuesday.
b. James wanted to be a judge.
c. There are two men in uniform.
d. Miss Jane drank a cup of coffee.
e. The artist drew me a sketch of it.
f. She became principal of the school.
g. I forgot bringing some books.
h. I remember him being unhappy.
i. The students are going to the bridge.
j. They suspect that the thief killed Ted.
k. I closed door and waited for the car.
l. Jenny walked home from school in the rain.
m.We had steak with different kinds of sauce.
n. We judge the ice cream perfectly safe.
o. The police took the brutal thief to the jail.

(2) Yes-no interrogative sentences

a. Is your sister coming on Tuesday?
b. Did James want to be a judge?
c. Are there two men in uniform?
d. Did Miss Jane drink a cup of coffee?
e. Did the artist draw you a sketch of it?
f. Did she become principal of the school?
g. Did you forget bringing some books?
h. Do you remember him being unhappy?
i. Are the students going to the bridge?
j. Do they suspect that the thief killed Ted?
k. Did you close door and wait for the car?
l. Did Jenny walk home from school in the rain?
m. Did you have steak with different kinds of sauce?
n. Do you judge the ice cream perfectly safe?
o. Did the police take the brutal thief to the jail?

3. Analysis

The analysis has been carried out to evaluate intonation pattern of each group (Koreans and native English speakers). The values of the upper and lower lines as a declination tilt such as pitch range and length in a whole sentence, mean F0 and duration in the boundary segments were analyzed. In this study, a linear F0-with-time regression line was also drawn. The duration and fundamental frequency were measured using waveforms and wideband spectrograms through PRAAT program (version 5.1.17). All acoustic cues were measured from the initial acoustic signals in both the waveform and the spectrograms to the final acoustic ones like burst or spectral cues of a boundary (Kent & Read, 2003; Ladefoged, 2001). Figure 1 and Figure 2 are measured parameters of declination tilt in both sentences, by following the study of Seokhan Kang et al. (2010).

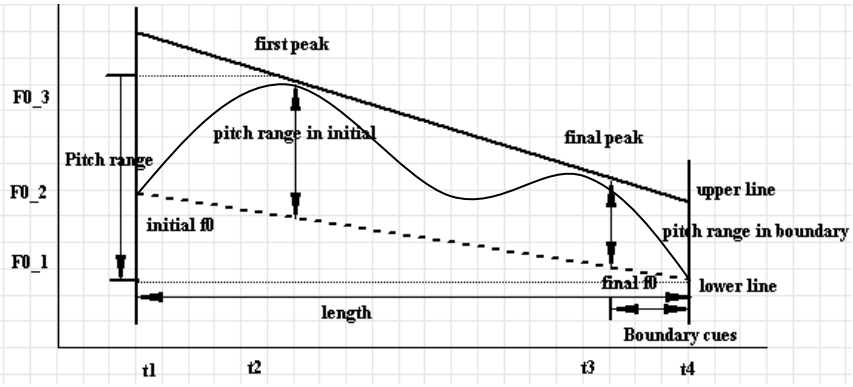

Figure 1. The parameters of declination tilt in the declarative sentence: Pitch range and length in a sentence, and F0 and duration in the boundary segment.

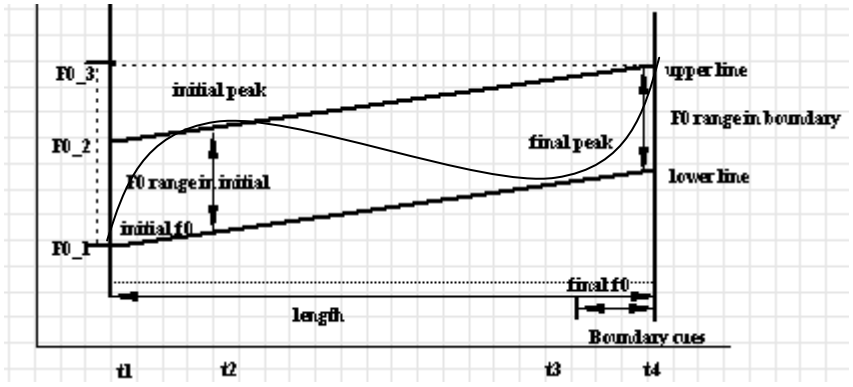

Figure 2. The parameters of declination tilt in the interrogative sentence: Pitch range and length in a sentence, and F0 and duration in the boundary segment.

In both sentences, F0s were measured at the onset of the sentences, the absolute maximum point of the first peak F0, the local maximum point of the final peak F0 in the boundary, and the offset of the phrases. By following the measurement of the fundamental frequency, the calculation of the upper and lower lines was done by following methods of Maeda (1976) and Lieberman, Katz, Jongman, Zimmerman, and Miller (1985). For the intonational patterns with the terminal structure, measurement was made on the upper lines and lower lines. The computed declination tilt *r* was computed using the formula in (3).

(3) $r = \Delta f / \Delta t$, where Δf is the average F0 declination on the time change

In the studies of Maeda (1976) and Cohen, Coller, and t'Hart (1982), the measurement methods of the top and bottom lines were adopted. Instead of the notions of the top and bottom lines, however, we used the upper and lower lines because the exact and absolute peak or valley point of the fundamental frequency was hard to decide. In this study, the upper line was a line connected from the initial peak point of the fundamental frequency to the higher point of the fundamental frequency in the boundary segment. On the contrary, the lower line was a line connected from the initial point of the fundamental frequency to the final valley point of the fundamental frequency in the boundary segment. The formula is like follows in (4):

(4) a. Upper line = (the initial peak values of F0 – the peak values of F0 in boundary) / (length *100)
b. Lower line = (the initial valley values of F0 – the valley values of F0 in boundary) / (length * 100)

If the declination tilt produces the positive numbers, this means that the initial peak point of F0 is higher than the final peak point of F0. In most cases, the numbers are between -1.00 to +1.00, in which 0 refers to the leveling F0 contour between the two check points.

The pitch range was measured from the highest point to the lowest point of the fundamental frequency in the sentence. We used the pitch track, and also the wave forms associated with the vibration of the vocal folds as a supplementary check. The durational length was measured from the initial acoustic signals in both the waveform and the spectrogram to the final acoustic or spectral cues of a boundary. This method was already applied in the study of Kang et al. (2010) and proved to be the effective way in finding out the intonational variation.

The data on the parameters were analyzed by a statistical method of independent t-test. Dependent variables of the upper line and the lower line were examined by between-group independent variables of GROUP (2).

III. RESULTS

1. Declarative Sentences

In the intonational slope, native English speakers showed 0.48 as upper line and 0.20 as lower line, while Korean learners of English expressed 0.35 as upper line and 0.13 as lower line. The correlation between upper line and lower line was $r = 0.293$ at the level of 0.01 (2-tailed). This tilt implies that the two lines acted in a similar fashion. Generally members of the native English speakers showed steeper declination tilt: wider range of F0 contour and faster speech rate in both lines. In the measurement of the initial point of F0, the highest F0, the final highest F0 in the boundary segment, and the final F0, the 4 points of F0 had a sequence of 120-172-117-90 Hz for native English speakers, while Korean learners of English showed a sequence of 121-157-122-91 Hz. Note that the variation of F0 contour for native English speakers was 1.2 times greater than that of Korean learners of English.

The independent t-test confirmed that there was a significant main effect for the upper line ($t = 28.619$, $p < .0001$). On the statistical analysis of the lower line in the declarative sentences, the GROUP variable was significant with regard to the lower line: group ($t = 18.272$, $p < .0001$). The results showed that the mean value of both lines was steeper for native English speakers than Korean learners of English. The results are summarized as seen in Figures 3 and 4.

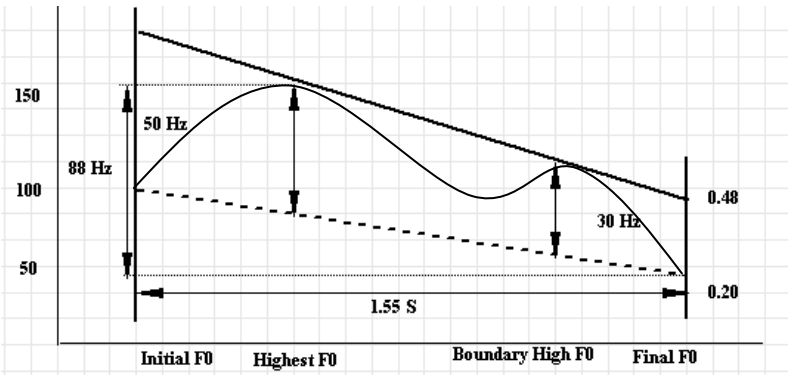

Figure 3. Native English speakers exhibited steeper slope of the upper and lower lines: A wider range of pitch of 88 HZ in the entire sentence, 50 Hz in the initial part and 30 Hz in the boundary, and faster speech rate (1.55 seconds).

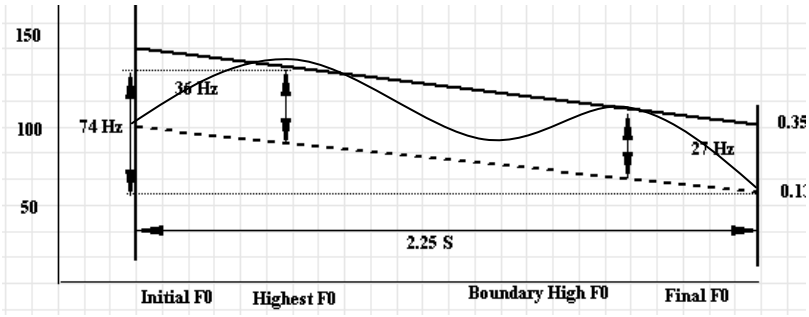

Figure 4. Korean learners of English exhibited slower slopes of the upper and lower lines: A narrower range of pitch of 74 Hz in the entire sentence, 36 Hz in the initial part and 27 Hz in the boundary part, and longer speech duration (2.25 seconds).

The characteristics of the intonation resided in the declarative sentences were expressed distinguishably in measuring the related cues. In this production experiment, the F0 range was smaller for Korean learners of English than native English speakers. This result supported some studies′ suggestions that the effect of background language had some influence on forming L2 F0 range (Scherer, 2000; van Benzooijen & Scherer, 2005). Even if both groups had a wider range in the initial part of the sentence and a narrower range in the final word of the sentence, it was noteworthy that the patterns of F0 range were different depending on the groups. Native English speakers′ initial range was almost two times larger than the range in the final segments, but the Korean learners′ range was almost leveled between two measured points of the F0, which caused a monotonous intonation.

In the intonational pattern, the sentence duration was shorter for native English speakers than for Korean learners of English. Figure 3 presented the mean value of duration produced by both groups. These results agreed with previous works in which more native-like speech was produced with a faster speech rate (Adams & Munro, 1978; Guion, Flege, Liu, Yeni-Komshian, & Grace, 2000; Lennon, 1990; Munro & Derwing, 1995; Sluijter & van Heuven, 1996).

In the mean F0 and duration of the sentence-final syllable, it revealed that the ratio of final-syllable duration against whole sentence length was shorter for the Korean learners than native English speakers as 78%. Also Koreans′ F0 was higher than native English speakers as 117 vs. 148 Hz. It was striking that the duration and F0 of the boundary segments was shorter and higher for Korean learners than for English natives. It seems justified that higher F0 and shorter duration induce the slow declination tilt—otherwise, monotonous intonation—for Koreans.

In a brief summary, native English speakers showed steeper slope of the upper and lower lines: a wider range of pitch in the entire sentence including the initial and final

boundary parts, faster duration timing, and lower F0 and longer duration in the final syllable. On the contrary, Korean learners of English showed slower slope of the upper and lower lines: a narrower range of pitch in the entire sentence including the initial and the boundary part, and slower duration timing, and higher F0 and shorter duration in the final syllable.

2. Interrogative Sentences

In the interrogative sentences, native English speakers exhibited negative declination tilt, while Korean learners of English showed positive or leveled declination tilt. Native English speakers showed -0.21 as upper line and -0.08 as lower line, while Korean learners of English expressed 0.08 as upper line and 0.01 as lower line. The correlation between upper line and lower line was $r = 0.325$ at the level of 0.01 (2-tailed). This tilt implies that the two lines acted in a similar fashion. Generally members of the native English speakers showed negative declination tilt: narrower range of F0 in the initial part and wider range of F0 in the final part. In the measurement of the initial point of F0, the highest F0, the final lowest F0 in the boundary segment, and the final F0, the 4 points of F0 showed a sequence of 126- 162-136-184 Hz for native English speakers, while Korean learners of English, a sequence of 117-173-117-161 Hz. Note that the variation of final F0 for the native English speakers presented higher than that of Korean learners.

The independent t-test confirmed that there was a significant main effect for the upper line ($t = 35.185$, $p < .0001$). On the statistical analysis of the lower line in the declarative sentences, the GROUP variable was significant with regard to the lower line: group ($t = 23.711$, $p < .0001$). The results revealed that the mean values of both lines were negative for native English group, but positive/leveled for Korean learners of English. The results are summarized in Figures 5 and 6.

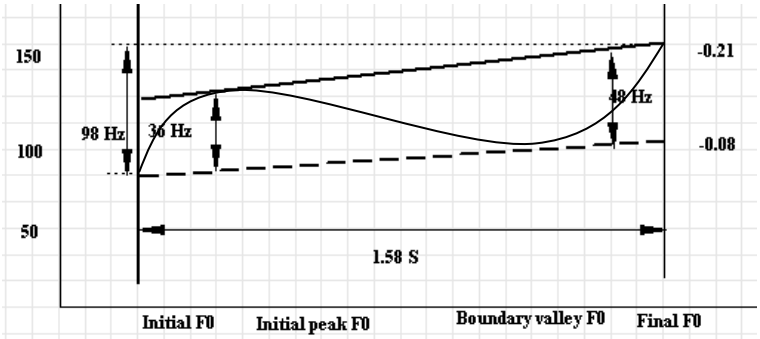

Figure 5. Native English speakers exhibited negative steeper slope for upper and lower lines: A narrower range of pitch in the initial part (36 Hz), a wider range of pitch in the final part (48Hz), and faster speech rate (1.58 seconds).

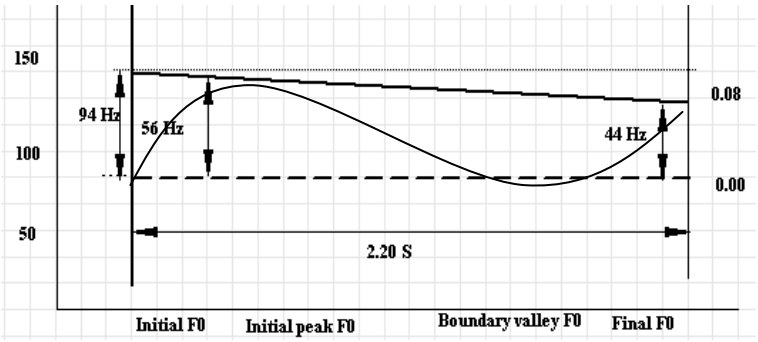

Figure 6. Korean learners of English exhibited a slower positive slope for upper and lower lines: A wider range of pitch in the initial part (56 Hz), a narrower range of pitch in the final part (44 Hz), and slower speech rate (2.20 seconds).

The important characteristics of the intonation presented in the interrogative sentences were distinguished in the declination tilt, in which Korean learners of English showed the positive tilt. Overall, native English speakers showed negative slope of the upper and lower lines: a narrower range of pitch in the initial part, a wider range of pitch in the final part, and faster speech rate. It means that the final peak point of the frequent frequency was higher than the first peak point of the fundamental frequency for native English speakers. On the contrary, Korean learners of English showed positive slope of the upper and lower lines: a wider range of pitch in the initial part, a narrower range of pitch in the final part, and slower speech rate.

In a *Yes-No* interrogative sentence, Korean learners of English did not produce native-like tone patterns in the boundary segments. Note that yes-no interrogative sentence required the final boundary tone to be higher than the initial peak point of F0. The highest peak point of F0 in the interrogative sentences for native English speakers was put on the final boundary segment, while that of Korean learners of English was on the initial peak point just like the declarative sentences. It is necessary that Korean learners of English should focus more on producing F0 contour correctly in the boundary segment.

Another characteristic we have seen in this sentence type was related with F0 range between the initial and the final parts. Native English speakers produced larger F0 range in the final part than in the initial part, while Korean learners of English made larger F0 range in the initial part just as we have seen in the declarative sentences. It seems justified that Korean learners of English may not control F0 contour correctly in various types of sentences.

In a brief summary, the duration in the whole sentences was longer for native English

speakers than for Korean learners, just like the declarative sentence. The result agreed with previous works in which more native-like speech was produced with a faster speech rate (e.g., Kang et al., 2010). Both mean F0 and duration of the sentence-final syllable were stronger/longer for native English speaker than for Korean learners of English. It was interesting that "final-lengthening" was applied to native English speakers rather than to Korean learners of English. That is, final syllables in the interrogative sentences produced by Korean learners showed higher F0 and shorter duration, while native English speakers showed lower F0 and longer duration.

IV. SUGGESTIONS FOR L2 INTONATION EDUCATION

Generally, intonation is related with breathing movement which forms a cycle of inspiration and expiration (Kent & Read, 2003). In the expiration, speech is produced in breath groups, which are units of words or syllables produced in a single breath. Since the units produced within a breath group have an overall coherence, such as fitting with an intonation pattern, Korean learners of English may not recognize the relationship between the breathing movement and the intonation of English. For the education of English pronunciation, we suggest some pedagogical implication.

First of all, controlling the breathing might be considerable factor in teaching English. In case of declarative sentence, Korean learners of English reach the initial peak of F0 at comparatively short intervals and then exhale the breath very slowly. Acoustically, these patterns of breath cause the short timing in reaching the initial peak point of F0 and slower duration of speech rate which extends from the initial peak point of F0 to the final high point of F0 in the boundary segment. On the contrary, native English speakers reach the initial peak of F0 at comparatively long interval and then exhale the breath faster. These physiological activities bring out the acoustic results like longer timing in reaching the initial peak point of F0 and shorter duration of speech rate. It is necessary to be trained to control the breathing movement very carefully.

Secondly, the boundary tones in the interrogative sentences might be pronounced more carefully so that F0 difference between the turning point of F0 and the final point of F0 in boundary is needed to be greater. Unfortunately Korean learners of English may not control F0 contour correctly in the final part of both sentences. Koreans' particular speaking style in this area is proved to be inherent coming from the background language. Seokhan Kang and Hyunkee Ahn (2010b), in the study on both experiments of production and perception, reported that Korean learners of English marked low percentage of correctness in F0-manipulated sentences rather than in the duration signals. Their study suggests that Koreans have problems in both perceiving and producing the appropriate F0

contour. Thus, their mistakenly performed F0 contour could transfer the wrong information to native English speakers.

Third, it is fundamental knowledge in L2 prosody teaching that length timing is another important factor in correct English intonation. Longer duration, another term of speech rate, may lead to a leveled intonation which brings up the monotonous tone perceptually. Teachers might adopt teaching method on how to speed the utterance correctly in reading a text.

Fourth, "final-lengthening" should be considered for Korean English speakers. They tend to cause shorter production in the final part of the declarative and interrogative sentences. In this area, Koreans produce higher F0 and shorter duration in the declarative sentence, while they express lower F0 and shorter duration in the interrogative sentence. Their particular production in the final syllable leads to the foreign-like intonation slope.

In a short summary, it is essential to teach the correct intonation patterns to Korean learners of English. The declarative sentence should lead steeper slope of the upper and lower lines: a wider range of pitch in the entire sentence, faster speech rate, and lower F0 value and longer duration in the final syllable. On the contrary, the interrogative sentence should follow the negative slope of the upper and lower lines: a wider range of pitch in the entire sentence, faster speech rate, and higher F0 and longer duration in the final syllable.

V. CONCLUSION

Korean learners of English produce different F0 contours from native English speakers in both types of sentences. The finding in the declarative sentences is that native English speakers produce steeper slope of the upper and lower lines: a wider range of pitch in the entire sentence, faster speech rate, and lower F0 value and longer duration in the final syllable. On the contrary, Korean learners of English show a slower slope of the upper and lower lines: a narrower range of pitch in the entire sentence, slower speech rate, and higher F0 value and shorter duration in the final syllable. In the interrogative sentences, native English speakers express a negative slope of the upper and lower lines: a wider range of pitch in the entire sentence, faster speech rate, and higher F0 and longer duration in the final syllable. On the contrary, Korean learners of English present positive or leveled slopes of both lines: a narrower range of pitch in the entire sentence, slower speech rate, and lower F0 and shorter duration in the final syllable.

In both sentences, Korean learners of English may not produce the F0 contour correctly in the whole sentences. Native English speakers, however, show comparatively large range of F0 at the initial part of the declarative sentences as well as at the final part of the interrogative sentences, while Korean learners of English considerably large F0 range at

the final part in the declarative sentences as well as at the first part of the interrogative sentences.

Another foreign-like production of Korean learners of English could be found in the boundary segments, especially in Yes-No interrogative sentences. As previous works pointed out, it is clear that the production of Korean learners of English fails to control F0 contour correctly in whole utterance as well as in the final segments. Even though we don't know whether the mismatched production results from L1 interference or not, it is clear that the incorrect F0 contour may transfer wrong information to the native English speakers perceptually.

On the whole, the slope rate of the upper and lower lines in the declarative sentences implies education of English pronunciation for the Korean speakers: sharp rising in the initial peak point of F0 and slow falling in the final point of F0. Also in case of the interrogative sentences, they should get F0 raise at the initial peak point, fall slowly at the final turning point of F0, and then rise again at the final point of F0. Also they need to speed utterance correctly because the length timing is another important factor to decide the intelligible intonation slope.

REFERENCES

Adams, C., & Munro, R. (1978). In search of the acoustic correlates of stress: Fundamental frequency, amplitude, and duration in the connected utterances of some native and nonnative speakers of English. *Phonetica, 35,* 125-156.

Anderson-Hsieh, J., & Koehler, K. (1988). The effect of foreign accent and speaking rate on native speaker comprehension. *Language Learning, 38,* 561-613.

Chun, D. M. (2002). *Discourse intonation in L2: From theory and research to practice*. Amsterdam: John Benjamins.

Cohen, A., Collier, R., & t'Hart, J. (1982). Declination: Construct or intrinsic feature of speech pitch? *Phonetica, 39*, 254-273.

Delattre, P. (1963). Comparing the prosodic features of English, German, Spanish, and French. *Interrnational Review of Applied Linguistics, 1,* 193-210.

Guion, S. G., Flege, J. E., Liu, S. H., Yeni-Komshian, & Grace, H. (2000). Age of learning effects on the duration of sentences produced in a second language. *Applied Psycholingusitics*, *21,* 205-228.

Kang, Seokhan, & Ahn, Hyunkee. (2010a). The automatic measurement of prosody in English pronunciation test. *Korean Journal of Applied Linguistics, 26*(4), 121-150.

Kang, Seokhan, & Ahn, Hyunkee. (2010b). The study of the L2 relationship between production and perception. *Bilingual Research, 44,* 1-24.

Kang Seokhan, Guion S, Rhee Seok-chae, & Ahn Hyunkee. (2010). The effect of language immersion on second language intonation. *Proceedings of Korean society of speech science, Korea, 2010,* 135-136.

Kent, R., & Read, C. (2003). *Acoustic analysis of English*. Boston: Singular Thomson Learning.

Laures, J. S., & Weismer, G. (1999). The effect of flattened F0 on intelligibility at the sentence level. *Journal of Speech, Language, and Hearing Research*, *42,* 1148–1156.

Ladefoged, P. (2001). *Vowels and consonants: An introduction to the sounds of languages*. Oxford: Blackwell.

Lee, Jookyung. (2008). An intonational assessment of English communicative competence of Korean college students with the 7th curriculum. *Modern English Education, 9*(1), 256-282.

Lennon, P**. (**1990**).** Investigating fluency in EFL: A quantitative approach. *Language Learning, 40,* 387–417.

Lieberman, P., Katz, W., Jongman, A., Zimmerman, R., & Miller, M. (1985). Measures of the sentence intonation of read and spontaneous speech in American English. *Journal of the Acoustical Society of America, 77*, 649-657.

Maeda, S. (1976). *A characterization of American English intonation*. Unpublished doctoral dissertation, MIT.

Munro, M. J., & Derwing, T. M. (1995). Foreign accent, comprehensibility, and intelligibility in the speech of second language learners. *Language Learning, 45*(1), 73-97.

Mennen, I. (2006). Phonetic and phonological influences in non-native intonation: An overview for language teachers. *QMUC Speech Science Research Center Working Paper WP, 9,* 1-18.

Rhee, Seok Chae, Cho, Cheol Hyun, & Moon, Sonyoung. (2003). Korean & native speakers' high-low range differences in F0 and its role in pronunciation assessment. *Korean Journal of Phonetic Science, 10*(4), 93-103.

Scherer, K. R. (2000). A cross-cultural investigation of emotion inferences from voice and speech: Implications for speech technology. In B. Yuan, T. Huang, & X. Tang (Eds.), *Proceedings of the sixth international conference on spoken language processing* 2 (pp. 379-382). Beijing: China Military Friendship.

Sluijter, A. M. C., & van Heuven, J. V. (1996). Acoustic correlates of linguistic stress and accent in Dutch and American English. *International Conference on Spoken Language Process, 2,* 630-633.

Sorensen. J., & Cooper. W. (1980). Syntactic coding of fundamental frequency in speech production; In R.A. Cole (Ed.) *Perception and production of fluent speech* (pp.

231-243). Hillsdale, NJ: Erlbaum.

Tajima, K., Port, R., & Dalby, J. (1997). Effects of speech timing on intelligibility of foreign accented English. *Journal of Phonetics, 25,* 1-24.

Thorsen, N. (1978). On the identification of selected Danish intonation contours. *Annual Report of Phonetics, 12,* 17-73.

Thorsen, N. (1985). Intonation and text in Standard Danish. *Journal of Acoustical Society of America, 77*(3), 1205-1216.

Van Banziger, T., & Scherer, K. (2005). The role of intonation in emotional expressions. *Speech Communication, 46,* 252-267.

Seokhan Kang
Department of Liberal Arts
Kyunghee University
1 Seocheon Dong, YongIn City,
Gyeonggi-Do, 446-701, Korea
Phone: 82-10-9120-2433
E-mail: kangs45@snu.ac.kr

Hyunkee Ahn
Department of English Language Education
Seoul National University
599, Gwanak-ro, Gwankak-gu
Seoul, 151-748, Korea
Phone: 82-2-880-7895
E-mail: ahnhk@snu.ac.kr

Received 15 December 2010
Revised 4 February 2011
Accepted 8 February 2011