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Degree of foreign accent in English sentences produced by Korean children and adults

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Abstract

The purpose of this longitudinal study was to evaluate the influence of age (adult vs. child) and length of residence (LOR) in an L2-speaking country (3 vs. 5 years) on degree of foreign accent in a second language (L2). Korean adults and children living in North America, and age-matched groups of native English (NE) adults and children, recorded English sentences in sessions held 1.2 years apart (T1 vs. T2). NE-speaking listeners rated the sentences for overall degree of perceived foreign accent using a 9-point scale. The native Korean (NK) children received significantly higher ratings than the NK adults did, but lower ratings than the NE children. The NK children—even those who had arrived as young children and been enrolled in English-medium schools for an average of 4 years—spoke English with detectable foreign accents. The effects of LOR and the T1–T2 differences were non-significant for both the NK adults and the NK children. The findings were inconsistent with the hypothesis that adult–child differences in L2 speech learning are due to the passing of a critical period. The suggestion is made that the milder foreign accents observed for children than adults are due, at least in part, to the greater L2 input typically received by immigrant children than adults.

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1. Introduction

People who learn a second language (L2) upon immigrating to a predominantly L2-speaking country often continue to speak it with a foreign accent, even after years of L2 use. Many factors appear to influence overall degree of perceived foreign accent (see Piske, MacKay, & Flege, 2001, for review). The two factors that have received most recent attention are the age of first exposure to the L2 (often indexed by age of arrival, AOA, in an L2-speaking country) and self-reported percentage use of the L2 and the native language (L1). Of the two factors (AOA, language use), it appears that AOA is the more potent predictor of foreign accent (e.g., Flege, Munro, & MacKay, 1995; Flege, Yeni-Komshian, & Liu, 1999). This has ensured continued interest in understanding the basis of "age" effects on foreign accent.

The purpose of this study was to provide additional insight into age effects. It did so by comparing the foreign accent ratings obtained for English sentences produced by Korean children and adults who were learning English as an L2 in North America, and by comparing the ratings obtained from both native Korean (NK) age groups to those obtained from age-matched groups of native English (NE) speakers.

1.1. Earlier is usually better

The most common explanation for age effects on L2 speech learning is that the ability to learn new form of speech diminishes after the passing of a critical period. Lenneberg (1966) observed that, as compared to motor skills such as learning to ice skate, there is much less individual variation in the outcome of speech and language learning, and little if any need for explicit training. Impressed by the regularity of developmental milestones in normally developing children, Lenneberg (1966) proposed that the emergence of speech and language is best accounted for by the interaction of aspects of neural maturation and "self-programmed" learning. He suggested that after about the age of 12 years, brain functions relevant to speech and language acquisition retain "some flexibility" but the "ability for self-organization and adjustment to the physiological demands of verbal behavior quickly declines" (pp. 239–240).

Lenneberg (1967, p. 176) later observed that foreign accents in an L2 "cannot be overcome easily after puberty". This observation triggered an extension of the critical period hypothesis from L1 to L2 acquisition (see studies collected in Krashen, Scarcella, & Long, 1982). For example, Scovel (1969) and Asher and Garcia (1969) suggested that a loss of neural plasticity might be responsible for native–non-native differences, including the presence of foreign accents (see also DeKeyser, 2000; Patkowski, 1990; Scovel 1981, 1988, 2000; for review, see Birdsong, 1999). As discussed by Moyer (1999, p. 82), it is widely accepted that individuals who learn an L2 after the end of a critical period are subject to "neurological or motor skill constraints" that render native-like speech production "highly unlikely or impossible". On this view, for example, immigrants with an AOA of 15–24 years (relatively 'late" learners) will speak their L2 with a stronger foreign accent than those having an AOA of 3–12 (relatively "early" learners) because they, but not the early learners, have passed a critical period.

Other explanations have been offered to account for age effects on L2 speech learning. One might hypothesize that late learners usually have a stronger foreign accent than early learners

because late learners generally receive less L2 input and/or more foreign-accented L2 input than early learners do. Input differences between early and late learners appear to arise from age-related differences in the opportunity and/or need to use the L2 (see Grenier, 1984; Jia & Aaronson, 1999; Krashen 1985; Oyama, 1976; Snow & Hoefnagel-Höhle, 1977). Also, in studies examining samples of immigrants to North America, a relatively late AOA is typically associated with a relatively short length of residence (LOR) in the host country (e.g., Bahrick, Hall, Goggin, Bahrick, & Berger, 1994; Flege et al., 1995, 1999; Shim, 1995; Yamada, 1995). This means that the late learners examined in many studies have generally spoken their L2 for a shorter period of time than the early learners did.

Alternatively, age effects might arise from age-related differences in the effect of cross-language phonetic interference. One might hypothesize that as the L1 phonetic/phonological system develops during childhood, the influence of the L1 sound system on L2 speech learning will grow stronger (see Baetens Beardsmore, 1986). Flege (1999, 2002, 2003) proposed that as L1 phonetic categories become more robust through childhood (e.g., Hazan & Barrett, 2000; Johnson, 2000; Pursell, Swanson, Hedrick, & Nabelek, 2002; Walley & Flege, 1999), they become stronger "attractors" of L2 vowels and consonants. According to Flege, this will reduce the likelihood that new categories will be established for L2 vowels and consonants which, in turn, will contribute to a stronger foreign accent.

Still another hypothesis pertains to how L2 input is processed. In infancy and early childhood, language learners' perception of speech becomes perceptually attuned to the language-specific phonetic properties of the ambient language (e.g., Aslin & Pisoni, 1980; Werker, 1991). Once such attunement occurs, the sensory properties associated with L2 phonetic contrasts might be "warped" at early stages of auditory processing to conform to the phonetic patterns experienced previously in the L1 (e.g., Iverson et al., 2003). If this warping persists, then L2 learners might never receive the input they need to develop native-like perceptual representations and, by extension, native-like speech production.

It is not possible at present to choose from among these competing explanations of age effects. This is because the hypotheses just mentioned have not been adequately tested, and also because factors hypothesized to affect L2 speech learning tend to co-vary (see Flege, 1987, 1998). For example, as the brain matures through childhood (see, e.g., Bates, 1999; Bates, Thal, & Janowsky, 1992), long-term memory representations for vowels and consonants may also develop. That being the case, a stronger foreign accent on the part of late than early bilinguals might be attributed either to a loss of neural plasticity or to stronger cross-language phonetic interference. To take another example, as immigrants' AOA increases, percentage L2 use and LOR in an L2-speaking country also tend to decrease (Flege, 1998). That being the case, a stronger foreign accent for late than early bilinguals might be attributed either to diminished neural plasticity on the part of late learners, or to less L2 input.

One approach that has been used in L2 research to "unconfound" factors that co-vary is to create, in post hoc analyses, subgroups of participants who are matched on a variable that was confounded in a larger sample (e.g., Flege, 1998; Flege et al., 1999; Yamada, 1995). The approach used here to provide new insight into age-related effects on foreign accent was to select groups of individuals differing in AOA who were matched on a variable—LOR—that has typically been confounded in previous L2 research.

1.2. Previous research with children

As discussed by Snow (1987, p. 192), children are generally credited with the ability to learn an L2 "quickly, automatically, effortlessly, and to a level indistinguishable from that of native speakers" whereas the L2 learning of adults is characterized as "slow, effortful, and often less than perfectly successful" (see also Carroll, 1963; Olson & Samuels, 1973). However, the three previous studies that have examined overall degree of perceived foreign accent in children have provided only partial support for this view.

Winitz, Gillespie, and Starcev (1995) carried out a longitudinal case study with a Polish boy ("AO") who immigrated from Poland to the United States (US) with his parents. AO, who lived in a small town and attended a school that did not offer English as a Second Language (ESL) classes, was recorded five times over a 7-year period beginning soon after his arrival in the US. Winitz et al. also recorded NE boys and groups of immigrant boys (aged 9–10 and 12–18 years, from five L1 backgrounds) who, unlike AO, were enrolled in ESL classes at schools they attended in a large city. NE-speaking college students used a 5-point scale to rate the participants' imitations of a NE adult's live voice productions of simple sentences (e.g., *This is a hat*). In agreement with the traditional view of children's L2 speech learning ability, the ratings obtained for AO's sentences became indistinguishable from ratings obtained for sentences spoken by the NE boys after about one year of US residence.

The findings of Tahta, Wood, and Loewenthal (1981a) also provided support for the traditional view of children's L2 learning ability. These authors tested children and adolescents from 20 different L1 backgrounds who had arrived in the United Kingdom (UK) between the ages of 6 and 15+ years. NE-speaking listeners judged paragraphs read by the participants as having "no foreign accent", a "detectable but slight accent", or a "marked accent". Ninety percent of participants with an AOA of 6–8 years, and 43% of those with an AOA of 9–11 years, were judged to speak English without a foreign accent.

Other research, however, has suggested that children who immigrate to an L2-speaking country often speak their L2 with a detectable foreign accent. As already mentioned, Winitz et al. (1995) recorded 9–10 and 12–18 year-old immigrant boys living in the US. Sentences produced by both groups received significantly lower rating than sentences produced by a group of NE boys.

Asher and Garcia (1969) tested 7–19 year-old native Spanish speakers whose AOA in the US ranged from 1 to 19 years and whose LOR ranged from 1 to 8 years. The participants read 12 to 14-word English sentences loaded with sounds that are especially difficult for native Spanish speakers to pronounce. The sentences were rehearsed "as many times" as needed before being recorded. NE high school students classified the sentences as "native", "near native", "slight foreign accent", or "definite foreign accent". None of the native Spanish participants were classified as "native". However, an increasingly large percentage of participants was classified as having a "near native" pronunciation of English as AOA decreased (13–19 years 7%, 7–12 years 41%, 1–6 years 68%).

What accounts for the divergence of findings obtained in the three studies just cited? One factor may be the contexts in which the non-native children were learning English. Winitz et al. (1995) attributed AO's success in learning to pronounce English to the fact that he listened to English for some time before attempting to speak it. Other explanations are possible, of course. AO may have had a greater than average ability to mimic speech (see Pike, 1959; Purcell & Suter, 1980), or he

may have grown more comfortable with the vocal imitation task as he was tested longitudinally (something not possible for the other immigrant children, who were tested just once). AO apparently had little if any opportunity to interact with other immigrants, and so may have received less foreign-accented English input than is typical. Finally, the fact that AO's English vocabulary size exceeded that of same-age NE children at the end of the study suggested that he may also have received an unusually large quantity of English input.

Methodological differences may also have contributed to differences in the results obtained in the three previous studies examining foreign accent in immigrant children. Flege and Fletcher (1992, Experiment 3) found that over the course of a testing session, listeners judged English sentences produced by non-native speakers to be more strongly foreign-accented. It is possible, therefore, that a higher percentage of young children were reported to have foreign accents in the Asher and Garcia (1969) study than in the Tahta, Wood, and Loewenthal (1981b) study and the Winitz et al. (1995) study because Asher and Garcia (1969) presented sentences in decreasing order of the participants' age, not randomly. More children may have been classified as foreign-accented by Asher and Garcia (1969) than Tahta et al. (1981b) for one or more of the following reasons: a difference in the speech samples examined (long, hard-to-pronounce sentences vs. a paragraph taken from an airline leaflet); more stable scores resulting from the use of a larger pool of listeners (19 vs. 3); more native speakers included in the sample of non-native speakers being evaluated (30 vs. 0; see Flege & Fletcher, 1992); a more fine-grained rating scale (4-point vs. 3-point; see Southwood & Flege, 1999).

It seems reasonable to think that children's L2 pronunciation will improve gradually over time as a function of L2 input and experience. For children who enroll in an L2-medium school upon immigrating to an L2-speaking country, LOR probably provides a reasonable estimate of L2 input and experience (see Flege & Liu, 2001; Jia & Aaronson, 1999). That being the case, another factor that makes it difficult to identify the source of differences between the studies cited earlier is that LOR was poorly controlled.

A regression analysis carried out by Tahta et al. (1981a) revealed that AOA accounted for 43% of the variance in foreign accent ratings, whereas LOR was not identified as a significant predictor. Unfortunately, the only information provided by Tahta et al. (1981a) regarding LOR was that all 109 non-native participants had lived in the UK for a "minimum" of two years.[1] Asher and Garcia (1969) reported that "near native" judgments were obtained for more children with an LOR of 5–8 than 1–4 years (51% vs. 15%). LOR was likely to have been confounded with AOA, as in previous research (e.g., Bahrick et al., 1994; Flege et al., 1995, 1999; Shim, 1995; Yamada, 1995). Unfortunately, Asher and Garcia (1969) reported no information pertinent to the LOR of their 71 participants other than the range of LOR values. Finally, the only indication given by Winitz et al. (1995) regarding the LOR of their 14 non-native participants (other than the Polish boy, AO) was that they had arrived "recently" in the US or had lived there for "a short while" (p. 125).

[1] Tahta et al. (1981a) indicated that their participants ranged in age from 9 to 77 years. When taken together with the absence of LOR data, this raises the issue of how many participants were actually children. We infer that most participants were children from the fact that the authors mentioned recruiting participants via "appeals to local schools" (p. 267).

In summary, previous studies evaluating degree of foreign accent in immigrant children have provided conflicting evidence as to whether immigrant children do or do not pronounce their L2 with a detectable foreign accent. Methodological differences and a lack of control of LOR makes it impossible to draw general conclusions from these studies.

1.3. Changes over time

Other research has provided evidence pertaining to children's initial response to foreign-language speech materials, and to their L2 performance following many years of L2 use.

Studies examining children's initial response to foreign-language speech materials have suggested that children may perform more poorly than adults (Asher & Price, 1967; Olson & Samuels, 1973; Winitz 1981a). Tahta et al.(1981b) asked British children to imitate French and Armenian words and phrases. Prosody was imitated significantly more accurately by children aged 12–15 than 5–7 years; a non-significant difference in the same direction was observed for segmental production. Snow and Hoefnagel-Höhle (1977) asked British children (age *range*: 5–17 years) and adults to imitate Dutch words. Pronunciation accuracy was found to increase linearly with increasing age. Winitz (1981a) found that adults discriminated foreign language tones more accurately than children did. Winitz (1981b, p. 169) suggested that adults may outperform children in such studies because they are "cognitively equipped to learn faster and retain more" than children, and because they have an "advanced understanding of symbols and concepts".

The results of studies employing a retrospective developmental design have provided evidence of how children speak their L2 after many years of L2 use. Such studies examine adults differing in AOA. Flege et al. (1995) recruited 240 Italians who differed in AOA to Canada, and Flege et al. (1999) recruited 240 Koreans differing in AOA to the US. As a rough criterion for "accent free" L2 pronunciation, individual non-native participants who obtained a rating that fell within 2-SDs of the mean rating obtained for the adult NE comparison group ($n = 24$ in each study) were identified. No non-native participant who began learning his or her L2 after the age of 15 years met the "2-SD" criterion. However, some individuals who began learning their L2 as children met the criterion, and so might be credited with speaking their L2 without a foreign accent. This held true for more Italians than Koreans, perhaps because the Italians had lived in North America longer than the Koreans (mean LOR = 32 vs. 15 years).

Other research with non-native adults has suggested that immigrants who use their L1 infrequently are more likely to speak their L2 without a detectable foreign accent than those who use their L1 often (Flege, Frieda, & Nozawa, 1997; Piske et al., 2001). This agrees with the results obtained by Tahta et al. (1981a), who reported a significant correlation, $r(107) = 0.28$, between degree of foreign accent and self-reported use of English in the home. The finding of Tahta et al. (1981a) implies that children who prefer using the L2 are more likely to have a good L2 pronunciation than those who prefer using the L1 (see also Jia & Aaronson, 1999).

1.4. The present study

The aim of this study was to evaluate overall degree of perceived foreign accent in English sentences produced by NK children and adults who had immigrated from Korea to a predominantly English-speaking community in either the US or Canada.

As in previous foreign accent research (Flege et al., 1995, 1997, 1999; Guion, Flege, & Loftin, 2000; Piske et al., 2001), the participants repeated simple aurally presented English sentences following a filled delay. NE-speaking adults later rated the sentences for overall degree of foreign accent using a 9-point equal appearing interval scale (see Southwood & Flege, 1999, for justification). Ratings obtained in this way are considered to index the extent to which speech conforms to the phonetic norms of the language spoken by the listeners who provide the ratings (Munro & Derwing, 1998).

The design of the present study afforded the opportunity to test for changes in English pronunciation over real time. The participants were tested on two occasions separated by an average of 1.2 years (T1, T2). This permitted us to determine if the NK participants would have significantly milder foreign accents at T2 than T1 and, if so, whether the reduction in foreign accent would be greater for children than adults as one might expect based on the traditional view of children's L2 learning abilities.

The design also afforded the opportunity to test for changes in English pronunciation over apparent time. Half of the NK participants had an LOR in North America of 3 years at Time 1, and the remaining half had an LOR of 5 years. The question of interest was whether an additional two years of English use would result in significantly milder foreign accents and, if so, whether the reduction in foreign accent would be greater for children than adults.

A novel feature of this study was that the ratings obtained for the NK adults and children were compared to the ratings obtained for age-matched NE children and adults. This was considered important inasmuch as NE children's pronunciation of English is known to change as they mature (e.g., Lee, Potamianos, & Narayanan, 1999), and because adult listeners might rate foreign-accented speech differently as a function of the perceived age of the talker.

The critical period hypothesis described earlier (see, e.g., Scovel, 2000) would not predict the presence of foreign accent in immigrant children. If children exposed to their L2 prior to the end of a critical period were demonstrated to speak it with a detectable foreign accent, it would not disprove the critical period hypothesis. However, it would at least demonstrate that factors other than maturation may contribute to the presence of foreign accent in L2 speech.

2. Method

The NE and NK participants were tested individually, in English, in a quiet room. The protocol administered at T1 and T2 lasted about 1 h. The participants began by responding to a language background questionnaire. After producing familiar English words, they produced English sentences as described below. Following the English sentence production task, the NK participants produced Korean sentences. The NK and NE participants then participated in English morphology and vowel discrimination tests. The participants' production of word-final English consonants has been reported by Tsukada et al. (2004); their production and discrimination of English vowels has been reported by Tsukada et al. (in press).

2.1. Participants

The 155 participants tested at T1 were all required to report having normal hearing and to pass a pure-tone hearing screening. The NE participants were required to have been born in an

English-speaking community in North America, to have learned English from NE-speaking parents, and to report not speaking any language other than English. The NK participants were required to have been born in Korea, to have immigrated to the US or Canada between the ages of 6 and 14 years (children) or 21 and 40 years (adults), to have lived in North America for 2–6 years, and to not speak any language other than Korean and English.

A total of 108 participants were selected from the 128 who returned for testing at T2 in order to form six groups of 18 each. The final selection of participants was done prior to any data analysis. LOR was the primary criterion in selecting NK participants, who were retained only if they had lived in North America for 2.0–3.8 or 4.0–6.0 years at T1. Through careful selection, it was possible to develop groups of NK adults and children with non-overlapping LOR values averaging about 3 and 5 years at T1. An attempt was made, within these constraints, to equalize the male/female gender ratio insofar as possible across the six groups, to match the two groups of NK children as closely as possible in age to the NE children, and to match the two groups of NK adults as closely as possible in age to the NE adults. Of the 108 participants who were retained, 25 were tested in Birmingham, AL, 22 in Palo Alto, CA, 22 in Champaign-Urbana, IL, 21 in Austin, TX and 18 in Toronto, ON. The interval between the two times of testing (T1, T2) averaged 1.2 years (SD = 0.1, range = 0.9–1.5). The effect of Group on the T1–T2 interval was non-significant, $F(5,102) = 1.5$, $p > 0.10$.

Characteristics of the six groups are summarized in Table 1. The two groups of NK children had average LOR values of 2.9 and 4.9 years, and will be designated the child "LOR3" and "LOR5" groups. The two groups of NK adults had mean LOR values of 3.0 and 4.8 years, and will be designated the adult "LOR3" and "LOR5" groups. The mean age of the NE children was intermediate to the mean ages of the two groups of Korean children (mean 12.7 vs. 12.3 and 13.7 years). Similarly, the mean age of the NE adults was intermediate to that of the two groups of NK adults (mean = 32.3 vs. 30.4 and 33.1 years). Neither the three groups of children nor the three groups of adults differed significantly in age (children $F(2,51) = 1.8$, $p > 0.10$; adults $F(2,51) = 1.4$,

Table 1
Characteristics (mean, SD, range) of the six groups of participants

Group	*N*	Age	LOR	AOA
NE Child	7m, 11f	12.7 (2.5) 8–17	—	—
Child LOR3	6m, 12f	12.3 (2.4) 9–17	2.9 (0.4) 2–4	9.4 (2.4) 6–14
Child LOR5	7m, 11f	13.7 (2.0) 10–17	4.9 (0.6) 4–6	8.9 (2.1) 6–13
NE Adult	7m, 11f	32.3 (4.4) 26–41	—	—
Adult LOR3	8m, 10f	30.4 (5.1) 23–40	3.0 (0.6) 2–4	27.4 (5.0) 21–38
Adult LOR5	5m, 13f	33.1 (5.3) 27–41	4.8 (0.6) 4–6	28.3 (5.2) 22–36

Note: NE, native English; Age, chronological age, in years; LOR, length of residence in North America at Time 1, in years; AOA, age of arrival in North America, in years.

$p > 0.10$). The small AOA differences between the two groups of NK children and the two groups of NK adults were also non-significant (children $F(1,34) = 0.5$, $p > 0.10$; adults $F(1,34) = 0.3$, $p > 0.10$).

The NK adults were more likely than the NK children to have studied English in Korea before coming to North America. All 36 NK adults reported having studied English (mean = 9 years, range = 5–13) but just seven NK children had done so, and then only briefly (range = 1–3 years). Most individuals who teach English in Korean schools are native speakers of Korean who speak English with a Korean accent. That being the case, the NK adults' longer study of English in Korea may have represented a disadvantage with respect to the NK children. The NK adults may also have been disadvantage somewhat by the fact that they had received somewhat less education in English-medium schools in North America than the NK children had. All 36 of the NK children were enrolled in school soon after their arrival in North America, and remained in school during their entire period of residence in North America. However, just 26 NK adults reported having studied in North America, all at the post-secondary level (mean = 6 years, range = 1–9 years).

The NK participants were asked to estimate, to the nearest 10%, their overall use of English as well as their use of English at home, with friends, and at work (adults) or school (children). The English use estimates obtained at T1 and T2 were correlated, $r = 0.62-0.76$, $p < 0.01$, and so were averaged. There was no systematic difference between the NK groups differing in LOR, and so the values will be reported for all 36 NK children and all 36 NK adults. In addition to reporting average percentages, the number of participants in each group who indicated no (0%) or minimal (10% or less) use of English will be reported.

The results suggested that although all of the NK participants used English on a regular basis (especially at their primary occupation outside the home, work or school), the NK children were more likely than the NK adults to use English with their friends and while at home. Overall English use was significantly higher on average for the NK children than for the NK adults (means = 58% vs. 40%, $F(1,70) = 19.7$, $p < 0.001$). None of the NK participants reporting 0% overall English use, and just two NK adults reporting minimal (10% or less) overall use of English.

The NK children reported using English somewhat more while at school than the NK adults reported using English while at work (mean = 87% vs. 82%). No participant reporting no or minimal use of English in these contexts. The NK children reported using English significantly more at home than the NK adults (means = 29% vs. 13%, $F(1,70) = 15.7$, $p < 0.001$). Fewer children than adults reported no (2 vs. 11) or minimal use of English (10 vs. 23) at home. Most striking, perhaps, was the adult–child difference in the use of English in social contexts. The NK children reported a significantly higher average use of English with friends than the NK adults (means = 76% vs. 29%, $F(1,68) = 85.1$, $p < 0.001$). Fewer children than adults reported no (0 vs. 2) or minimal use of English (0 vs. 8) with friends.

2.2. Sentence elicitation

The delayed repetition technique developed by Flege et al. (1995) was used to elicit the production of eight short English sentences (see Appendix A). Auditorily presented English sentences were used to elicit the target sentences. The elicitation materials were produced by a

male native speaker who was born in the Midwest and lived in Alabama, and by a female native speaker of English who was born in Texas and lived in Alabama. These sentences were presented to participants over a loudspeaker using a notebook computer in question–answer–question sequences such as:

Question (male voice): How much does it cost?
Answer (female voice): *It costs five dollars.*
Question (male voice): How much does it cost?

A delay was provided after the third sentence in each sequence, allowing time for the production of the target sentences. It was hoped that interpolating an auditorily presented "question" between the "answer" (target sentence) and its repetition would prevent direct imitation from sensory memory.

The sequences were presented three times in the order shown in Appendix A. The first elicitation of the eight target sentences was for practice, and so was not recorded. The participants were furnished with a written list of the target sentences to be produced during the practice. The list was withdrawn, however, when recordings were made (Sony TCD-D8 DAT recorder, Shure SM10A head mounted microphone) of the subsequent two elicitations. This was done to reduce the possible effect of orthography on pronunciation (see Piske, Flege, MacKay, & Meador, 2002).

The first four target sentences (*I'm fine, thank you, It's now ten o'clock, It costs five dollars, They went to school*) were later down sampled to 22.05 kHz (16-bit amplitude resolution) on a PC. A previous study (Yeni-Komshian, Flege, & Liu (2000) indicated little difference in ratings obtained for two tokens of English sentences produced by Korean immigrants living in the US. However, for the sake of consistency, the first of the two recorded tokens of each target sentences was used. (In rare cases where the first token was marred by an extraneous noise or dysfluency, the second token was used.) The 862 selected sentence tokens (6 groups × 18 participants × 4 sentences × 2 times of testing)[2] were normalized for peak intensity.

2.3. Foreign accent ratings

The sentence stimuli were rated by 18 native speakers of English (7 male, 11 female) having a mean age of 34 years (SD = 8). All passed a pure-tone hearing screening (re: 20 dB HL) prior to participating. None of the listeners had special training in speech or language. They were selected primarily on the basis of where they had been born and raised in order to represent the English dialects to which the NK participants had been exposed (Alabama-5, California-4, Texas-3, Illinois-3, Ontario-3).

Selecting listeners on the basis of their place of origin may have been an unneeded precaution for two reasons. First, participants tested at the five sites (Alabama, California, Illinois, Texas, Ontario) were evenly distributed across the six groups. Second, recent research suggests that listeners' dialect and L1 background has surprisingly little influence on foreign accent ratings. Flege et al. (1997) obtained ratings of English sentences that were produced by NE speakers

[2]One sentence token was missing for each of two NK adults.

($n = 20$) and native Italian immigrants to Canada ($n = 40$) from groups of listeners who were born and raised in Alabama and Ontario. The two sets of ratings were highly correlated, $r(58) = 0.96$, $p < .0001$. MacKay, Flege, and Imai (in press) obtained ratings of similar sentences from NE and native Arabic-speaking listeners residing in Ottawa; these ratings were also highly correlated, $r(118) = 0.94$, $p < 0.0001$.

The listeners, who were tested individually in a sound booth, heard the test at a self-selected comfortable level via loudspeakers. Each listener participated in two approximately 45-min sessions held on successive days. The decision was made to not present sentences produced by adults and children together in a single block. The four sentences produced by the adults and children were presented in eight separate blocks of 108 sentences each (3 groups × 18 participants × 2 times of testing). On the first day of testing, half of the listeners judged two sentences spoken by children and then, following a break, two sentences spoken by adults. On the second day, these participants were tested on the remaining two sentences spoken by children and the remaining two sentences spoken by adults. The age of the talkers was reversed for the other one-half of the listeners.

The listeners used a scale ranging from "strongest foreign accent" (1) to "no foreign accent" (9) to rate each sentence. The listeners were not given any instruction regarding how to use the scale. They were permitted as much time as they wanted to rate to each sentence. Sentences could be replayed, but ratings could not be changed once given. The next sentence was presented 1 s after each rating response was given.

The 108 sentences in each block were randomly presented four times each. Responses to the first randomized presentation of the sentences were not analyzed. This was done to permit the listeners to become familiar with the range of possible foreign accents present in the block. The median of the final three replicate ratings of each sentence was determined for each listener. As expected (e.g., Flege et al., 1995), the median ratings obtained for the four test sentences were highly correlated for all six groups ($p < 0.0001$), and so average ratings were computed over sentences.

Two types of scores were computed from the average ratings just described. In computing 216 "talker-based" scores (6 groups × 18 participants × 2 times of testing), ratings given by the 18 listeners to the sentences produced by each participant (talker) were averaged. In computing 216 "listener-based" scores, on the other hand, the ratings given by each of the 18 listeners were determined by averaging over the ratings given to the 18 participants (talkers) in each group. The T1 mean values for three NK adults were lost due to experimenter error. The talker-based scores for these participants were replaced using a multiple imputation technique (Little & Rubin, 1987); the listener-based scores were computed over 17 rather than 18 talkers in the relevant cells.

The talker- and listener-based scores were submitted to separate mixed-design ANOVAs. We reasoned that results obtained in ANOVAs examining talker-based scores would generalize to other groups of L2 learners drawn from the same population, but not necessarily to another panel of NE-speaking listeners. Conversely, the results obtained in analyses of the listener-based scores might generalize to other groups of listeners from the same population, but not necessarily to other groups of participants (talkers). Accordingly, following the practice of Flege et al. (1997), a between-group difference was considered statistically reliable only if significant at the 0.05 level in analyses of both talker- and listener-based scores.

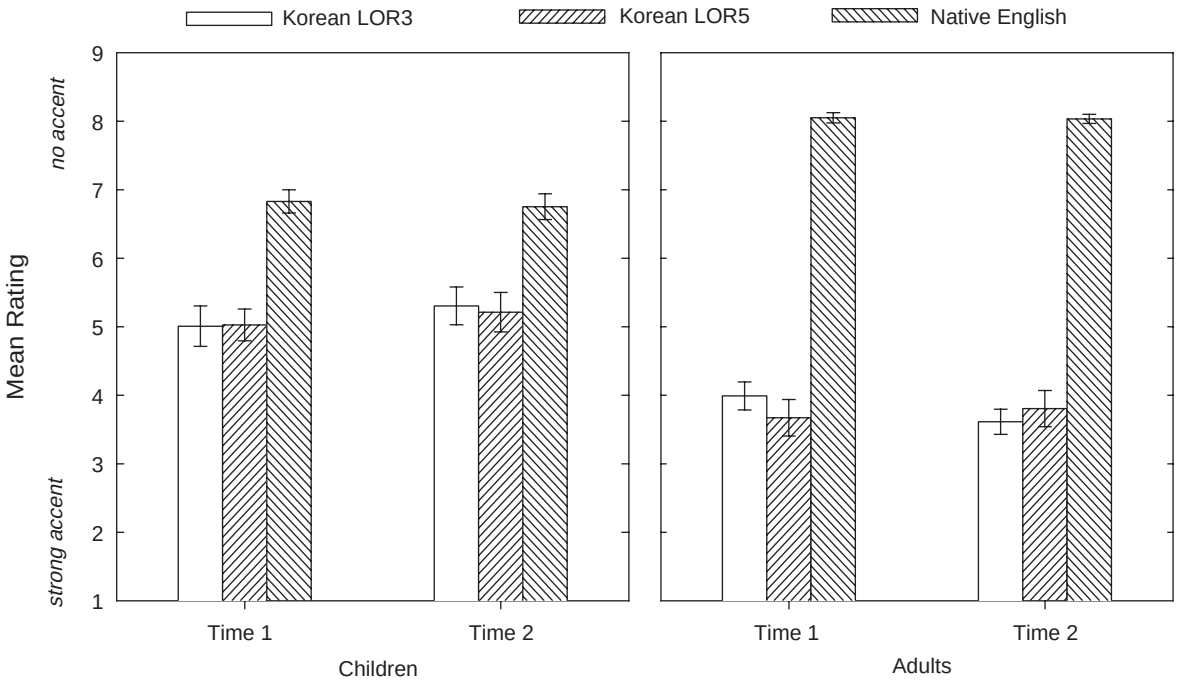

Fig. 1. Mean foreign accent ratings obtained for native English adults and children and native Korean adults and children who differed in length of residence in North America (LOR3, LOR5). The error bars enclose ±1 SE.

3. Results

Fig. 1 shows the mean foreign accent ratings obtained for the three groups of children (LOR3, LOR5, NE) and the three groups of adults (LOR3, LOR5, NE) as a function of the time of testing (T1, T2).[3] There was little difference in the ratings obtained for sentences produced by NK participants who differed in LOR (3 vs. 5 years). This held true for both the NK adults and the NK children, and for sentences recorded at both T1 and T2. As well, there was little difference in ratings obtained for sentences produced at T1 and T2, regardless of age or LOR. Inspection of Fig. 1 does reveal several important differences, however. The NE participants' sentences obtained higher ratings than sentences produced by age-matched NK speakers, indicating a better pronunciation by the native speakers. The native–non-native differences were smaller for children than adults as the result of two countervailing effects: higher ratings for NK children than NK adults but lower ratings for NE children than NE adults.

The talker- and listener-based scores described earlier were submitted to separate ANOVAs in which Age (adult, child) and Experience (LOR3, LOR5, NE) served as between-subjects factors, and Time of testing (T1, T2) served as a within-subjects factor. As summarized in Table 2, the analyses yielded significant main effects of Age and Experience ($p<0.05$) but not Time of testing.

[3]The means shown are based on the talker-based scores. Means obtained for the listener-based scores were the same, but were associated with somewhat different standard errors.

Table 2
Summary of ANOVAs examining mean listener- and talker-based foreign accent ratings (see text)

Factor	*df*	Talker-based		Listener-based	
		F	*p*	*F*	*p*
Age (A)	1102	8.3	0.005	6.6	0.012
Experience (E)	2102	131.9	0.000	104.4	0.000
A × E	2102	25.8	0.000	20.4	0.000
Time of testing (T)	1102	0.2	0.672	2.5	0.115
A × T	1102	3.9	0.050	54.9	0.000
E × T	2102	1.5	0.231	20.8	0.000
A × E × T	2102	4.2	0.018	58.6	0.000

Note: Age, adults vs. child; Experience, LOR3 vs. LOR5 vs. NE; Time of testing, two intervals (T1, T2) separated by an average of 1.2 years.

Two two-way interactions reached significance (Age × Experience, Age × Time of testing), as did the Age × Experience × Time of testing interaction ($p<0.05$).

The significant three-way interaction was explored by testing the simple effects of Age (adult vs. child), Experience (NE, LOR5, LOR3), and Time of testing (T1, T2). Given that significance at the 0.05 level was required in analyses of both talker- and listener-based scores, no further adjustment in the alpha level was made to compensate for the number of tests. Tukey tests were used to evaluate pair-wise differences between groups following a significant simple effect of Experience, which had three levels. A pair-wise difference between groups was considered statistically reliable only when the difference reached the 0.05 level in post-hoc tests of both talker- and listener-based scores.

Tests of the simple effect of Time of testing indicated that ratings did not change over the average 1.2-year interval between T1 and T2 for any group, even the NK children with an average LOR of 3 years at T1. The ratings obtained at T1 and T2 were similar for the three groups of children (NE, 6.8 vs. 6.8; LOR5, 5.0 vs. 5.2; LOR3, 5.0 vs. 5.3) and the three groups of adults (NE, 8.1 vs. 8.0; LOR5, 3.7 vs. 3.8; LOR3, 4.0 vs. 3.6). The simple effect of Time of testing was non-significant at all six possible combinations of the Age and Experience factors.

Tests of the simple effect of Experience indicated that both the NK children and the NK adults obtained significantly lower ratings (indicating the presence of foreign accent) than age-matched NE speakers did at both T1 and T2 ($p<0.05$). These tests also revealed that the Koreans' pronunciation of English did not improve significantly as the result of an additional two years of residence in an English-speaking country (LOR3 vs. LOR5). The NE children obtained significantly higher ratings than both groups of NK children at T1 (6.8 vs. 5.0, 5.0) and T2 (6.8 vs. 5.2, 5.3). Similarly, the NE adults obtained significantly higher ratings than both groups of NK adults at T1 (8.1 vs. 3.7, 4.0) and T2 (8.0 vs. 3.8, 3.6). The simple effect of Experience was significant for all four Age × Time combinations ($p<0.05$). Tukey tests revealed the same pattern of between-group differences in all four instances: The NE speakers obtained significantly higher ratings than NK groups having an LOR of 3 and 5 years ($p<0.05$), who did not differ significantly from one another.

Test of the simple effect of Age revealed that differences between adults and children varied as a function of native language. For native speakers of English, significantly higher ratings were obtained for adults than children at both T1 (8.1 vs. 6.8) and T2 (8.0 vs. 6.0).[4] The opposite held true for NK participants. That is, for native speakers of Korean, significantly lower ratings were obtained for adults than children regardless of Time of testing or LOR (LOR5-T1. 3.7 vs. 5.0; LOR5-T2, 3.8 vs. 5.2; LOR3-T1, 4.0 vs. 5.0; LOR3-T2, 3.6 vs. 5.3).

The results presented so far indicate that neither the Korean adults' nor children's pronunciation of English improved after an additional two years of residence in North America (a null effect of LOR). The results also indicate that although the Korean children had a better pronunciation of English than the Korean adults, both the Korean adults and children spoke English with detectable foreign accents.

To estimate how many NK participants spoke English with a foreign accent, the 2-SD criterion discussed in Section 1 was applied to the data from this study. The NE children's mean talker-based ratings averaged 6.8 (SD = 0.7) at T1 and 6.8 (SD = 0.8) at T2. The T1 and T2 ratings obtained for each of the 36 NK children were checked to determine if they did or did not fall within 2-SDs of the NE children's T1 and T2 mean ratings. Fifteen NK children met the 2-SD criterion at T1, and 20 did so at T2. A χ^2 test revealed that the increase was non-significant ($X(1) = 0.71$, $p > 0.10$).

The NE adults' ratings averaged 8.0 (SD = 0.3) at T1 and 8.0 (SD = 0.3) at T2. The T1 and T2 ratings obtained for the 36 NK adults were checked to determine if they fell within 2 SDs of the NE adults' mean T1 and T2 ratings. No NK adult met the 2-SD criterion at either T1 or T2.

The 2-SD criterion has been used as an index of accent-free L2 pronunciation in previous research with adults (see, e.g., Flege, 2003). However, this procedure might not be valid for use with the NK children who participated in this study. This is because there was more variance in ratings obtained for sentences spoken by the NE children than adults (Levene, 1960). The ratings obtained for individual NE children diverged significantly more from the NE children's mean rating than the ratings obtained from individual NE adults' diverged from the NE adult's mean ratings. This held true both at T1 (mean differences = 0.63 vs. 0.24, $F(1,34) = 21.2$, $p < 0.001$) and at T2 (mean differences = 0.61 vs. 0.22, $F(1,34) = 9.7$, $p < 0.01$). When the 2-SD test was re-applied using the NE children's mean values but the NE adults' SD, just 5 NK children met the 2-SD criterion at T1 and 10 did so at T2 ($X(1) = 0.71$, $p > 0.10$).

To provide insight into factors that influence overall degree of perceived accent, Pearson correlations were computed between sentence ratings (talker-based scores averaged over T1 and T2) obtained for the 36 NK children and the 36 NK adults and the following variables: chronological age at T1, AOA in North America, LOR in North America at T1, self-reported use of English at home (averaged over T1 and T2), and self-reported overall use of English (also averaged over T1 and T2). Inter-correlations between the last five variables were also computed.

The correlations obtained for the NK children and adults are summarized in Table 3. A significant AOA-sentence rating correlation was obtained for the NK adults but not the NK children. For both NK adults and children, a strong positive correlation existed between AOA

[4]The lack of a significant Age × Order interaction, $F(1,68) = 0.5$, *ns*, in a (2) Age × (2) Order × (2) Time ANOVA indicated that the difference between NE adults and children was observed for listeners who rated the adults' sentences first as well as for those who rated the children's sentences first.

Table 3
Pearson correlations between ratings of English sentence production and five variables, as well as inter-variable correlations, for the native Korean adults and children

		Age	AOA	LOR	Overall use	Home use
Degree of foreign accent	Children	−0.14	−0.19	0.10	0.57*	0.60*
	Adults	−0.52*	−0.55*	0.02	0.47*	0.15
Chronological age (Age)	Children		0.88*	0.27	−0.06	−0.54*
	Adults		0.98*	0.31	−0.34	−0.14
Age of arrival (AOA)	Children			−0.21	−0.06	−0.58*
	Adults			0.11	−0.34	−0.13
Length of residence (LOR)	Children				0.00	0.04
	Adults				−0.05	−0.08
Overall English use	Children					0.47*
	Adults					0.19

Note: Each age group consisted of 36 participants. High sentence ratings indicated a relatively good pronunciation of English. The values for chronological age and LOR are those at the first time of testing (T1); the sentence ratings and English use estimates were averaged over T1 and T2. Overall English use, overall self-reported percentage use of English. Home use, self-reported percentage use of English at home. An asterisk indicates significance at the 0.01 level.

and chronological age (the later the arrival in North America, the older at test). Thus the AOA-sentence rating correlation that was observed for the NK adults but not the NK children probably cannot be attributed to the confounding of AOA and chronological age.

For both NK adults and children, significant moderate correlations existed between sentence ratings and overall percentage use of English (the more the use of English, the milder the foreign accents). The finding for adults agrees with the results obtained by Flege et al. (1999) for NK adults differing in AOA to the US. The correlation between sentence ratings and percentage use of English in the home that was obtained here for the NK children agrees with the results of Tahta et al. (1981a). It is noteworthy that for NK adults, the sentence rating-home use correlation was non-significant.

Percentage home use of English was correlated with chronological age and AOA for the NK children but not the NK adults. That is, the younger the NK children were at T1 and the earlier they were upon arrival in North America, the more the NK children tended to use English at home. This is consistent with the observation that immigrant children are more likely than older immigrant children and adolescents to develop a preference for speaking the L2 rather than the L1 (Jia & Aaronson, 1999).

The purpose of the final analysis was to evaluate the effect of fine-grained AOA differences among the NK children. The 36 NK children were rank-ordered according to AOA, and then assigned to AOA-defined subgroups of six each. The subgroups differed significantly in chronological age (range = 10.5–16.1 years, $F(5,30) = 19.2$, $p < 0.0001$) but not LOR (range = 3.3–4.3 years, $F(5,30) = 0.8$, $p > 0.10$). The mean foreign accent ratings obtained for the NK child subgroups is plotted in Fig. 2 as a function of AOA. Mean values for three subgroups of NE children ($n = 6$ each), who were selected on the basis of chronological age rather than AOA, have been plotted adjacent to the NK subgroup(s) that was closest in chronological age.

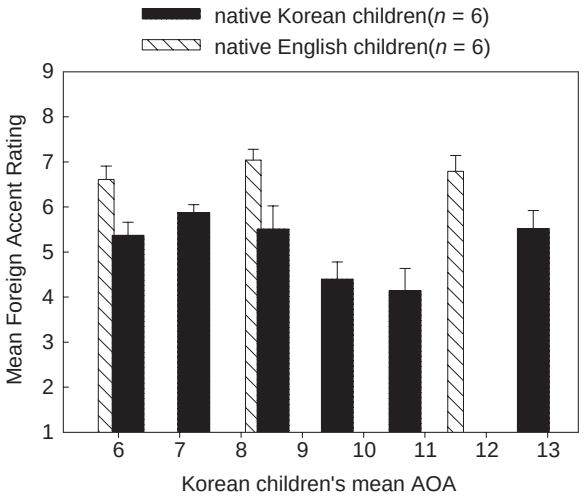

Fig. 2. Mean foreign accent ratings obtained for subgroups of native Korean (NK) children ($n = 6$ each) grouped on age of arrival in North America and native English (NE) children ($n = 6$ each) grouped on age. The NE children's values are plotted alongside those of the NK subgroup closest in chronological age. The error bars enclose ± 1 SE.

All six NK subgroups received lower ratings than did all three NE subgroups. A series of *t*-tests was carried out to test for differences in chronological age and sentence ratings between age-adjacent NK and NE subgroups. The NK children with an AOA of 6.2 did not differ significantly in age from the first NE subgroup (10.5 vs. 10.1 years; $t(1) = 0.6$, $p > 0.10$), but they received significantly lower ratings (5.4 vs. 6.6, $t(1) = 2.9$, $p = 0.014$), indicating the presence of foreign accent. The NK children with an AOA of 8.5 years did not differ significantly in age from the second NE subgroup (12.8 vs. 12.7 years; $t(1) = 0.3$, $p > 0.10$), but received significantly lower ratings (5.5 vs. 7.0, $t(1) = 2.7$, $p = 0.023$). NK subgroups having mean AOA values of 10.7 and 12.8 years were compared to the third NE subgroup. These NK subgroups did not differ significantly in age from the NE children (means = 14.7 and 16.1 vs. 15.4, $t(1) = 0.9$ in both instances, $p > 0.10$), but both received significantly lower ratings (4.2 and 5.5 vs. 6.7, $t(1) = 4.3$, $p = 0.002$, $t(1) = 2.2$, $p = 0.049$). These findings indicated that Korean children who arrived in an English-speaking environment as young children, were enrolled in English-medium schools, and had lived in an English speaking community for about four years on the average, spoke English with a foreign accent.

4. Discussion

The NK children examined in this study were judged to produce English sentences with milder foreign accents than the NK adults. This agrees with Flege et al. (1999), who examined an AOA-stratified sample of 240 Korean adults who were highly experienced in English (mean LOR in the US = 15 years) but differed in AOA. The NK children's sentences nevertheless received significantly lower ratings than sentences produced by NE children. The observation of foreign accents in the NK children's speech agrees with the results of previous studies examining adult

early learners who had spoken their L2 for decades (e.g., Flege et al., 1995, 1997, 1999; Piske et al., 2001).

Many of the 36 NK children appear to have spoken English with a detectable foreign accent. At T1, 15 NK children obtained a rating that fell within 2-SDs of the mean rating obtained for the NE children, and 20 met the 2-SD criterion at T2. These proportions appear to be higher than the proportion of adult NK early learners from the Flege et al. (1999) study who met the 2-SD criterion, even though one might have expected fewer NK children in this study to be "accent free" because they had lived for shorter periods in the US (or Canada) than those in the Flege et al. (1999) study. In fact, the number of NK children meeting the 2-SD criterion dropped to 5 (T1) and 10 (T2) when the smaller SDs obtained from the NE adults rather than from the NE children were applied to the NE children's mean values. Additional research using a sensitive paired-comparison task is needed to better define the proportion of foreign-accented non-native children.

Another important finding of this study was the lack of evidence of change over time in degree of foreign accent. There was not a significant difference in ratings obtained for sentences recorded at T1 and T2, indicating that degree of foreign accent did not change measurably over the mean 1.2-year interval separating T1 and T2. This agrees with an acoustic analysis by Tsukada et al. (in press), who did not observe a significant difference in the production of English vowels at T1 and T2 by the NK participants of this study. However, Aoyama, Flege, Guion, Akahane-Yamada, and Yamada (2003; see also Snow & Hoefnagel-Höhle, 1978) observed a difference in English words produced by native Japanese (NJ) participants at two times (T1: 0.5 years in the US, T2: one year later). NE-speaking listeners gave significantly higher ratings to words produced by children but not adults at T2 than T1. It is therefore possible that a significant T1−T2 difference would have been obtained in this study, at least for the NK children, if the NK participants had a shorter LOR at T1.

A discussed in Section 1, a number of hypotheses have been offered to account for adult–child differences in L2 speech learning. The results obtained here bear on one of those, the critical period hypothesis (CPH). Many NK children—even ones who had arrived at the age of 6 years and had lived in North America for an average of four years—spoke English with a detectable foreign accent. This finding is inconsistent with the CPH.

Another finding that was inconsistent with the CPH was the observation of a significant correlation between the sentence ratings and AOA for the NK adults but not children. If foreign accents arise from the passing of a maturationally defined critical period for L2 learning, then foreign accents should be increasingly mild as the age of first exposure to the L2 (AOA) nears the end of the critical period, but not as AOA extends beyond the critical period. Proponents of the CPH maintain that a critical period ends at the age of 12 (Scovel, 1988) or 15 years (Patkowski, 1990). The AOA of NK children and adults in this study ranged from 6–14 to 21–38 years, respectively (see Table 1). Therefore, the rating-AOA correlation pattern obtained here (significant for adults, non-significant for children) is the opposite of what would be predicted by the CPH.

In a study examining 240 Korean immigrants to the US whose AOA ranged from 1 to 23 and whose LOR averaged 15 years, Flege et al. (1999) found that AOA and LOR accounted for a significant amount of variance in sentence ratings (68% and 4%, respectively) but not language use. The lack of an effect of language use stands in contrast to the results of a similar study examining 240 Italian immigrants to Canada (Flege et al., 1995). Self-reported use of English and

Italian accounted for about 15% of the variance in the Italians' foreign accent ratings. The difference between the 1999 and 1995 studies might have arisen from a difference in how language use was estimated (5-point scales vs. percentages). More likely, it was due to the fact that far more of the Korean than Italian immigrants had received a university education in North America. As a result of this and their long US residence, the Koreans may have had a uniformly high use of English, which prevented their language use estimates from predicting degree of foreign accent.

We speculate that age-related differences in English use may have contributed to the difference in strength of foreign accent observed for the NK children and adults. The NK children reported using English more overall than the NK adults did (58% vs. 40%). They also reported using English more than the adults did with friends (76% vs. 29%) and at home (29% vs. 13%). A significant correlation was found to exist between degree of foreign accent and overall use of English for the NK children ($r = 0.57$) as well as the NK adults ($r = 0.47$). However, while a significant correlation was found to exist between degree of accent and use of English in the home for the NK children ($r = 0.60$), the correlation was non-significant for the NK adults ($r = 0.15$).

The adult–child difference just reported might be attributed to the role English played in the lives of the NK children and adults rather than simply to an age-related difference in how much English L2 input the children and adults had received while in North America. All of the NK participants used English in their principle occupation outside the home (work or school). Using English in these contexts was nearly unavoidable because the NK participants all lived in a predominantly English-speaking community. However the use of English at home and with friends was more nearly a matter of personal preference.

Far fewer NK children than NK adults reported no or minimal use of English at home (2 vs. 11, 10 vs. 23). This might reflect a shift in dominance from Korean to English. Close observation of Chinese immigrants in the US by Jia and Aaronson (1999; see also Grenier, 1984) suggested that immigrant children are more likely than adolscent or adult immigrants to seek out opportunities to speak L2 with native speakers of the L2. Immigrant children who were younger than 13 years of age tended to become more proficient in the L2 than they were in the L1, and to prefer speaking the L2. Older immigrants usually remained more proficient in their L1 than L2, and preferred speaking the L1.

If child immigrants hear the L2 more than adult immigrants and actively use the L2 more, this might result in better L2 pronunciation, especially if the (heard) L2 input comes from L2 native speakers. This hypothesis will need to be investigated carefully in future research, because at least two competing hypotheses can be advanced. The first is that immigrant children use the L2 more than immigrant adults because they have greater success in learning the L2 as the result of not having passed a critical period. The second hypothesis is that the immigrant children use the L2 more than immigrant adults because they are more strongly motivated to learn the L2 or have more positive attitudes toward the L2 and/or the culture represented by L2 native speakers (see Flege, 1988b, for review). These factors, in turn, could be linked to variation in attention paid to fine-grained phonetic characteristics that distinguish the L2 from the L1.

The present study evaluated the effect of L2 experience by comparing NK participants who had lived in North America for 3 and 5 years. The lack of a significant difference between participants differing in LOR meant that an additional two years of residence did not measurably reduce degree of foreign accent for either the NK adults or children. The null effect of LOR in this study agrees with the results obtained by Flege (1988a), who did not observe a significant difference in

overall degree of perceived foreign accent in English sentences produced by groups of Chinese adults who had lived in the US for averages of 1.1 and 5.1 years. Perhaps an LOR effect would have been obtained had the LOR difference been larger (see Flege & Fletcher, 1992).

Caution must be exercised, however, in reaching conclusions regarding the effect of LOR. This variable is used as a rough index of overall amount of L2 input. Tahta et al. (1981a, p. 265) acknowledged they "took it for granted" that their non-native participants received appropriate native-speaker input, but this working assumption may be unwise. Immigrants to an L2-speaking country will almost certainly receive passive exposure to the L2, but there is no guarantee they will listen to and understand the L2 as spoken by native speakers, or use the L2 to communicate.

Evidence of a weak link between LOR and L2 input, at least for adults, was provided by Flege and Liu (2001). These authors administered three L2 tests (one focusing on the identification of word-final stops) to groups of Chinese adults having mean LOR values of about 2 and 7 years. Both LOR groups were subdivided according to occupational status. A significant effect of LOR was obtained on all three tests for participants holding jobs that required frequent use of English (e.g., graduate students) but not for participants holding jobs that typically do not require frequent use of English (e.g., laboratory workers in a medical center, homemakers).

One final finding of this study is of methodological importance, viz., the finding that significantly lower ratings were obtained for sentences produced by NE children than adults. The NE children could not, of course, have spoken English with a foreign accent because they were monolingual native speakers of English. The adult–child difference may have arisen because some of the NE children's speech had not yet reached maturity (e.g., Lee et al., 1999) and the listeners were unable to completely dissociate speech immaturity from foreign accent. Winitz (1981a) suggested that it would be inappropriate to directly compare ratings obtained for the L2 speech of immigrant adults and children if listeners apply different standards to participants differing in age. The results obtained here suggest that they do, leading to the recommendation that groups of non-native participants be compared only to same-age native-speaker groups in future studies.

In summary, the present study showed that although NK children produced English sentences in a more native-like way than NK adults, they spoke English with a detectable foreign accent. There was surprisingly little evidence of change over real time (from T1 to T2) or apparent time (comparisons of NK participants differing in LOR). The study yielded findings that were inconsistent with the hypothesis that adult–child differences are due to maturational constraints, but the basis for age effects on L2 speech production remains uncertain. The suggestion was made that adult–child differences in L2 speech production are due in part to the fact that immigrant children receive more native-speaker L2 input than immigrant adults do.

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Appendix A. The questions and answers used to elicit the production of eight English sentences (see text). Productions of the four italicized sentences were rated for foreign accent

Questions	Answers
1. How are you today?	*I'm fine, thank you.*
2. What time is it?	*It's now ten o'clock.*
3. How much does it cost?	*It costs five dollars.*
4. Where did the children go?	*They went to school.*
5. Where did the man go?	He went to work.
6. What did he drink?	He drank a glass of water.
7. What did the girl eat?	She ate a sandwich.
8. What did you read?	I read a good book.

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