Effects of L1 language background and L2 experience on adult L2 acquisition of five suprasegmentals

Seokhan Kang
(Konkuk University)

Kang, Seokhan. 2014. Effects of L1 language background and L2 experience on adult L2 acquisition of five suprasegmentals. *Studies in Phonetics, Phonology and Morphology*. 20.3. 277-295. This study investigated how various adult groups with different mother tongues and diverse levels of experience with an L2 acquire the suprasegmental phonetic cues of the L2 speech. Two hundred subjects in ten groups took part in the experiment. The results show that the L1 language background and L2 experience exhibit dissimilar influences on the acquisition of the L2 suprasegmentals. More specifically, the L1 background impacts the fluency of L2 speech more strongly in the early stage, while L2 experience mitigates the L1 effect dramatically in the later stage for the adult L2 learners. The acquisition of L2 suprasegmental cues, however, triggers an uneven influence on native speakers' judgments of the fluency of L2 speech; speech rate has the most influence on judging L2 fluency, while F0 range has the least. Among three L1 groups, comparatively inexperienced Japanese learners of Korean control these cues well compared to English and Mandarin learners of Korean as an L2. **(Konkuk University)**

Keywords: suprasegmental, second language acquisition, mother tongue, immersion

1. Introduction

The suprasegmental features of a second language (L2) are considered to be major factors in pronouncing fluent L2 speech. Indeed, fluent L2 acquisition might be impacted, to a greater extent, by suprasegmental factors. The degree of L2 suprasegmental acquisition, however, is determined by subject-dependent factors, such as the native language (L1) background and L2 levels of experience. The aim of this study is to investigate to what extent these mixed effects exert influence over the L2 acquisition of suprasegmentals.

In the area of L2 acquisition, fluency is known as the key aspect in determining the degree of learners' acquisition, i.e., to what extent they achieve the target language (Guion et al., 2000; Riazantseva, 2001). Generally, the feature of fluidity or flow is closely tied to the articulator's production, which involves lexical access, phonological short-term memory, and control of attention (Mennen, 2004). To gain a better understanding for L2 fluency, the relationship between L2 fluency and foreign accent should be considered. L2 Fluency may be broadly defined as the speech fluidity judged by the native listeners, while foreign accent is actually assessed on what extent L2 speakers' speech includes foreign-accent, but there is no universally accepted way of assessing it. Because there is different focus on the speech, it is safe to say that there is no clear relationship between the two (*see* Munro and Derwing (1995) for the

further discussion).

Some research proposes that oral fluency could be affected by L2 suprasegmental rather the segmental factors (e,g,, Derwing and Munro 1997, Kang 2014). In this respect, a number of studies investigating L2 acquisition have focused on what suprasegmental phonetic cues affect L2 fluency. The features that researchers have found to be significant in L2 fluent speech include speaking rate (Guion et al. 2000, Derwing and Munro 2001), pause structure (Anderson-Hsieh and Vengatagiri 1994, Riazantseva 2001), peak alignment (Mennen 2004, Trofimovich and Baker 2006), F0 range (Wennerstrom 1994, Mennen 2006), and intonation (Bolinger 1978, Wennerstrom 2001, Chun 2002).

The features involved in L2 suprasegmental acquisition are closely tied to temporal and spectral cues. Temporal aspects dominating features in L2 speech fluency refer to durational features including speech rate, articulation rate, pause duration, and frequency. Along with temporal factors, spectral features such as pitch range, peak alignment, stress, and intonation determine L2 fluency. For example, improper pitch contours, narrow pitch range, and tones in the middle of phrases lead to foreign-like pronunciation.

The acquisition of these fluency cues are known to be affected by some subject-specific variables such as the age of L2 learners (Guion et al. 2000), language experience (Trofimovich and Baker 2006), the L1 background (Scherer 2000), motivation (Moyer 1999), and training (Missaglia 1999). Among various factors determining fluency in L2 suprasegmentals, experience could have a crucial effect on adult learners' production of fluent L2 speech. Some studies (Uyeama and Jun 1998, Bradlow et al. 1996) have demonstrated that learners can and do improve fluency aspects of their L2 pronunciation by augmenting their experience levels. Ueyama and Jun (1998), in their study of the L2 acquisition of prosody, observed that the production of a rising and falling intonation pattern in English by native Korean learners of English differs according to the levels of language experience. Their study suggests that less experienced speakers of an L2 rely more on the prosodic structure of the L1 when producing a similar prosodic contrast in the L2. Moreover, with more experience in the target language, a similar prosodic structure is acquired, as indicated by the speech production of more proficient L2 speakers.

The current study investigates the mixed influence of language background and experience levels on the suprasegmental acquisition of Korean, the target language. The goal of the study is to extend our understanding of what features influence the acquisition of L2 suprasegmentals, which is measured by the perception of L2 fluency. Thus, in perception tests, the mutual effects of L1 backgrounds and L2 experience levels on fluency judgments were investigated. Also, in the production test, L2 suprasegmental production was acoustically examined to determine the mutual effects. The production of Korean suprasegmentals was elicited from native English, Japanese, and Mandarin adults with three different experience levels (beginner, intermediate, and

advanced) and then rated by native Korean speakers.

2. Experimental procedure

2.1 Participants

The data were collected from 201 adult participants who were learning Korean in Korea. They were learning the language at a Korean Language Institute affiliated with universities at the time of recording. Most of the recordings were carried out in Yonsei University, Korea. The subjects were drawn from class levels ranging from beginner to advanced, so that the students' sample would include differing levels of Korean proficiency. The language institute classified students into one of six class levels according to their aggregate scores on a placement test measuring four Korean language skills (listening, reading, speaking, and writing). Each class, consisting of six levels (lowest 1 to highest 6), required students to take a pass-fail exam every ten weeks when they were promoted to higher levels. Following authorities in the institutes, most of the test-takers passed the exams such that the levels were clearly synchronized with the duration of L2 experience. No participant reported being diagnosed with a language or speech disorder. The participants were divided into ten groups by L1 language background and L2 experience.

Table 1. The 10 subgroups

L1	Levels	N	Age	AOA	TOL	LOR
K.or		20m	22.1(0.8)			
Eng	B.eg.	20m	28.7(3.7)	27.2(2.5)	1.4(0.8)	1.2(0.6)
	Mid.	21m	25.6(3.3)	23.1(3.4)	3.2(1.2)	2.3(0.8)
	A.dv.	20m	30.9(5.2)	23.8(3.5)	7.2(1.6)	6.3(1.1)
J.ap.	Beg.	19m	25.8(2.6)	24.2(2.4)	1.4(0.4)	1.4(0.5)
	Mid.	20m	25.1(2.3)	22.4(3.0)	2.7(0.7)	2.5(0.4)
	A.dv.	20m	27.3(3.1.)	22.6(2.3)	4.5(1.2)	4.4(1.2)
Man.	B.eg.	20m	24.7(1.6)	23.3(1.3)	1.5(0.2)	1.3(0.5)
	Mid.	20m	23.3(2.3)	20.3(1.4)	2.8(0.5)	2.5(0.7)
	A.dv.	21m	27.6(2.1)	22.5(2.3)	4.5(0.6)	4.1(0.9)

Note: N, numbers of the subjects; Age, chronological age, in years; AOA, age of arrival in Korea, in years; TOL, total years of learning Korean including in their homelands, in years; LOR, length of residence in Korea, in years; m refers to male; Standard deviations are in parentheses. K.or: Korean, Eng: English, J.ap: Japanese, Man: Mandarin, B.eg: Beginner, Mid: Middle, A.dv: Advanced

2.2 Production

Speech production was elicited through a delayed sentence repetition task. The participants produced seven Korean declarative sentences in response to question prompts (Appendix A). The sentences were presented in three randomized blocks, but only the sentences spoken in the second block were used in the analyses to ensure that the participants were familiar with the task and could produce each sentence to the best of their ability. The analyses were based on 1407 sentences (201 participants * 7 sentences). All audio recordings were done using a Marantz PMD 650 with a Shure SM 10A microphone, digitized at 44.01 kHz and 16-bit resolution. These sentences were presented to participants over a loudspeaker, using a laptop computer, in question-answer-question sequences. A delay of around ten seconds was provided after the second question in each sequence, allowing some time for the production of the target sentences. The purpose of this delay was to avoid direct imitation from sensory memory. The sequences were presented to the participants randomly. Before they produced the sentences, it was confirmed that they knew what the sentences meant, and how to pronounce them.

2.3 Rating and raters

Samples from L2 speech recordings ensured that the content was held relatively constant across speakers. The 1407 samples were randomized and presented to the raters using a loudspeaker. A total of twenty native-speaking Korean listeners (twelve males and eight females; age range 20-26 years, M = 23) were recruited to evaluate the fluency of the L2 speakers using a 9-point Likert scale (from 1 = very poor fluent speech to 9 = extremely native-like fluent speech). All of the raters were native Koreans with some linguistic training at the graduate level and some experience in rating L2 production. All raters reported normal hearing. The raters were encouraged to use the entire scale and to guess if they were unsure. After confirming their pre-rating tests, they started rating the speech separately.

2.4 Data analysis

Three analyses were performed. The analysis of the first test examined the extent to which the learners were able to produce L2 suprasegmentals fluently, as measured by overall fluency ratings. In this analysis, the sentences spoken by the subjects were presented to twenty native Korean raters for evaluation. Then, the judgments were compared across the nine groups of L2 learners and the native Korean speaking control group. The analysis of the second test investigated the extent to which the learners were able to accurately produce specific suprasegmentals: pitch range, peak alignment, speech rate, pause frequency, and pause duration. The results of the acoustic measurements obtained were compared. The purpose of the experiment was to determine to what extent each measurement differed over

both L1 backgrounds and L2 experience levels. The final analysis extended the findings of the first two by using a multiple regression procedure to investigate how the learners' production of specific suprasegmentals contributed to native listeners' fluency judgments of the L2 speech.

3. Fluency judgment

A correlation analysis of fluency judgments was conducted to investigate whether most of the raters maintained reliable results in the samplings. The dependent variable was the mean of the fluency ratings calculated by averaging the twenty Korean listeners' ratings on the 201 subjects. The intra-class correlation coefficient was used to measure the degree of inter-rater reliability in the evaluations of the subjects' speech for each group of raters. The raters' coefficient was highly correlated, r (20) = 0.96, $p < 0.0001$. This result indicates the high degree of consensus among all the native raters.

Figure 1 presents the mean scores of the fluency ratings obtained for the three groups of L1 (English, Japanese, Mandarin) speakers and the three groups of proficiency levels (beginner, intermediate, advanced). The scores for all groups vary significantly, ranging from 2.0 to 5.0 out of 9. There is a difference in the effects of L1 backgrounds and L2 proficiency levels. In Figure 1, higher mean ratings were obtained for the Japanese bilinguals than for the English and Mandarin bilinguals. The difference in fluency ratings was significant (Japanese = 4.69, English = 3.74, Mandarin = 3.63, $p < 0.0001$). Also, as shown in the figure, the mean ratings obtained for the advanced level bilinguals were higher than those obtained for the low level bilinguals. Even though the difference was significant (beginner = 2.66, intermediate = 4.12, advanced = 5.20, $p < 0.0001$), indicating a high proficiency for the bilinguals, they were far behind native Korean speakers' scores (Means = 8.70).

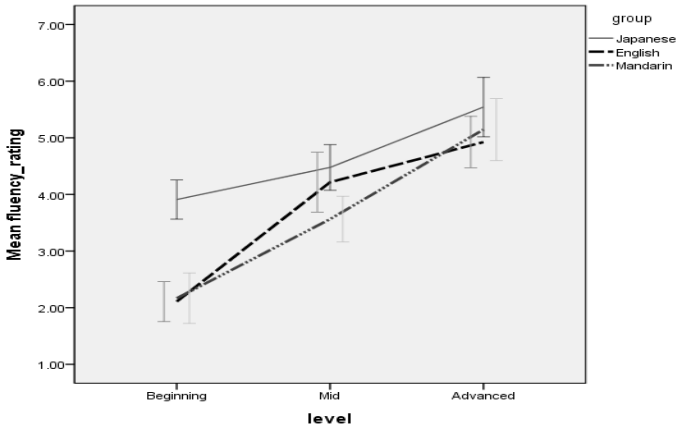

Figure 1. Group means for fluency ratings (±1 SE) for three levels of three L1s

The collected ratings were submitted to a mixed-design ANOVA with the L1 group (English, Japanese, Mandarin Chinese) and experience levels (beginner, mid (intermediate), and advanced) as between- and within-groups factors, respectively. This analysis revealed a significant effect of the L1 group, $F(2, 1407) = 28.049$, $\eta^2 = .101$, $p < 0.001$, and level, $F(2, 1407) = 160.896$, $\eta^2 = .392$, $p < 0.001$. The interaction of the L1 group and proficiency level was moderately significant, $F(4, 1407) = 3.859$, $\eta^2 = 0.055$, $p < 0.05$.

A follow-up Bonferroni test (with $\alpha = 0.0125$ to adjust for nine pairwise comparisons in this and all subsequent analyses) exploring the simple main effect of the L1 revealed that fluency ratings for English and Mandarin learners of Korean did not differ ($p = 0.91$), while the ratings for Japanese learners of Korean were significantly higher than those of both groups ($p < 0.0001$). This result shows that the effect of L1 background generally plays a significant role in judging the L2 speaking fluency. Bonferroni tests exploring the simple main effect of experience levels further revealed that the ratings of beginner classes were significantly lower than those of intermediate and advanced classes ($p < 0.0001$). This result shows that the experience level clearly influences the L2 fluency degree. To obtain a deeper analysis, a post-hoc test for the interaction between L1 and experience levels was conducted. The result indicates that, although the ratings are dependent on both the effects of L1 backgrounds and L2 experience levels, the effects exhibit different patterns ($p < 0.0001$). The interaction was explored by means of the post hoc Bonferroni test, which revealed that the Japanese group's fluency ratings did not show significant improvement between beginner and intermediate classes (Ms = 3.91, 4.47; SDs = 0.93, 1.08) ($p = 0.091$), whereas those of the English (Ms = 2.11, 4.21; SDs = 1.02, 1.51) and Mandarin groups (Ms = 2.16, 3.56; SDs = 1.29, 0.97) did in this stage ($p < 0.0001$). It appears that the fluency ratings of the Japanese beginner group were high enough to be close to those of the intermediate class so that the degree of improvement was comparatively small. However, all three L1 groups showed significant improvement in fluency between intermediate and advanced levels ($p < 0.0001$).

The analysis indicates that the L1 determines the degree of improvement of L2 speech fluency to a native-like level. Japanese learners start learning Korean with comparatively good fluent speech and still show a significant difference from Mandarin and English natives even in the final stage measured. English learners exhibit a sharp increase in the initial stage, but the increase becomes gentle in the advanced level, whereas Mandarin Chinese speakers show an almost equal rate of improvement in each level. It is safe to conclude that the effect of the L1 plays a significant role in the first stage for adult L2 learners.

To determine whether the learners' experience level had an effect on L2 acquisition independent of the effect of the learners' L1 background, a first-order partial correlation was computed between the learners' fluency ratings

and experience levels, with the L1 partialed out. This analysis yielded a significant correlation between experience level and fluency ratings after the L1 was partialed out, r(1407) = 0.611, $p < 0.001$ (two-tailed computation in this and all subsequent analyses). The reverse also was the case: the correlation between the L1 and fluency ratings was statistically significant after the effect of experience levels was partialed out, r(1407) = 0.396, $p < 0.001$. These findings suggest that there is an independent contribution of the L1 to the relationship between the learners' experience levels and their fluency ratings.

4. Acoustic analysis

The acoustic analysis sought to identify which specific suprasegmentals contributed to the fluency ratings in the L2 learner's speech and to determine the extent to which they did so. Five specific suprasegmentals that might have contributed to the fluency judgment were examined in the acoustic analyses: F0 range, peak alignment, speech rate, pause duration, and pause frequency. The measured suprasegmentals represent the potential source contributing to L2 fluency ratings.

Selected declarative sentences were used to evaluate the prosody of each group. Several acoustic measurements dealing with the fundamental frequency (in Hertz) and duration (in milliseconds) were made. Duration and fundamental frequency were measured using a waveform display with a time-locked wideband spectrogram with Praat (5.1.17) software.

4.1 F0 range

The F0 range is known as an indicator of L2 acquisition in acquiring stress-timed languages such as English (Mennen 2006). Similarly, this cue could be the crucial one in determining fluent speech for syllable-based languages (Kang 2014). In this study, the range was measured from the highest point to the lowest point of the fundamental frequency: the overall range of F0 across the intonational phrase.

Figure 2 presents the mean range of F0 by three L1 groups and three experience levels. Note that the line indicates the movement of the F0 range over three levels by each group. Overall, the longer their experience levels are, the wider their F0 range regardless of their L1 background.

The F0 ranges obtained for each subject were submitted to a mixed-design ANOVA (L1 * experience). The analysis missed a statistical L1 group effect, $p > 0.05$. However, it revealed a meaningful statistical effect on experience, $F(2, 1407) = 6.068$, $\eta^2 = .035$, $p < 0.05$. The interaction of the L1 and the L2 level was not significant, $F(4, 1407) = 0.186$, $p > 0.05$. Follow-up Bonferroni tests exploring the simple effect of experience levels revealed that the F0 range of the beginner level (58 Hz) showed a significant difference as opposed to the intermediate (68 Hz) and advanced level (69 Hz) ($p < 0.0001$).

On the other hand, the three L1 learner groups showed no statistical difference in F0 range (English 62 Hz, Japanese 66 Hz, Mandarin 67 Hz). The interaction was explored by means of the post hoc Bonferroni test, which revealed that only the group of English learners showed a statistically meaningful difference between beginner and intermediate levels, whereas the others did not show any significant change of F0 range at any other level ($p > 0.05$).

This result supports partially the results of the previous research that more fluent learners have a wider F0 range when speaking the target language than less fluent learners (Mennen 2006, Bradlow et al. 1996), opposing the argument that a narrower F0 range could be evidence of the influence of the L1 (Scherer 2000). The variation of F0 range for English, Japanese, and Mandarin confirms that increasing experience levels lead to wider F0 ranges, regardless of speakers' L1 background, even when they acquire the syllable-based language Korean.

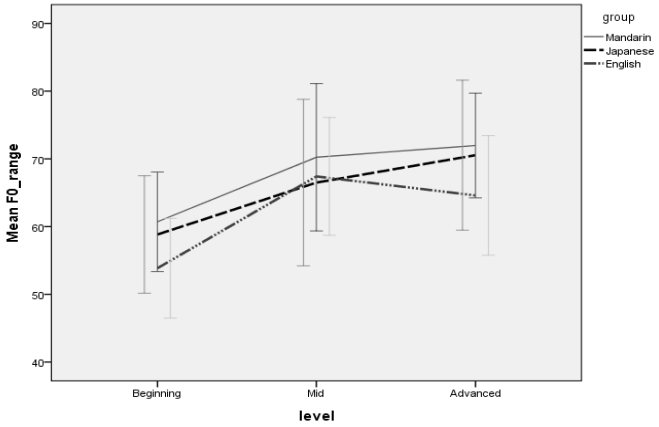

Figure 2. Group means for F0_range (±1 SE) for three levels of three L1s

4.2 Peak alignment

Peak alignment, which refers to the temporal relation of high (H) or low (L) tones to the segmental string (i.e. the timing of a peak or valley with the vowels and consonants in speech), is another suprasegmental measurement of L2 proficiency. In this study, it was measured as the durational distance from the vowel initials to the highest pitch peak in the stressed syllable realized in Korean focused words. Several studies have reported that languages differ considerably in their use of peak alignment (Mennen 2004 2006, Trofimovich and Baker 2006). Examining peak alignment in Greek sentences spoken by native Dutch speakers, Mennen (2006) reported that Dutch speakers have difficulty acquiring Greek peak alignment even after an extensive amount of experience with Greek (12-35 years). Clearly, L2

learners' difficulty in acquiring proper peak alignment results from the L1 effect. According to Ladd et al. (2000), when compared with English or German, Italian has earlier peaks, and the falling pitch contour starts before the occurrence of the next syllable. Therefore, L2 speakers whose native language is English tend to pronounce Italian with relatively later peaks and produce English-like Italian.

In the Korean language, pitch prominence marks the boundary of an accentual phrase (Jun 2005). However, when focused words or suffixes appear in sentences, accentual or phonetic prominence takes place even in the initial or the middle of the intonational phrases. Focused words or suffixes are realized phonetically with a higher pitch, wider pitch range, and longer duration than their unfocused counterparts. There is no doubt that focus is important in an utterance, as focus in any language not only conveys linguistic information, but also plays a key role in setting up the discourse structure and, therefore, is an important indicator of L2 learners' speech fluency. Because of its role in L2 speech, the prosodic features of focus have been known to be important for fluent pronunciation. In this study, the stressed syllable was used to measure the peak alignment realized in the focused words in Figure 3.

The mixed-design ANOVA revealed a significant effect of the L1 group, $F(2, 1407) = 8.253$, $\eta^2 = 0.055$, $p < 0.001$, and experience level, $F(2, 1407) = 50.536$, $\eta^2 = 0.262$, $p < 0.001$. The interaction of the L1 and experience levels was moderately significant, $F(4, 1407) = 3.122$, $\eta^2 = 0.042$, $p < 0.05$. The Bonferroni tests exploring the simple main effect of the L1 revealed that the peak alignment of Mandarin learners was much closer (Ms = 0.13 s) to Korean than that of English or Japanese learners (Ms = 0.25 s, 0.22 s, respectively, $p < 0.05$). Considering that the mean of native Korean peak alignment is around 0.11 second, Mandarin learners' acquisition is quite interesting because of its closeness to the native Korean speakers'. Bonferroni tests exploring the simple main effect of proficiency levels further revealed that the values of the beginner group were significantly closer than those of the intermediate and advanced classes ($p < 0.001$). The interaction was explored by means of post hoc tests, which revealed that the three L1 groups' peak alignments showed significant improvement between beginner and intermediate classes ($p < 0.001$), whereas those of all three groups did not show a meaningful difference between the intermediate and advanced levels ($p > 0.05$).

This result is not in accordance with previous works that found that even more advanced Dutch learners of Greek did not obtain the proper peak alignment (Mennen, 2004), or more experienced Korean learners of English with early AOA showed some difficulty in acquiring proper peak alignment in English stress (Trofimovich and Baker 2006). The peak alignment of Korean as a target language, however, may be acquired quickly. More specifically, it is comparatively easy for most of the experienced L2 learners, regardless of the L1, to acquire the Korean peak alignment correctly. It

appears that the learning direction from a rhythmic-based language to a syllable-based language implies a comparatively easy acquisition of the peak alignment, compared with the reverse direction.

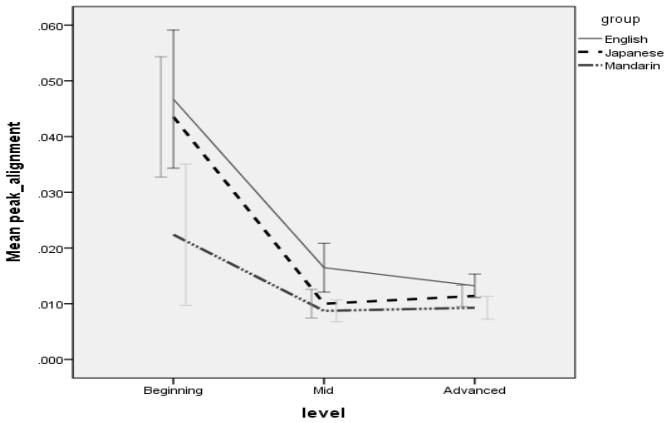

Figure 3. Group means for peak alignment (±1 SE) for three levels of three L1s

4.3 Speech rate

Speech rate has been proven to be a good indicator of L2 fluency (Guion et al. 2000, Derwing and Munro 2001). Speech rate is calculated by dividing the total number of syllables produced in a given speech sample by the total time expressed in seconds. In this study, the speech rate was operationalized as the duration measured from the initial acoustic signal of the phrase in both the waveform and the spectrograms to the final acoustic or spectral cues of the phrase boundary. Next, the resulting total number of syllables was divided by the total speech time excluding pauses of two or more seconds.

The mixed-design ANOVA revealed a significant effect of the L1 group, $F(2, 1407) = 4.742$, $\eta^2 = 0.028$, $p < 0.05$, and experience level, $F(2, 1407) = 50.503$, $\eta^2 = 0.232$, $p < 0.001$. The interaction of the L1 and experience levels was moderately significant, $F(4, 1407) = 2.524$, $\eta^2 = 0.029$, $p < 0.05$. The Bonferroni tests exploring the simple main effect of L1 revealed that the speech rate of Japanese learners was much faster than that of the English and Mandarin learners ($p < 0.05$). Bonferroni tests exploring the simple main effect of experience levels further revealed that the ratings of beginner classes were significantly lower than those of intermediate and advanced classes ($p < 0.001$). The interaction was explored by means of post hoc tests, which revealed that the speech rate of the three L1 groups did not show any significant improvement between intermediate and advanced classes ($p > 0.05$), whereas those of English and Mandarin did between the beginning and intermediate levels ($p < 0.001$). Japanese learners' speech rate did not show any statistical difference among the three stages ($p > 0.05$).

These results are consistent with previous works in which more fluent speech was produced with a faster speech rate (Derwing and Munro 2001), and in which the advanced groups with higher ratings of fluency had a faster speech rate (Guion et al. 2000). Some research has suggested that speech rate is not tied to the L1 effect. For instance, Munro and Derwing (2006) reported that the listeners, regardless of the L1 language background, had a tendency to assign the highest ratings of foreign accent to L2 speech that was somewhat faster than the rates generally used by L2 speakers, and also that very fast and very slow speech tended to be less highly rated. In this study, however, at least in the initial stage for the L2 learners in a post-critical period, the effect of the L1 influences speech rate very strongly as shown by the fact that the speech rate of Japanese learners is the fastest, while that of English learners is the slowest ($p < 0.05$). It appears that the structure of Japanese provides the beneficiary tools to assist the fast acquisition of an appropriate speech rate in early L2 Korean learning stages.

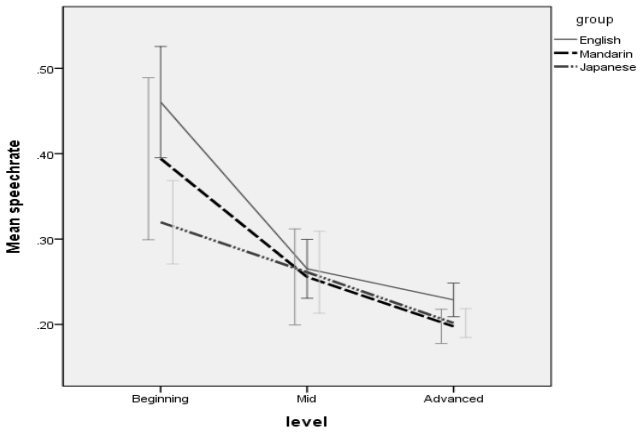

Figure 4. Group means for speech rate (±1 SE) for three levels of three L1s

4.4 Pause duration and frequency

A large number of the L2 acquisition studies report that both pause duration and frequency affect listeners' ratings of foreign accents in L2 speech (Riazantseva 2001), and that both are often viewed as determinants of L1 and L2 fluency (Trofimovich and Baker 2006). Pauses might indicate the speaker's difficulty with the task, perhaps reflecting processing or memory constraints unique to L2 speech. It is suggested that pause duration and frequency are cross-linguistic factors regardless of L1 backgrounds (Mennen 2006). In this study, the pause frequency was calculated by counting the number of pauses at 2 seconds or more that occurred in the speech, while pause duration (as a total pausing time) was calculated by adding up all the unfilled pauses.

The duration and frequency of pauses were submitted to a mixed-design ANOVA (L1 * levels). First of all, the ANOVA for the pause duration was conducted. The effect of the L1 group was not significant, $F(2, 1407) = 2.318$, $\eta^2 = 0.014$, $p > 0.05$, whereas the effect of the proficiency level was, $F(2, 1407) = 19.242$, $\eta^2 = 0.142$, $p < 0.001$. The interaction of the L1 background and L2 experience level was not significant, $F(4, 1407) = 0.654$, $\eta^2 = 0.008$, $p > 0.05$. Follow-up Bonferroni tests exploring the simple main effect of the L1 revealed that the pause duration and frequency of all three L1 groups did not show any difference ($p > 0.05$). Bonferroni tests exploring the simple main effect of experience levels further revealed that the pause durations of beginner classes were significantly longer than those of intermediate and advanced classes ($p < 0.001$), whereas those of intermediate and advanced groups did not show any difference ($p = 0.171$). The interaction was explored by means of post hoc tests, which revealed that all three L1 groups' pause durations did not show any statistical improvement between intermediate and advanced classes ($p > 0.05$), whereas those of English and Mandarin did between the beginner and intermediate levels ($p < 0.001$). Japanese learners' pause duration did not show any meaningful difference among the three levels ($p > 0.05$). The results are summarized in Figure 5.

These results are consistent in which pause duration was related to the experience level, but not to the L1 background. In the very beginning stage of Korean learning, however, the L1 background has some influence on the pause duration: in particular, Japanese learners of Korean (Ms = 0.85 s per sentence) produced Korean speech with significantly shorter durations of pauses than English (Ms = 1.25 s per sentence) or Chinese speakers (Ms = 1.33 s per sentence).

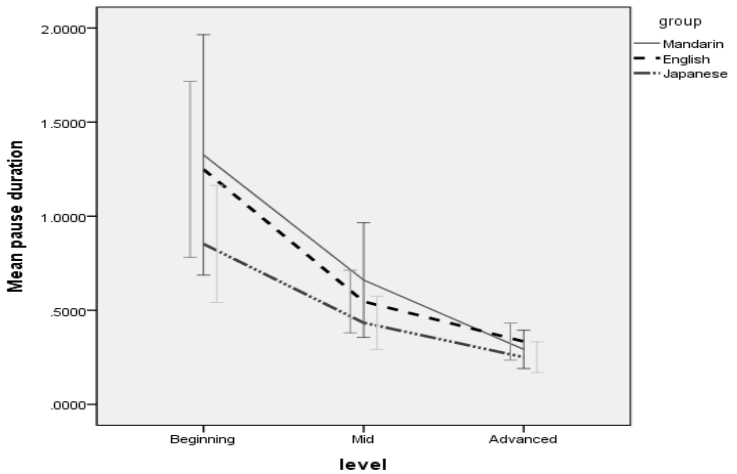

Figure 5. Group means for pause duration (±1 SE) for three levels of three L1s

The frequency of pauses was submitted to a mixed-design ANOVA (L1 * levels). As shown in Figure 6, the mixed-design ANOVA revealed a significant effect of the L1 group, $F(2, 1407) = 5.241$, $\eta^2 = 0.03$, $p < 0.05$, and experience levels, $F(2, 1407) = 23.077$, $\eta^2 = 0.121$, $p < 0.001$. The interaction of L1s and experience levels was moderately significant with $F(4, 1407) = 1.785$, $\eta^2 = 0.021$, $p > 0.05$. Application of the Bonferroni test to explore the L1 effect revealed that the pausing frequency of English learners of Korean was moderately higher than those of Japanese and Mandarin learners ($p < 0.05$), whereas those of Japanese and Mandarin did not show any difference ($p = 1.000$). Similarly, application of the Bonferroni test to explore the effect of the experience level further revealed that the pause frequency of beginner classes was significantly greater than those of intermediate and advanced classes ($p < 0.001$). The interaction was explored by means of post hoc tests, which revealed that all three L1 groups' pause frequency did not show any significant improvement between beginner and intermediate classes ($p > 0.05$), whereas those of English and Mandarin did between the intermediate and advanced levels ($p < 0.001$). The Japanese learners' pause frequency did not show any meaningful difference among the three levels ($p > 0.05$). It is safe to say that the differences in pause patterns disappear in the later stage of L2 learning for all adult learners.

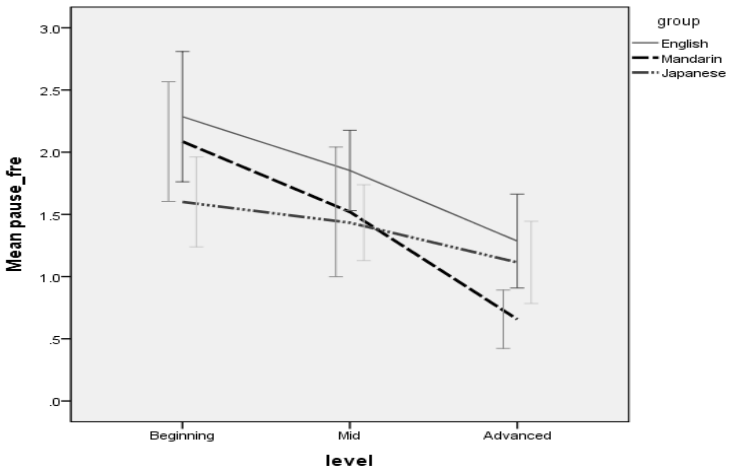

Figure 6. Group means for pause frequency (±1 SE) for three levels of three L1s

5. Relationship between suprasegmental production and fluency test

The production analysis showed that both effects influence L2 learners' acquisition of Korean prosody dependently or independently. One of the remaining questions concerning the production tests is to what extent learners' L2 improvement in the suprasegmental cues could contribute to the

fluency judgments. For the analysis, both fluency-rating scores of L2 learners of Korean and their values of suprasegmentals examined in this study were submitted to correlation and regression analyses. Zero-order correlations were computed between the learners' fluency ratings (n=20) and their suprasegmental measured values (F0 range, peak alignment, speech rate, frequency, and duration of pauses).

The analysis indicates that most of the acoustic values measured in this study are differently correlated with the fluency ratings in Table 2, suggesting that the temporal cues (e.g., speech rate, and duration and frequency of the pauses) are strong predictors of fluency judgments. On the contrary, spectral cues (peak alignment and F0 range) are less tied with the rating scores.

Table 2. Summary of correlation analyses between fluency ratings and acoustic measurement

	Acoustic measurement				
	F0_ Range	Peak alignment	Speech rate	Pause frequency	Pause duration
Fluency ratings	-.060	-.297*	-.630**	-.538**	-.453**

**: $p < 0.001$, *: $p < 05$

The fluency scores for each of the five suprasegmentals were individually regressed on the ratings. The goal of the analyses was to estimate the degree to which each of the five suprasegmentals examined here predicted the L2 learners' fluency ratings. These five separate linear regression analyses (Bonferroni adjusted α=0.0125) allowed for determining the degree of variance that each of the suprasegmental measures shared with the fluency ratings.

Table 3 indicates that each of the five suprasegmental values significantly predicted the share of fluency ratings: the speech rate variable explained 39.6% of the variance with the pause frequency of 28.9%, pause duration of 20.6%, peak alignment of 8.0%, and F0 range of 0.4%. It is clear that the temporal cues are the most important variables in fluency judgments by native Koreans. However, it remains to be understood why some spectral signals such as the peak alignment or the F0 range did not appear to have shared an important variance with L2 learners' fluency ratings. The results are in accordance with previous studies shown in Derwing and Munro (2004) and Trofimovich and Baker (2006). They suggested that spectral features may be insensitive to the fluency judgments of native speakers. Therefore, for the Korean raters, fine-grained spectral differences in some signals are so subtle that they are virtually imperceptible to them and therefore have little impact on fluency judgments.

Table 3. Summary of regression analyses for acoustic measurements as predictors of fluency ratings

		B	SE B	B	R^2	T
Speech r	Constant	0.474	0.015			30.732**
	Speech rate	-8.988	0.601	-0.630	0.396	-14.991**
F0 ran	Constant	5.045	0.338			14.924**
	F0 range	-.005	0.005	-0.060	0.004	-1.109
Pause d.	Constant	5.358	0.132			40.681**
	Pause duration	-1.138	0.121	-0.453	0.206	-9.409**
Pause f.	Constant	6.086	0.157			38.676**
	Pause fre.	-1.026	0.087	-0.538	0.289	-11.798**
Peak align.	Constant	5.241	0.152			34.422**
	Peak align	-28.758	4.994	-0.297	0.088	-5.758*

**: $p < 0.001$, *: $p < 0.05$

In summary, the results suggest that native speakers' judgments of L2 speech may reflect a universal feature of fluency judgments; a strong perceptual effect is dependent mainly on the temporal cues such as the speech rate and the frequency and duration of the pauses.

6. Discussion

Both the effects of L1 and experience levels were found to have a meaningful influence on the fluent production of suprasegmentals in terms of the F0 range, peak alignment, speech rate, and frequency and duration of the pause. The relationship between the effects, however, is contradictory in the adult L2 learners' suprasegmentals; the improved proficiency levels mitigate the effect of the L1 to some degree. The beginner groups show a comparatively large difference in fluency ratings depending on their L1, whereas the difference decreases greatly, approaching the advanced levels, which exhibited patterns more similar to those of native Korean speakers. The result highly supports the reports of current L2 prosody studies (Mennen 2006, Trofimovich and Baker 2006) in that experience has a positive effect on L2 prosody acquisition for late learners. In the study, the speech of L2 adult learners of Korean who were immersed for 4.5 years of training in a formal setting was getting closer and closer to the speech of the native Koreans, regardless of their background language.

The Japanese learners examined in this study were judged to produce Korean suprasegmentals with statistically better fluency than English and Mandarin learners in the early stages, but not in the later stages. Bongaerts and colleagues (2000) examined the fluency difference between Dutch-speaking learners of English and French and suggested that typological distance between the L1 and the L2 is a crucial factor for adult L2 learners.

Their argument is that typological proximity may be one of the determining factors of ultimate native-like performance. By following their argument, this study carefully indicates that there is some relationship between Korean and Japanese in the suprasegmental structure.

In the early stage, the division of fluency ratings between two categories – English and Mandarin vs. Japanese – may be due to the fact that some powerful temporal cues play significant roles in judging L2 fluency. In other words, Japanese learners' success in early stage results from their comparatively fluent production of temporal cues such as speech rate, and duration and frequency of the pauses, which seem to be the crucial cues in determining L2 fluency.

The positive effect, however, may decrease gradually over the experience levels and loses its influence in the later stage for adult learners. Even though the beginner Japanese learners received significantly higher ratings than the English and Mandarin speakers (Japanese 4.03, English 2.18, Mandarin 2.19, full score 10), the difference in their score ratings decreases statistically in the later stage (Japanese 5.63, English 5.06, Mandarin 5.17). The result of the study offers a broad conclusion regarding the relationship of L1 language background with the experience after the critical period; the positive effect from the L1 has the most influence in the initial stage, but its effect is mitigated in the advanced stage of L2 proficiency.

The mutual effects – decreasing L1 effect and increasing experience levels – raise the issues of what particular patterns of L2 suprasegmental acquisition occur for late adult learners. This study suggests that, for the L1 beneficiary, the acquisition of L2 suprasegmentals improves rapidly in the first stage and then reduces to a gentle improvement in the later stage. On the contrary, for the learners from comparatively disadvantaged L1 backgrounds, the patterns show a gentle improvement in the first stage and rapid growth in the later stage. Either way, it appears that the patterns of development form an S-shaped curve: an early peak for the Japanese L1 and a later peak for the English and Mandarin L1s. In short, the initial stage after the critical period was affected by the advantage of the L1 very strongly. Conversely, the later stage was affected by the experience levels, which involve large amounts of exposure to the target language, high motivation to learn, or intensive training.

7. Conclusion

The characterization of comparatively late L2 learners has some important implications for our understanding of acoustic-phonetic variability of L2 suprasegmental acquisition and its effects on overall speech fluency. The crucial implication of the findings concerns variation depending on L1 mother tongues and L2 experience levels. Generally, the learners with an L1 advantage were found to have more fluent speaking skills than those that did not. The positive effect, however, decreased in the later stage of L2 learning;

all three L1 groups showed similar suprasegmental patterns of the L2 speech. The effect influences raters' fluency judgment based on uneven cue weight, in which temporal cues are more important than the F0-related cues. The higher scoring L2 learners marked a faster speech rate, shorter pause duration, and lower frequency of pauses, while their peak alignment and F0 range were behind the other groups compared in the study. This indicates that cue weighting could play a meaningful role in judging the degree of L2 speech fluency.

Appendix A

Korean speaking

A: question (prompt)
B: answer (response)

A: 지금 뭐하니?
B(01): 응, 식사 중 이야.
A: 뭐, 식사? 지금 몇 시인줄 아니?
B(02): 몰라. 지금에만 시간이 나거든. 너는 점심 먹었니?
A: 아니. 나도 못 먹었어.
B(03): 그래? 그럼, 이리로 와. 만나서 같이 먹자.
A: 아니. 지금 거기로 갈 시간이 없어.
B(04): 그래. 하여튼 조금 있다 꼭 챙겨라.
A: 모르겠어. 너무 할 일이 많아.
B: 저녁 식사할 시간은 있니?
A: 몰라. 내일 시험이 있어. 너는 시험 준비 많이 했니?
B(05): 당연하지. 벌써 다했지. 너는?
A: 아직 못했어.
B(06): 빨리해. 준비할게 상당히 많아.
A: 근데, 정말로 공부하기 싫어.
B(07): 너 그러다 큰일난다.

English translation

A: What are you doing?
B(01): Yep. I am eating lunch now.
A: What! Lunch? What time is it now?
B(02): Nop, I was free only in this time. Did you have lunch?
A: No. I didn't have lunch yet.
B(03): Didn't you? Come over here. Let's have lunch together.
A: No, I didn't have time.
B(04): Anyway you take care of yourself.
A: I am not sure. I have a lot of works to do.
B: Do you have time tomorrow?

A: I don't know. I will take exams tomorrow. Do you prepare for the exams?
B(05): Of course. I've finished it. How about you?
A: I didn't prepare.
B(06): Do it right now. You can find lots of stuff to work with.
A: Anyway I didn't like to study today.
B(07): You should meet big trouble.

REFERENCES

ANDERSON-HSIEH, JANET and HORABAIL VENKATAGIRI. 1994. Syllable duration and pausing in the speech of Chinese ESL speakers. *TESOL Quarterly* 28, 807-812.

BOLINGER, DWIGHT. 1978. Intonation across languages. In Joseph H. Greenberg (ed.). *Universals of Human Language* 2, 473-519.

BONGAERTS, THEO, SUSAN MENNEN and FRANS VAN DER SILK. 2000. Authenticity of pronunciation in naturalistic second language acquisition: The case of very advanced late learners of Dutch as a second language. *Studia Linguistica* 54*,* 298-308

BRADLOW, ANN R., GINA TORRETTA and DAVID PISONI. 1996. Intelligibility of normal speech I: Global and fine-grained acoustic-phonetic talker characteristics. *Speech Communication* 20*,* 255-272.

CHUN, DOROTHY M. 2002. *Discourse Intonation in L2: From Theory and Research to Practice*, 1-250. Amsterdam, PA: John Benjamins Publishing Company.

DERWING, TRACEY M. and MURRAY MUNRO. 1997. Accent, intelligibility, and comprehensibility. *Studies in Second Language Acquisition* 19, 1-15.

_____. 2001. Modeling perceptions of the accentedness and comprehensibility of L2 speech: The role of speaking rate. *Studies in Second Language Acquisition* 23.4, 451-468.

GUION, SUSAN G., JAMES FLEGE, SERENE LIU and GRACE YENI-KOMSHIAN. 2000. Age of learning effects on the duration of sentences produced in a second language. *Applied Psycholinguistics* 21*,* 205-228.

HAKANSSON, GISELA, MANFRED PIENEMANN and SUSAN SAYEHLI. 2002. Transfer and typological proximity in the context of second language processing. *Second Language Research* 18, 250-273.

JUN, SUN-AH. 2005. Prosodic typology. In Sun-Ah Jun (ed.). *Prosodic Typology: The Phonology of Intonation and Phrasing*, 431-458. London: Oxford University Press.

KANG, SEOKHAN. 2014. The production of the English sentence-final foot by the effect of immersion. *Studies in Linguistics* 32, 1-20.

LADD, D. ROBERT, INEKE MENNEN and ASTRID SCHEPMAN. 2000. Phonological conditioning of peak alignment in rising pitch accents in Dutch. *Journal of the Acoustical Society of America* 107*,* 2685-2696.

MENNEN, INEKE. 2004. Bi-directional interference in the intonation of Dutch speakers of Greek. *Journal of Phonetics* 32, 543-563.

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

MOYER, ALENE. 1999. Ultimate attainment in L2 phonology: The critical factors of age motivation and instruction. *Studies in Second Language Acquisition* 21, 81-108.

MUNRO, MURRAY J., and TRACEY DERWING. 1995. Foreign accent, comprehensibility, and intelligibility in the speech of second language learners. *Language Learning*. 45.1, 73-97.

_____. 2006. The mutual intelligibility of L2 speech. *Studies in Second Language Acquisition* 28, 111-131.

RIAZANTSEVA, ANASTASIA. 2001. Second language proficiency and pausing: A study of Russian speakers of English. *Studies in Second Language Acquisition* 23, 497-526.

SCHERER, KLAUS R. 2000. A cross-cultural investigation of emotion inferences from voice and speech: Implications for speech technology. In B. Yuan, T. Huang and X. Tang (eds.). *Proceedings of the Sixth International Conference of Spoken Language Processing* 2, 379-382.

TROFIMOVICH, PAVEL and WENDY BAKER 2006. Learning second language suprasegmentals: Effect of L2 experience on prosody and fluency characteristics of L2 speech. *Studies in Second Language Acquisition* 28, 1. 1-30.

UEYAMA, MOTOKO and SUN-AH JUN. 1998. Focus realization in Japanese English and Korean English intonation. *Japanese and Korean Linguistics*, Volume. 7, 629–645. Cambridge: CSLI Cambridge U.P.

WENNERSTROM, ANN. 1994. Intonational meaning in English discourse: A study of non-native speakers. *Applied Linguistics* 15.4, 399-420.

_____. 2001. Intonation and evaluation in oral narratives. *Journal of Pragmatics* 33.8, 1183-1206.

Seokhan Kang
General Education Institute
Konkuk University
268 Chungwon-daero, Chungju-si, Chungcheongbuk-do,
Korea 380-701
e-mail: kangs45@kku.ac.kr

received: November 20, 2014
revised: December 12, 2014
accepted: December 19, 2014