The Influence of English
on Articulatory Accuracy of Korean Nonwords[*]

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국문요약

윤석연. 2014. 9. 30. **한국어 무의미 단어의 조음정확성에 미치는 영어의 영향.** *이중언어학 56*, 183-202. 이 연구는 제2언어인 영어가 먼저 습득한 제1언어인 한국어 자음 및 모음을 정조음하는데 부정적인 영향을 미치는지 알아보고자 한다. 본 연구에서는 한국에서 태어나 미국으로 이주하여 평균 4년 7개월을 거주한 8~13세 아동 9명, 만 11세 이후 미국으로 이주하여 평균 4년 8개월을 거주하고 미국 대학 또는 대학원에 재학 중인 21~33세 성인 8명, 영어권 지역에 거주한 경험이 없으며, 학교 교과과정 외에 영어학습을 하지 않은 8~13세 아동 18명이 참여하였다. 이 세 집단은 한국어의 음운규칙을 따르지만, 의미를 가지고 있지 않은 16개의 무의미단어를 듣고 따라 말하였다. 이들의 발화전사를 토대로 계산한 음운정확도, 자음정확도, 모음정확도는 통계적으로 집단 간 유의한 차이를 보였는데, 사후검정에 의하면 이중언어아동의 조음정확도(M=90.2)가 이중언어성인(M=94.9)과 단일어아동(M=94.6)보다 발음 정확도에서 유의하게 낮은 수행성과를 보인 것으로 나타났다. 한국어 단일어 아동의 조음정확도와 한국어-영어 이중언어 성인의 조음정확도가 차이가 없음은 일반적으로 조음음운발달이 완성되는 시기이후에 습득한 영어는 한국어 음소정확도에 미치는 영향이 미미함을 시사한다. 반면에, 만9세 이전 영어에 집중적으로 노출된 아동의 조음정확도는 한국어 단일어 아동의 조음정확도와 통계적으로 유의한 차이를 보임으로써 아동기 때 영어에 집중적으로 노출될 경우 제1언어인 한국어를 조음하는데 부정적 영향을 미칠 수 있다는 것을 시사한다.**(원광디지털대학교)**

　【핵심어】 이중언어(bilingual), 조음정확도(percentage of phonemes correct or PPC), 무의미단어 (nonwords), 제2언어 영향 (the influence of L2), 제1언어 쇠퇴 (L1 attrition),

1. Introduction

In the field of bilingualism and second language acquisition, there exists extensive research on how a first language (L1) influences second language (L2) learning. The influence of L2 on L1, however, was investigated much less although research on L1 attrition indicates that the L1-L2 relationship cannot be unidirectional. L1 attrition can be defined as declining ability in L1 (e.g., word-retrieval problems, ungrammatical sentences, nonnative-like pronunciation, etc.) due to language contact-induced changes but not due to pathological conditions such as aphasia, apraxia of speech, articulation and phonological disorders, and so on. The loss of L1 may not result from the immediate interference of L2; however, it is indisputable that L1 attrition is a consequence of L2 acquisition (Cook, 1991; Jarvis & Pavlenko, 2008; Lambert & Freed, 1982; Major, 1992; Seliger & Vago, 1991). The present study investigates the effect of English as L2 on articulatory accuracy of Korean as L1 and the effect of age of L2 acquisition on L1 phonological attrition. The findings from the present study may contribute to the understanding of reciprocal interactions between L1 and L2, particularly between English as L2 and Korean as L1.

1.1. Literature Review

As a Korean-English bilingual (KEB) speaker, I often experience moments in which I cannot retrieve the Korean word for a concept that I can name in English or moments in which I pronounce English loanwords with an English accent to native Korean ears. Indeed, such experience is confirmed by some research on Korean attrition. Ok-Kim (2007) observed KEB adults

who moved to New Zealand at 12 and 13 years of age and had lived there for at least two years. These participants exhibited significantly lower lexical diversity in Korean than Korean monolingual (KM) adults, as measured by the Korean-Boston Naming Test. In Shim's (1994) study, fluent English learners who are Korean native speakers participated in a task of speaking English loanwords. She argued that these L2 learners produced English loanwords not with Korean phonological rules but rather with English phonological rules. Similarly, Tark and Lee (2014) showed that the values of fundamental frequency at the utterance-initial syllable were significantly different between two native male speakers of Korean and three male bilinguals, who were born and learned Korean in the U.S. from their parents (i.e., the heritage speakers of Korean). Ventureyra, Pallier, and Yoo (2004) demonstrated that Korean adults who were adopted in France between the ages of 3 and 9 (M = 5;8, years;months) and completed higher-education in France with no exposure to Korean after the adoption, are not able to discern Korean phonemes. The performance of these Korean adults was not significantly different from the performance of French monolingual adults who had never been exposed to Korean.

The onset age of L2 acquisition is considered as a critical factor to predict L1 influence on L2. Would this hold true for L2 influence on L1? Numerous findings demonstrated that bilinguals who are exposed to an L2 earlier in life produced L2 sounds with higher accuracy than bilinguals who are exposed later in life (Johnson & Newport, 1987; Yeni-Komshian, Flege, & Liu, 2000). Yeni-Komshian, Flege, and Liu (2000) found that KEBs who arrived in the United States between the ages of 1 and 5 produced English sounds similar to native English speakers. Nonetheless, KEBs who arrived between the ages of 12 and 23 spoke English with a

heavy foreign accent and exhibited considerable variability in L2 proficiency. Likewise, the age of L2 exposure is closely related to L2 attrition. Fillmore (1991) found that the earlier the onset of L2 learning, the greater the impact of L2 on L1 attrition. Consistent with Fillmore's arguments, Birdsong (1992) claimed that late bilinguals, those who learn an L2 later in life, are much less susceptible to L1 attrition because they have already reached the ultimate attainment of L1.

To determine whether the influence of one language negatively affects the articulatory accuracy of the other, one can measure the percentage of phonemes correct (PPC). In order to calculate PPC, the number of phonemes that are produced correctly out of all sounds is divided by the total number of target phonemes and multiplied by 100 (Shriberg, 1986). Goldstein and Washington (2001) recruited twelve typically developing 4-year-old Spanish-English bilinguals and asked them to produce 28 Spanish words and 26 English words. The percentage of consonants correct (PCC) and the percentage of vowels correct (PVC) of Spanish words were not significantly different from those of English words. Nevertheless, PCC of Spanish words in this study was lower than PCC by the fifty-four Spanish-speaking 3-to 4-year-olds who participated in Goldstein and Iglesias (1996). Although parents of bilingual children in Goldstein and Washington (2001) spoke Spanish at home and learned Spanish before English, these children produced Spanish less correctly than Spanish monolingual children in Goldstein and Iglesias (1996).

Which consonants or vowels may be affected by L2 English acquisition? One of the influential frameworks for predicting difficult sounds in L2 learners is Flege's speech learning model (SLM; Flege, 1987; Flege, Takagi, & Mann, 1995). In the 1960s, the contrastive

analysis hypothesis (Lado, 1957) was extensively used to provide a theoretical explanation of why some features of L2 more difficult to learn than others. Lado (1957) claimed that L2 learners will have more difficulty learning L2 sounds which have no equivalent in the L1 than learning L2 sounds which are similar or equivalent to those in L1. Contrary to the contrastive analysis hypothesis, Flege (1987) showed that English-speaking learners of French can pronounce dissimilar or new French vowels with a more native-like pronunciation. A French /y/ produced by English-speaking L2 learners was much closed to the French norm than a French /u/ in terms of acoustic characteristics. Flege explained that L2 learners fail to reach the L2 production norm for similar sounds because the learner does not readily notice minor differences between L1 sounds and target L2 sounds. This finding led to the SLM, which argues that a new perceptual category is developed for previously unknown sounds over the course of training in L2 and that such a category is more L2 native-like than a perceptual category for similar L2 sounds. SLM, however, explains how L1 influences speech production of L2 but not the opposite. It is worthy investigating whether SLM is applicable to speech production of L1 under the influence of L2.

The present study examines whether KEB children produce Korean phonemes less correctly than Korean monolingual (KM) children and/or KEB adults, as measured by PPC, PCC, and PVC. A nonword repetition task (NRT) was used to compare articulatory accuracy among the three groups because NRT is not knowledge-dependent and is not biased against test takers from diverse backgrounds (Adler & Birdsong, 1983; Dollaghan & Campbell, 1998). The NRT developed by Dollaghan and Campbell (1998) is widely used to diagnose speech sound disorders in English-speaking

children not only with language impairment but also with diverse backgrounds. The task consists of 16 stimuli that conform to English phonotactic constraints but correspond to no real English word (e.g., /tʃɪnɔɪtaʊb/). The results from Weismer, Tomblin, Zhang, Buckwalter, Chynoweth, and Jones (2000) support the validity of the NRT as a culturally and socio-economically non-biased measure after testing 581 children with and without language impairments. Assuming that NRT is less vulnerable to English proficiency of the bilingual participants, the present study adopted this methodology. 16 Korean nonwords that obey Korean phonotactic rules but have no meanings were created by the author, and articulatory accuracy in these Korean nonwords was compared by group and by syllable length. To examine whether SLM is applicable to L1 phonological attrition is not the main purport of this research; however, the analyses of misarticulated Korean phonemes may indicate the possibility of SLM as theoretical framework for L2 influence on L1 speech production.

2. Method

2.1. Participants

Table 1 is a display of characteristics of KEB children and adults and KM children. The three experimental groups consisted of nine KEB children and eighteen KM children between the ages of 8 and 13 and eight KEB adults aged 21 years and older. All participants had normal hearing sensitivity and no emotional, psychological or neurological problems, as reported by the participants or their parents. Bilingual child participants were exposed to English prior to age 9 at a mean age of 5;2

(years;months) and had lived in the U.S. at least 2 years with a mean length of 4;7. Bilingual adult participants were full-time students at an American university or college in Illinois and were exposed to L2 after age 11 and had lived in the U.S. at least 2 years with a mean length of 4;9. KM participants from South Korea had never lived in an English-speaking community at the time of the participation.

A language survey was given to the adult participants or to parents of the child participants. The survey included age of acquisition, L2 experience, and self-assessed language proficiency for speaking, listening, writing and reading both in Korean and English. Their choices were numerically coded on the four scales: 1 point for a beginner's level, 2 points for an intermediate level, 3 points for an advanced level, and 4 points for a native level. The averages of the four language areas were reported. All participants were also given two standardized tests of English articulation, namely the Goldman Fristoe Test of Articulation-2 (GFTA-2), and expressive English vocabulary, namely the Expressive Vocabulary Test (EVT). These two tests are designed to diagnose the presence of speech or language disorders and normed on typically developing English-speaking monolinguals. The given values for GFTA-2 in Table 1 the average numbers of consonant produced incorrectly, and the given values for EVT in Table 1 are raw scores out of 100. The results of these two tests indicated that the bilingual participants possessed a good command of English as L2 but that KM children performed similarly to English-speaking monolinguals with speech and language impairments. In other words, performance of KEB children and adults on GFTA-2 and EVT was not significantly different from that of English monolinguals without developmental delays of speech and language.

<Table 1> *Characteristics of Korean-English bilingual (KEB) children,*
KEB adults, and Korean monolingual (KM) children

	KEB Children[a]	KEB Adults[b]	KM Children[c]
Age	10;3 (2;1)	22;8 (2;1)	11;0 (0;6)
[age range]	[8 ~ 13]	[21 ~33]	[8 ~ 13]
Age of arrival	5;8 (3;7)	18;0 (2;6)	N/A
Length of residence	4;7 (1;7)	4;9 (0;7)	N/A
Self-reported or perceived proficiency in English	2.78 (0.36)	3.19 (0.85)	1.28 (0.41)
Self-reported or perceived proficiency in Korean	2.56 (0.16)	4 (0)	4 (0)
GFTA-2	3.1 (2.2)	6.3 (1.6)	13.9 (5.5)
EVT	80 (10)	96 (12)	60 (7)

Note. The means of ages, ages of arrival, and length of residence in the U.S. are given in "years; months" with standard deviations in parentheses. Self-reported or perceived language proficiency in English and in Korean was measured on the four scales: 1-beginners' level, 2-intermediate level, 3-advanced level, and 4-native level. GFTA-2 refers to the Goldman Fristoe Test of Articulation-2, and the given value is the number of sound errors on average for the group. EVT refers to the Expressive Vocabulary Test, and the given value is the average standard score. $N = 35$; [a]n = 9; [b]n = 8; [c]n = 18.

2.2. Stimuli

The stimuli for the Korean NRT are nonsense words that increase in length from 1 to 4 syllables and conform to Korean phonotactic constraints (see Table 2). Monosyllabic nonwords were composed of an onset consonant, a nuclear vowel, and a coda consonant (i.e., CVC form). Multisyllabic nonwords were in either CV or CVC forms. These stimuli were designed to include common phonological processes such as tensification (e.g., [sik̚*ɛban]), neutralization (e.g., [patʰoŋda̠t͈ɕ*u]),

palatalization (e.g., [ʃimwasotɕʰʌn]), lateralization of nasal onset consonant ([tasɛtɕʰulˠok]), etc. Three Korean-speaking graduate students enrolled in doctoral program in Linguistics or Speech and Hearing Science examined the 16 stimuli. They confirmed that these words are not semantically related to real Korean words and do not violate Korean phonotactic constraints. The auditory stimuli given to the participants were produced by a Korean female speaker. She was asked to read the 16 nonwords written in Korean as naturally as possible, and her utterances were recorded in an acoustic booth. Each stimulus was presented to the participants once over headphones without visual stimuli such as written forms. The participant was asked to repeat each word, proceeding from 1- to 4-syllabic nonwords. The participants' oral responses were recorded and digitized for subsequent phonetic transcription and evaluation.

<Table 2> *Stimuli in the Korean nonword repetition task*

Syllable Length	Nonword Stimuli
1 syllable	pʰʌn, kwim, sɛn, tɕʰim 펀, 귐, 센, 틈
2 syllables	pʰɛtɕʰam, kaŋhjul, pɛs*om, notʰim 패참, 강흏, 베쏨, 노틈
3 syllables	sambʌˠu, hamtʰulgi, tumbatɕʰu, sikt*ɛban 삼버루, 함틀기, 둠바추, 식대반
4 syllables	patʰoŋdatɕ*u, tasɛtɕʰulˠok, tuŋtɕʰumolha, simwasotɕʰʌn 바통닫주, 다세출녹, 둥추몰하, 심와소천

Note. A Korean female speaker who produced the stimuli for the task was asked to read Korean nonwords written in Korean alphabets as naturally as possible. Her utterances were later transcribed using IPA symbols as were given above.

2.3. Data Analyses

The recorded responses were transcribed and evaluated to determine whether the target phonemes were correctly produced. Substituted and deleted phonemes were considered incorrect productions, whereas distortions, as marked by diacritics, were considered correct productions (e.g., nasalization of vowels such as in [nãnɨn]). The performance of each participant was converted to numerical values by computing the PPC, PCC, and PVC. To examine the reliability of the phonetic transcription, all recorded stimuli were evaluated by two other professors who are native speakers of Korean and professionally trained to evaluate articulatory accuracy of Korean phonemes. The average values of PPCs for all participants by the three evaluators were 93.63%, 91.23%, and 91.29%, respectively. A Cronbach's alpha for the inter-rater's reliability was .82, which is much greater than the significance level of .70. That is, consistency in evaluating articulatory accuracy is very high among the three evaluators. To compare performance of the three groups, a univariate analysis of variance (ANOVA) and a Scheffe post-hoc test were chosen to explore any significant group differences for PPC, PCC and PVC. Then, patterns of phonological processes found in KEB children were reviewed to determine which Korean consonants and vowels are most challenging. In addition, a two-way repeated measures ANOVA was conducted to see whether the syllable length has something to do with the performance of the Korean NRT. For this statistical analysis, the four syllable lengths (i.e., monosyllabic nonwords, disyllabic nonwords, 3-syllabic nonwords, and 4-syllabic nonwords) and the three groups were served as main

effects. As a follow-up test for any significant interaction of the length and the group, several independent *t*-tests were conducted.
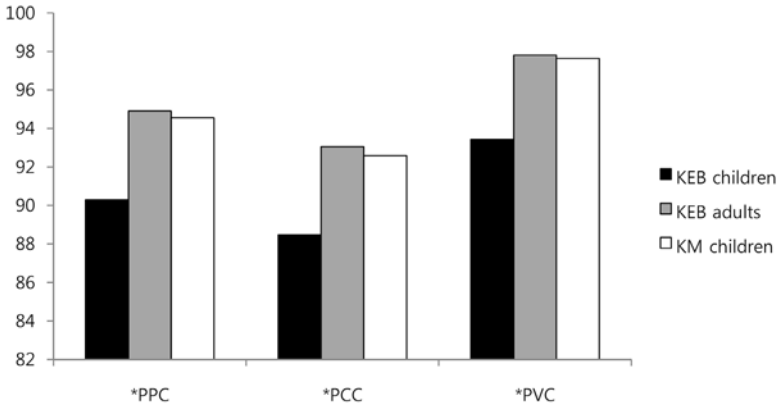
3. Results

The means and standard deviations for PPC, PCC, and PVC were calculated and presented in Table 3 and Figure 1. Overall, KEB children produced Korean phonemes less correctly than KEB adults and KM children. A one-way ANOVA revealed significant group differences for PPC ($F = 8.055$, $p = .022$), PCC ($F = 4.897$, $p = .014$), and PVC ($F = 5.123$, $p = .012$). According to a follow-up Scheffe post-hoc test, KEB children produced phonemes less correctly than KEB adults ($p = .007$) and KM children ($p = .003$). Both PCC and PVC of the KEB child group were significantly lower than those of the KEB adult group ($p = .037$ and $p = .041$) and the KM child group ($p = .026$ and $p = .019$). In sum, articulatory accuracy for consonants and vowels in KEB children was lower than KEB adults and KM children. Speech errors by KEB children were most frequent in the consonant /ʨʰ/. A palato-alveolar affricate /ʨʰ/ was realized as its lenis counterpart /ʨ/ in [tasɛʨʰulʔok] or as an alveolar stop /tʰ/ in [ʨʰɨm] and [pʰɛʨʰam]. The second most frequent speech errors were found in a liquid, where the coda /l/ is deleted in /tasɛʨʰulʔok/ and /tuŋʨʰumol̲ha/. The vowel /o/ was diphthongized as in English /oʊ/ in the context that the coda consonant is deleted in [tasɛʨʰulʔok̲]. Interestingly, the bilabial nasal stop /m/ was substituted by /n/ in [pɛs*om] and the glottal fricative /h/ was substituted by /r/ in [tuŋʨʰumolha].

<Table 3> *Average percent correct for phonemes, consonants, and vowels.*

	Percentage of Phonemes Correct	Percentage of Consonants Correct	Percentage of Vowels Correct
KEB Children[a]	90.2 (3.9)	88.5 (3.9)	93.4 (5.2)
KEB Adults[b]	94.9 (1.8)	93.1 (2.9)	97.8 (2.5)
KM Children[c]	94.6 (2.4)	92.6 (3.3)	97.6 (2.5)

Note. The provided value is the mean percent correct; the standard deviation is in parentheses. KEB = Korean-English bilingual; KM = Korean monolingual. N = 35; [a]n = 9; [b]n = 8; [c]n = 18.

<Figure 1> *Average percent correct for phonemes, consonants, and vowels in the three groups*. KEB = Korean-English bilingual, KM = Korean monolingual, PPC = percentage of phonemes correct, PCC = percentage of consonants correct, PVC = percentage of vowels correct. The symbol " * " to the left indicates a significant group difference.

Table 4 is a descriptive statistics of PPCs for 1-syllabic nonwords (1PPC), 2-syllabic nonwords (2PPC), 3-syllabic nonwords (3PPC), and 4-syllabic nonwords (4PPC). A two-way repeated measures ANOVA was conducted whether the syllable length affects performance of the Korean

NRT. A two-way repeated measures ANOVA revealed a significant interaction between the four syllable lengths and the three groups (F = 2.811, p = .007). In other words, articulatory accuracy of Korean phonemes was significantly different among the three groups by the syllable length. Therefore, twelve independent t-tests were conducted as a follow-up post-hoc test for the three pairs of the three groups (i.e., KEB children vs. KEB adults; KEB children vs. KM children; KEB adults vs. KM children) with 4 length variables (i.e., 1PPC, 2PPC, 3PPC, and 4PPC). For the pair of KEB children and adults, an independent t-test showed significant group differences for 1PPC (t = 4.320, p = .001) and 4PPC (t = 2.187, p = .046). For the pair of KEB children and KM children, the t-test revealed significant group differences for 2PPC (t = 2.925, p = .007), and 4PPC (t = 3.064, p = .005). Nonetheless, no significant group difference was found for the pair of KEB adults and KM children.

<Table 4> *Average percent correct for 1- to 4-syllabic nonwords.*

	1 PPC	2 PPC	3 PPC	4 PPC
KEB Children	89.58 (3.86)	92.86 (3.60)	93.33 (2.52)	86.88 (9.14)
KEB Adults	97.92 (3.86)	97.02 (3.86)	92.5 (2.95)	94.69 (4.32)
KM Children	91.20 (8.8)	97.09 (3.32)	94.44 (2.56)	94.31 (3.41)

Note. The provided value is the mean percent correct; the standard deviation is in parentheses. PPC = the percentage of phonemes correct. KEB = Korean-English bilingual; KM = Korean monolingual. N = 35; [a]n = 9; [b]n = 8; [c]n = 18.

4. Summary and Discussion

The objective of the present study was to examine whether English as L2 negatively affects articulatory accuracy of Korean as L1 and whether the degree of L1 phonological attrition varies depending on the age of arrival to the U.S. For this purpose, the research question asked whether KEB children and adults under the influence of English produce Korean phonemes with lower accuracy than KM children and whether KEB children who were exposed to English early in life perform poorer than KEB adults who were exposed to English later in life. The results of the Korean NRT indicated that KEB children produced Korean phonemes, including consonants and vowels, significantly less correctly than KEB adults and KM children. With respect to syllable-length, KEB children performed poorer than KEB adults for monosyllabic and 4-syllabic nonwords and than KM children for disyllabic and 4-syllabic nonwords.

Some speech errors are explicable by the influence of English on Korean. The /l/-deletion in /tasɛtɕʰulɔok/ produced by KEB children implies the influence of English on Korean in the sense that English /l/ is generally realized as a dark 'l', i.e., [ɫ] in a coda position. Such an allophonic variation may have caused /l/-deletion in speech production of Korean nonwords. The diphthongization of the vowel /o/ at the word-finial position (e.g., [tasɛtɕʰulnoʊ]) supports L2 influence as well, because the English vowel /oʊ/ is always realized as a diphthong. In addition, the loss of aspiration and stopping of /tɕʰ/ can be explained by the interference of English. The Korean consonant /tɕʰ/ is similar but slightly different from the English consonant /ʧ/. As argued by Flege's Speech Learning Model (or SLM), a similar but slightly different sound between the two

languages is more challenging to produce correctly than a new or very different sound between the two (Flege, 1987; 1992). Therefore, SLM may account for inaccuracy of the consonant /tɕʰ/. Nonetheless, other phonological processes such as the substitution of /m/ with /n/ or the substitution of /h/ with /r/ are rather obscure to be explained by the influence of English. Rather, these two substitution processes are explicable in terms of assimilation processes of place of articulation, where the bilabial nasal coda consonant assimilates to the alveolar onset fricative (i.e., /m/ → /n/ / [+alveolar] V __#) and where the glottal fricative onset consonant assimilates to the preceding alveolar liquid consonant (i.e., /h/ → /ɾ/ / [+alveolar, +liquid] __).

Nonetheless, one should be cautious to conclude that early exposure to English as L2 hinders phonological development of Korean. Some parents are afraid of teaching young children two languages simultaneously as some researchers claim that second language acquisition (SLA) early in life hinders the mastery of one's mother tongue and even causes delays in language and cognitive development (Lee, 2003; Seo, 2003 as mentioned in Shin, 2004). These studies, however, provided neither empirical evidences of the negative effect of SLA nor significant correlations between SLA and developmental disorders. In contrasts, other studies argued that being exposed to two languages enhances mental growth and flexibility (Ben-Zeev, 1984; Bialystok, 1999; Leopold, 1949; Vygotsky, 1986) and may even delay the onset of dementia (Bialystok, Craik, & Freedman, 2007). There is growing evidence that being bilingual does not cause language disorders or mental retardation in recent years (see also Bialystok, 2009).

Investigating Korean-English bilinguals is worthwhile. According to the

U.S. census (2010), Korean is the 7th most spoken language in the U.S. and 90% of Korean parents with children in first or second grade in Korea begin their child's English education between the ages of 3 and 5 according to a study by the Korea Institute of Child Care and Education (2011). The pros and cons of early childhood education of English as L2 are still debated in Korea, thus the influence of L2 English on the speech production of L1 Korean would attract attention not only from language educators and speech therapists but also from the nonprofessional population. Understanding phonological development in Korean-English bilinguals may help educators and clinicians construct their developmental reference data, develop appropriate curricula, and support speech and language development in both languages. Also, it may help parents who are interested in bilingual education determine child-rearing or education for their child.

5. Conclusion

The findings of the Korean NRT suggest that acquisition of English as L2 early in life may negatively influence the articulatory accuracy of Korean phonemes; however, acquisition of English later in life may not. Previous studies of L1 attrition suggest that children or early bilinguals who were exposed to L2 but intercepted from L1 exposure before the age of 7 are more susceptible to L1 attrition than adult or late bilinguals (Birdsong, 1992; Caramazza, Yeni-Komshian, Zurif, & Carbone, 1973; Fillmore, 1991; Ventureyra et al., 2004). The results of the task in this study are congruent with results of literature on L1 attrition, where KEB adults who were exposed to English at the age of 11 or older produced

consonants and vowels more correctly than KEB children did. However, it is noteworthy that four KEB child participants were intensively exposed to L2 but blocked off from L1 exposure before the age 6, at which most children master producing Korean consonants and vowels (Kim, 1996; Kim, Pae, & Park, 2007). Therefore, the lower accuracy of KEB children may be attributed to the premature development of Korean articulation and phonology rather than the negative effect of learning English early in life. It would be interesting to investigate whether these child participants would eventually be able to reach the level of articulatory accuracy of Korean monolingual speakers. Further, a future research may examine whether Flege's SLM hold true for L1 attrition of articulation and phonology. For this purpose, a study should address similarities and dissimilarites between the two languages with respect to articulatory and phonological characteristics and develop appropriate experimental methodology.

\<References\>

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