『영미연구』
제41집 (2017): 135-158

The Effects of the Early Acquisition of English on Korean-English Bilingual Children's Production of Korean Prosody*

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[Abstract]

The current study examines Korean prosodic features produced by Korean speaking children varying in the amount of L2 experience. The primary goal is to examine the effect of L2 (English) experience on the production of the L1 (Korean) segments and prosody. Two groups (Experienced vs. Inexperienced) of 10 Korean children have participated in the production study. The four-syllable Accentual Phrases produced by the experienced child groups returned a significant effect of a two-way stop system in English. As for the F0 pattern, the experienced child group's three-way stop contrast and the AP tonal pattern were produced in a nonnative-like manner. Also, results of syllable duration coupled with intensity showed a rhythmic pattern of a stressed-timed language. The results suggests that an early exposure to the L2 can yield a significant delay in the development of both the segmental and prosodic features of the L1.

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* This paper contains a section of the author's unpublished doctoral dissertation.

Key Words: Effects of early L2 acquisition, Korean laryngeal stop contrasts, pitch, syllable duration, intensity

1. Introduction

The course of bilinguals' language acquisition and development has been the topic of much interest for many years. Several studies have striven to unfold bilinguals' unique learning mechanism and linguistic identity that is thought to differ from the monolinguals in both production and perception. Although bilinguals' production of L1 and L2 has allowed researchers to gain insight into several factors that indicate the degree and direction of L1-L2 interaction and the native-likeness of the L2, there are still remaining questions as to how two (or more) languages compete and interact to create distinctive systems and what factors determine the degree of separation as well as the direction of interaction between the two languages.

Studies comparing early and late bilinguals have reported the age of L2 exposure as the strongest predictor of native-like L2 attainment (Guion 2003; Baker & Trofimovich 2005; Flege, Birdsong, Bialystok, Mack, Sung, & Tsukakda 2006; Baker, Trofimovich, Flege, Mack, & Halt 2008). Namely, different patterns of language interaction may arise depending on whether the bilingual acquired the L2 during the early (development) or late (ultimate) stage of language acquisition. Flege (1991) examined the voice onset time (VOT) production of English /t/ by Spanish-English early (Age of Acquisition (AOA) = 0-6) and late bilinguals (AOA = 11-35). Flege (1991) reporeted that the early bilinguals' overall VOT for English /t/ was not different from the monolingual English speakers' VOT, whereas the late bilinguals' VOT differed from monolinguals' production. Similarly, Kang and Guion

(2006) examined early (AOA = 1-6) and late adult bilinguals'(AOA = 15-34) production of English and Korean stops. The results showed that the early, but not late, bilinguals' production of English and Korean stops was comparable to both English and Korean speaking monolinguals' production in terms of VOT, voice quality, and F0 (fundamental frequency). The results suggests that the L2 sounds acquired at an early age is more likely to be distinctive from the similar L1 sounds.

However, the benefit of an early exposure to the L1 may not guarantee the earlier acquisition of L1 phonetic features than the corresponding L2 features. For instance, Johnson and Wilson (2002) examined two Japanese (L1)-English (L2) bilingual children (aged 2:10 and 4:8)'s VOT production of Japanese and English. Although both English and Japanese have a two-way voicing contrast, Japanese has a pre-voicing and short-lag VOT distinction that is thought to be acquired later than short-lag and long-lag VOT distinction in English (Macken & Barton, 1980). Following the universal pattern, the younger Japanese bilingual child produced short- and long-lag VOT for Japanese stops as in English. In lieu of showing a prevoicing pattern, the older bilingual child made a greater difference between the Japanese and English by producing longer VOT for English voiceless stops. Even though both of the bilingual children's language VOT contrast in the L1 was not adult-like until the age of 4:8, they were able to make a significant distinction between Japanese and English in terms of VOT. The emergence of the two separate VOT systems indicated that bilingual children are likely to have developed separate representations for the two languages. The adult-like realization of the language-specific details of the L1 and L2 may simply take time, especially for young children with immature articulatory skills.

Similarly, Lee and Iverson (2012) argued that acquiring the L2 categories before the full establishment of L1 categories could affect the developmental pattern and

native-likeness in the L1. The study examined the VOT and voice-onset F0 of Korean and English stops produced by thirty simultaneous Korean (L1) –English (L2) bilingual children aged 5 and 10 years old. The 5 year-old children have resided in the US for approximately 2 years and 10 year-old children around 5 years. The bilingual children were referred to as simultaneous bilinguals because they were first exposed to English before the age of 5 which has been shown to be the age that the Korean monolingual children begin to distinguish Korean stops (Lee & Iverson, 2012). The results showed that the 10 year-old children were able to separate all five English and Korean stop categories (English voiced, voiceless, Korean lenis, fortis, aspirated stops) whereas the 5 year-old children produced a binary two-way VOT distinction. The 5 year-old children also produced a merged F0 for voiced-fortis, voiceless-lenis, voiceless-aspirated stops. The VOT and F0 assimilation of Korean stops into English voiced and voiceless stops in younger bilingual children's production was described as the effect of English acquisition on Korean development. The L1 categories assimilating into later-acquired L2 categories showed that the early exposure to the L1 may not fully override bilingual children's preference for more distinctive, universal and easily articulated features in the L2. Whether segmental or prosodic features, a certain period of time is needed for a complete separation between the L1 and L2 to take place in bilingual children's production.

Studies on bilingual children's speech production have often been described at the level of segments (Guion, 2003; Kang & Guion, 2006; Baker et al., 2008; Sundra & Polka, 2008). However, the effects of age and the degree of L1-L2 interaction in prosody may differ from those in segments. Children are known to acquired prosody before segments in their L1: neonates can discriminate different rhythmic-class languages (Mehler, Jusczyk, Lambertz, Halsted, Bertoncini & Amiel-Tison, 1988, Moon, Panneton-Cooper & Fifer, 1993), whereas the ability to discriminate vowels

and consonants are shown later in life (Polka & Werker, 1994; Werkers & Tees, 1984). Along with the early acquisition of the perceptual discrimination ability in the L1, studies on monolingual children's L1 production further suggest that L1 prosodic features are also mastered earlier than segmental features (Li & Thompson, 1976; Jun, 2007).

If knowledge of prosodic features is acquired earlier than segments and thus is more entrenched in early bilinguals' language systems, one may expect to find greater interaction between the L1 and L2 prosody. In Lee, Guion, and Harada (2006), multisyllabic English words produced by early and late Korean-English bilinguals were examined. One of the primary research goal was to examine the effect of Korean on the acquisition of English stressed and unstressed vowels. The hypothesis was that if knowledge of Korean interferes with the acquisition of English, not only late but also early bilinguals would show difficulties in attaining native-like L2 phonetic features that are used to signal stressed vowels. The results showed that even early bilinguals produced nonnative-like cues to distinguish stressed from unstressed vowels.

Furthermore, the age at the time of testing and the amount of L2 experience can influence the degree of L1 establishment and the separability between the L1 and L2. Trofimovich and Baker (2007), for example, investigated five English suprasegmental features (stress timing, peak alignment, speech rate, frequency and duration of pausing) produced by Korean child and adult learners of English who differed in age and the amount of English experience. Overall, the five features were more accurately produced by the adult than the child learners. The authors suggested that native-like accuracy of suprasegmental learning depends on extended amounts of L2 experience.

The current study examined Korean prosodic features produced by Korean

speaking children varying in the amount of L2 experience (6 months vs. 6 years). The primary goal was to examine the effect of L2 (English) experience on the production of the L1 (Korean) segments and prosody. In Korean, the smallest prosodic domain is the Accentual Phrase (AP) which is primarily realized by different F0 patterns. The prosodic aspect (i.e., F0) of Korean APs produced by Korean-English bilingual children was compared to that produced by monolingual Korean-speaking children. The tone pattern of the AP in Seoul dialect varies depending on the laryngeal features of phrase initial segments (Jun, 1998). Aspirated and fortis phrase initial obstruents start with high tone and lenis with low tone, which are respectively realized as High (aspirated, fortis)-High-Low-High and Low (lenis)-High-Low-High in four syllable phrases. Lenis stops are realized with distinctively lower F0 compared to aspirated and fortis stops. Due to their salient prosodic cue, the F0 contrast between lenis and aspirated stops was found in a U.S.-born Korean child's production as early as the age of 18 months (Jun, 2007).

Also, as a syllable-timed language, successive syllables in Korean phrases are thought to be produced with near-equal duration, whereas time intervals between stresses are likely to be near-equal in English (Pike, 1945; Abercrombie, 1967). In English, intensity and duration are used as correlates of stress to signal lexical contrasts and thus the assumption was that Korean-English bilinguals may use intensity and duration to mark prosodic prominence in the production of Korean phrases as a result of an early acquisition of English. Namely, the question was whether the early exposure to the L2 would have any effect on the production of the L1 prosody. In the first section of the study, bilingual children's production of segmentally-induced AP-initial tones are compared as a function of F0 differences across three different stop types (i.e., aspirated, lenis, fortis). In the second section of the study, intensity and syllable duration were compared across the two child groups

to determine the effects of the English stress system on Korean-English bilingual children's Korean production.

2. Methods

2.1 Participants

A total of 20 Korean children with different amount of L2 exposure participated in the production study. The mean age at the time of testing was 7.2 years old (s.d. = 1.2). 10 Korean-English bilingual children (4 male, 6 female) were recruited from the Northwestern region of the United States. They were all born and raised in the area to a Korean-speaking family. According to the language background survey, they were mainly exposed to Korean before the age of three but began to use more English (62%) after attending preschool. The parents of the children were all immigrants who speak Seoul Korean. The Korean-English bilingual children group, referred to as KEC (Korean experienced children) group, was compared to the age matched Korean inexperienced children (KIC) group who had resided in the same area less than six months at the time of testing. The KIC group children had some prior experience with English but none had received intensive training on English pronunciation (i.e., attending an international school or English-language Kindergarten in Korea). The background information is provided in Table 1.

Table 1. Korean Experienced and Inexperienced Children Participants

Group	Age	LOR	AOA	English use
KEC (4m, 6f)	7.1(1.2)	7.1(1.2)	2.4(1.6)	62%(18%)
KIC (4m, 6f)	7.3(1.3)	0.5(0.1)	6.7(1.5)	42%(8%)

2.2 Materials

Korean lenis, fortis, and aspirated stops were each produced in six frequently used Korean phrases. Because familiar and imageable expressions had to be chosen for the bilingual children's elicitation procedure, syllable structures and vowel contexts across the stimuli were not perfectly matched. However, the analysis is not compromised as the stimuli were produced in the same surrounding vowel context and each stop type was compared across groups. Each phrase was presented in Korean characters with a corresponding picture on a computer screen. The four-syllable phrases ended in either /rɨm.ni.da/ or /sɨm.ni.da/ (present indicative ending in a polite form). The first syllables representing the three Korean stop types were matched for their place of articulation (i.e. alveolar and velar). Except for the lenis and fortis alveolar phrase-initial stops, /ta, t*a/, the first words were CVC syllables (/that/, /kʌt/, /k*ʌt/ and /khʌt/). In order to control the vowel context, the first syllable started with low back vowels (/a/ or /ʌ/). The randomized phrases were spoken in isolation at a normal speech rate. The target phrases are shown in Table 2.

Table 2. Speech stimuli

Aspirated	Lenis	Fortis
/t^{h}at.sim.ni.da/ 'to ride'	/ta.rim.ni.da/ 'to be different'	/t*a.rim.ni.da/ 'to follow'
/k^{h}ʌt.sim.ni.da/ 'to grow'	/kʌt.sim.ni.da/ 'to walk'	/k*ʌt.sim.ni.da/ 'to turn X off'

2.3 Procedure

The experiment was conducted in a quiet room in the home of the participants or in the phonetic lab and they all wore a baseball cap with a wireless microphone clipped on adjacent to their forehead. The children were presented with pictures describing the four-syllable phrases in Korean. During the practice session, the audio cues recorded by a Seoul Korean female speaker were also presented with each picture. For the experiment, only visual cues were given and the children produced each word twice in a random order. The recording is made onto a Marantz PMD 660 Professional solid state recorder.

2.4 Measurements

The four-syllable phrases produced by Korean adults and children were displayed in Praat as oscillograms and spectrograms. F0 was measured at the temporal midpoint of each vowel in four syllables. Vowel onset was determined from the onset of the periodic waveform to the stop or nasal coda with reference to spectrograms. The first vowel duration measured the time from the onset of periodic phonation to the stop closure or to the lowering of the third formant frequency in the case where /r/ followed. The vowel of the second syllable starting with /r/ was identified by abrupt

changes in the third formant frequency. VOT (in milliseconds) of stops and affricates was measured as the time from the onset of the noise burst to the onset of the first clear periodic cycle of the waveform for the initial vowel of the target words. None of the Korean stops were pre-voiced.

Each syllable duration (in milliseconds) was measured using Praat. The first syllables were measured from the release of the initial stop to the end of the stop closure of the syllable-final coda. The boundary between the second and third syllable, where /m/ and /n/ adjoined (sim/ni), was determined by abrupt changes in periodic energy and the transition of the second formant (i.e., often higher F2 frequency for /n/ than /m/). Intensity (in decibels) was measured at the temporal midpoint of each vowel in the four syllables. The onset of each vowel was determined from the onset of the periodic waveform to the stop or nasal coda with reference to spectrogram.

3. Results

In order to determine the whether the two stop types were distinguished by F0, mean F0 values for the two stop types were compared for each group. The independent variable were group (2) and stop type (3), as repeated measures, and the dependent variable was F0 values averaged across the two repetitions for each speaker. In case of a significant interaction, the effect of group on the F0 values for each stop type was tested.

The results returned significant main effects of group [$F(1, 108) = 8.793$, $p = .004$] and stop type [$F(2, 108) = 32.082$, $p < .000$]. The interaction between the two variables was not meaningful, indicating that both groups differentiated the Korean

aspirated and lenis stops with F0 in a similar manner. When analyzed separately, no significant difference was found between aspirated and fortis stops in KEC group's production [p = .24], whereas all three stops were distinctive different in KIC group's production [p < .000]. As illustrated in Figure 1, the F0 difference across the stop types in KEC group's production was not as distinctive as that in KIC group's production. Especially, aspirated and lenis stops were produced with a significantly greater F0 difference by the KIC group (diff = 68 Hz) than the KEC group (diff = 47 Hz). In addition, the F0 difference between the first and second syllables for the lenis stops was larger in the KIC group's production. As shown below, the KEC group's F0 target for lenis stops were relatively undershot, resulting in a smaller F0 distinction across the stop types and a less distinctive tonal pattern for the lenis stops.

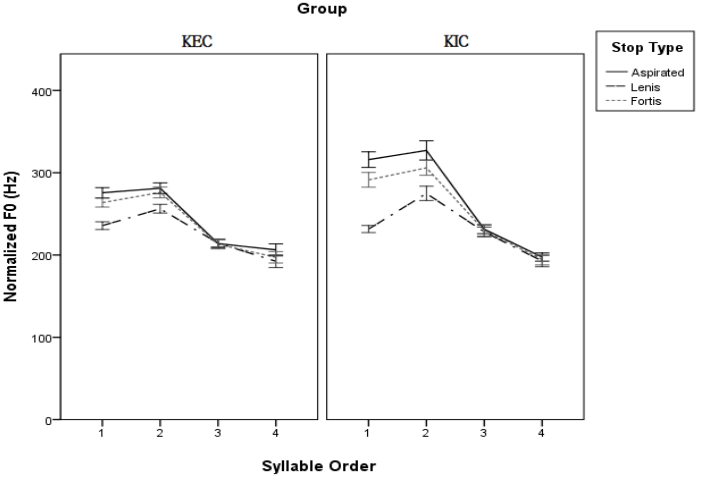

Figure 1. The mean fundamental frequency values (in hertz) of Korean four-syllable phrases beginning with aspirated (upper solid line) and lenis stops (lower dashed line) produced by Korean Inexperienced (KIC) and Experienced Child (KEC) groups are shown.

The results shown in Figure 1 suggest that the early bilingual children with extensive exposure to English were not able to produce Korean three-way stops in a native-like manner. The tonal pattern of the Accentual Phrase deviated from the native norm as well. To further examine the effects of early English acquisition on the suprasegmental (i.e., temporal and rhythmic) features of Korean production, the duration and intensity of the four-syllable phrases were compared.

For normalization, the mean duration of each syllable was divided by the mean syllable duration for that phrase for that speaker. For syllable duration and intensity, differences between the stop type was no longer a topic of interest, and thus, measurements for each syllable were averaged across the two repetitions for each speaker. The normalized duration was submitted to ANOVAs using repeated measures. If the syllable (4) and group (2) interaction was significant, the effect of group on each syllable was separately examined. The results showed significant main effect of syllable [$F(3, 16) = 39.001$, $p = .000$] and a syllable and group interaction [$F(3, 16) = 18.037$, $p = .000$]. When the group effect on each syllable was examined, the second [$F(1, 18) = 7.039$, $p = .011$] and third syllables [$F(1, 18) = 10.526$, $p = .005$] were significantly different between the groups. Considerably longer second syllable followed by a sudden duration drop in the third syllable in KEC group's production is shown in Figure 2.

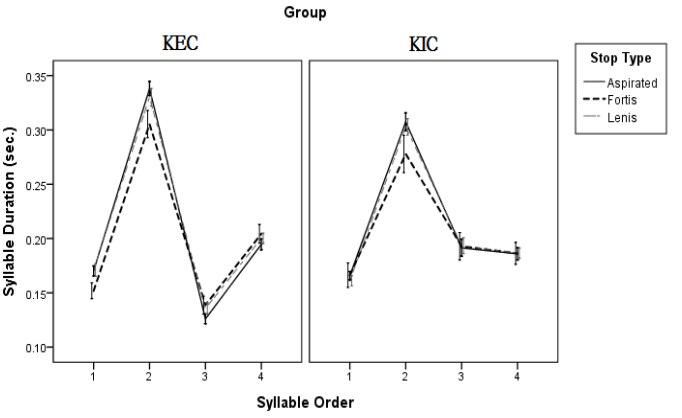

Figure 2. The mean syllable duration (in milliseconds) of Korean four-syllable phrases produced by Korean Experienced (KEC) and Inexperienced Child (KIC) group is shown.

Similarly to the method used for syllable duration, each syllable's intensity values were collapsed and averaged across the two repetitions for each speaker. Then the raw intensity values for the four syllables were each divided by the mean intensity for that speaker. The mean intensity for each speaker was obtained by averaging the intensity values across the four syllables. The normalized intensity was submitted to ANOVAs using repeated measures.

The two groups showed a significant effect of syllable [F(3, 16) = 12,235 p = .000] as well as a significant syllable and group interaction [F(3, 16) = 9.095, p = .001]. Separate analyses returned a significant group effect on the third syllable [F(1, 18) = 39.012, p = .000]. Figure 3 illustrates the distinctively lower intensity for the vowel of the third syllable in KEC group's production.

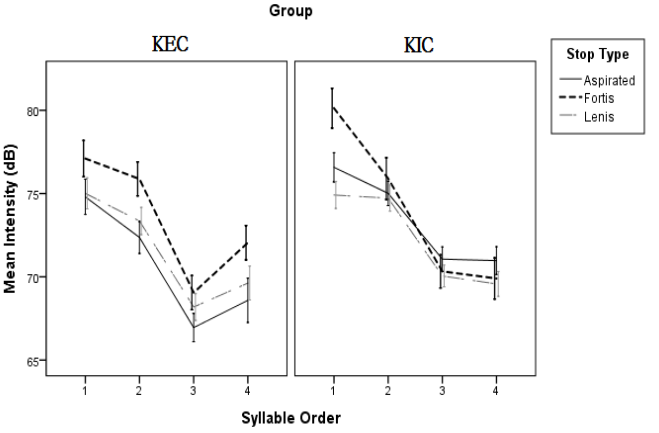

Figure 3 The mean intensity (in decibels) at the midpoint of each vowel in Korean four-syllable phrases produced by Korean Experienced (KEC) and Inexperienced Child (KIC) group is shown.

4. Discussion

Studies have shown that native languages exhibiting different phonetic realization for word-initial stops than a L2 can create difficulties creating distinctive phonetic categories for the L1 and L2 (Flege & Eefting, 1988, Thornburgh & Ryalls, 1998, MacKay, Flege, Piske, & Schirru, 2001, Wang & Behne, 2007). The current study examined the developmental patterns of language-specific features in Korean-English bilingual children's stop production. If native Korean children can learn to fully distinguish three Korean stop categories after the age of four (Kim & Stoel-Gammon, 2009), the bilinguals who have been exposed to English before the Korean stop system was fully established were expected to show delayed onset or non-nativelike acquisition of Korean stops. As predicted, the Korean-American bilingual children

were not able to acquire a native-like Korean stop contrast. Not only the F0 difference across stop types were smaller but the AP tonal pattern was significantly less distinctive compared to the native Korean speaking children. The merging of aspirate and fortis stops and thus producing a two-way stop contrast indicate a strong effect of early acquisition of English. It is likely that the bilingual children may have employed VOT as the primary cue and F0 as a secondary cue to discriminate aspirated from lenis stops as the influence of the English two-way stop system.

On a separate note, although the differences between the High and Low F0 target was not as distinctive as those observed in native Korean children's production, the experienced Korean children were able to separate High-High pattern for aspirated-initial phrases from the Low-High pattern for lenis-initial phrases. Namely, the bilingual children were able to produce the AP tonal pattern but not as prominent as that produced by the same-age Korean children. As suggested by Lee and Iverson (2012), a certain period of time is needed for a complete separation between the L1 and L2 to take place in bilingual children's production.

To assess the extent and effects of early exposure to English on Korean acquisition, the temporal and rhythmic features of the four-syllable Korean phrases were examined. As duration has been described to be one of the most reliable acoustic correlates to signal stress across languages (Campbell & Beckman, 1997 for English, Sluijter & van Heuven, 1996 for Dutch, Ortega-Llebaria & Prieto, 2006 for Spanish), syllable duration was expected to capture crucial cues to different rhythmic types between Korean and English. The absolute syllable duration and duration intervals in the bilinguals' production were significantly less consistent. Put together with the intensity pattern, significantly longer syllable duration for the second syllable and significantly decreased intensity coupled with shorter duration for the third syllable can be attributed to the effect of English stress pattern. In particular,

intensity is thought to be a relatively less important phonetic cue in Korean, whereas native English-speaking adults as well as children as young as three years old have been shown to employ intensity to signal stress in English (Pollock, Brammer, & Hageman, 1993, Lee et al., 2006). Considering its small weight in Korean word-level prosody, the sudden drop in intensity (and duration) in the bilingual children's production can be considered as the transfer of English stress and rhythm into Korean.

The question as to why the weakest intensity and shortest duration were given to the third syllable. According to Hall (2007), 76% of the four-syllable words in native English-speaking children's vocabulary have stress on either first or second syllable. Among the overall high-familiarity four-syllable English words, the second syllable was most likely to receive main stress in adults' speech (43%). Relatively lower percentage of four-syllable words with main stress on the third syllable suggests that the bilinguals were likely to perceive the third syllable of the Korean phrase as an unstressed syllable, especially when its syllabic weight is light (CV). Given the durational pattern, the bilingual children appeared to have assigned main stress on the second syllable. Taken together, the pattern resembles the iambic foot structure (i.e., 1st (weak)-2nd (strong) and 3rd (weak)-4th (strong)). The results indicate that the bilingual children's early exposure to the rhythmic features of a stressed-time language (i.e., English) may have influenced not only the segmental feature (VOT) of stop categories but also the overall prosody of a syllable-timed language (i.e., Korean), which is thought to be realized with roughly equal duration between successive syllables.

To summarize, the delay in the native-like acquisition of F0 contrasts for Korean stops and nonnative-like distribution of intensity and duration across syllables in the production of Korean phrases indicate that the bilingual children were not able to

fully demarcate the cross-linguistically different phonetic and prosodic features due to the early and continuous exposure to English. It should be noted, however, these bilinguals' production examined in the developmental stage may look very different from their production in the ultimate stage. Considering the bilingual children's the higher English use and general tendency for bilingual children to quickly shift their dominant language from the L1 to L2 in an L2-speaking environment (Jia & Aaronson, 2003), greater use of English acoustic cues may partake in shaping these bilingual children's production of Korean.

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국문초록

영어의 조기 습득이 한국어-영어 이중언어 구사 어린이들의 한국어 운율 발화에 미치는 영향

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본 논문은 제2 외국어(영어)의 경험에 따른 한국어 운율 체계의 습득에 대한 연구이다. 영어를 조기습득하고 경험이 많은 한국어-영어 이중언어구사 어린이들의 발화가 한국어만 구사하는 어린이들의 발화와 비교했을 때 분절음과 초분절음의 단위에서 보이는 차이를 알아보고자 두 어린이 집단을 대상으로 발화 실험을 실시하였다. 총 20명으로 구성된 평균 7세의 한국어-영어 이중언어 구사 어린이들(경험 집단)과 그렇지 않은 한국어 구사 어린이들(무경험 집단)에게 첫 자음이 평음, 격음, 경음으로 시작하는 4음절의 한국어 구(phrase)를 발화하게 하였다. 먼저, 분절음 단위에서 경험 집단은 한국어의 평음을 격음, 경음과 구분 짓는 기본주파수(F0)의 차이가 무경험집단의 기본주파수보다 유의미하게 작았으며, 운율구(Accentual Phrase)에서 차이를 보이는 평음의 운율적 특징(LHLH) 역시 미미했다. 또한 초분절음 단위에서 역시 영어의 강세를 실현하기 위해 사용되는 음향학적 특징들이(음절의 길이와 음의 강도) 한국어 발화에 현저히 나타났다. 이러한 결과는 제2 외국어의 조기 습득이 모국어에 미치는 영향이 분절음뿐만 아닌 운율 단계에서도 나타나며 이는 모국어 발달의 지연으로 이어질 수 있음을 보여준다. 그러나 조기 영어 습득을 경험한 아이들의 영어 발화의 발달 정도와 두 언어의 운율적 특징들이 양방향으로 미치는 언어 간의 상호영향을 연구하기 위해서는 이중구사 어린이들의 영어 발화도 함께 비교분석할 필요가 있다.

주제어: 이른 제2외국어 습득의 영향, 한국어 폐쇄음 체계, 음의 높낮이, 음절 길이, 음의 강도

논문접수일: 2017.08.11
심사완료일: 2017.10.09
게재확정일: 2017.10.10

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