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# A longitudinal study of Chinese children and adolescents learning English in the United States

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## ABSTRACT

Ten native Chinese-speaking children and adolescents who immigrated to the United States between ages 5 and 16 were studied for 3 years. The changes in their language preferences, language environments, and proficiency in English, their second language (L2), as well as Chinese, their first language (L1), were measured quantitatively and qualitatively. Participants with arrival ages of 9 or younger switched their language preference from L1 to L2 within the first year, were exposed to a significantly richer L2 than L1 environment, and became more proficient in L2 than in L1. The older participants maintained their preference for L1 across the 3 years, were exposed to a significantly richer L1 than L2 environment, and maintained L1 as the more proficient language. Interactions among L1 proficiency, peer interactions, social abilities, and cultural preferences jointly influenced the dominant language switch or maintenance processes.

For immigrant children and adolescents, learning the language of their host country constitutes an important part of their adaptation to the new world. That learning process has been intensively studied from both practical and theoretical standpoints. In this article, we join in these efforts by reporting a longitudinal study that has documented some important linguistic and sociocultural processes by which 10 Chinese children and adolescents became bilinguals in the United States. We describe and explain the changes in their language preferences, environment, and proficiency, as well as interactions among these three aspects during the first 3 years of English immersion. The following is a discussion of past research relevant to these issues.

## UNDERSTANDING THE RELATION BETWEEN FIRST (L1) AND SECOND LANGUAGE (L2) PROFICIENCY

Although L2 acquisition by immigrants can be studied in various ways, long-term attainment studies seem to have attracted the most concentrated efforts of psycholinguists during the past 3 decades. These studies examine immigrants' L2 (English) attainment after they have lived in the United States for a given number of years (Asher & Garcia, 1969; Johnson & Newport, 1989; Oyama, 1976, 1978; Patkowski, 1982). A persistent finding is that age of arrival in the United States is the most robust predictor of long-term L2 attainment, regardless of immigrant group or linguistic attributes measured. Namely, as arrival age increases, long-term L2 proficiency decreases, a phenomenon termed the long-term L2 attainment decline or arrival age effect. The causes of this phenomenon have been a topic of much debate (see Birdsong, 1998; Harley & Wang, 1997; and Marinova-Todd, Marshall, & Snow, 2000, for reviews). Although some researchers hold long-term L2 attainment decline to be evidence for a critical period for L2 acquisition that is genetically preprogrammed and domain specific (e.g., Johnson, 1992; Johnson & Newport, 1989; Patkowski, 1990), others propose cognitive, social, and environmental factors as the major causes (e.g., Bialystok & Hakuta, 1994, 1998; Snow, 1983; Snow & Hoefnagel-Höhle, 1987).

As bilinguals' two languages closely interact with each other at different levels (Grosjean, 1989; Heredia & Altarriba, 2001), researchers have begun to advance this line of inquiry by examining long-term attainment, not only in L2, but also in L1, using comparable measures of L2 and L1 proficiency simultaneously. These findings have consistently shown that with increasing arrival age, although long-term L2 attainment decreases, long-term L1 attainment increases. With arrival ages of between 9 and 12 years old serving as a cutoff period, those who immigrated at a younger age show higher L2 proficiency than L1 proficiency, and those who immigrated at an older age show the reverse. Such trends have been found for the pronunciation accuracy of Korean-English (Yeni-Komshian, Flege, & Liu, 2000) and Italian-English bilinguals (Flege, Munro, & Mackay, 1995), for the lexical retrieval speed and accuracy of Russian-English (McElree, Jia, & Litvak, 2000) and Spanish-English bilinguals (Kohnert, Bates, & Hernandez, 1999), and for the syntactic proficiency of Chinese-English bilinguals (Jia & Aaronson, 1999; Jia, Aaronson, & Wu, 2002). Considering that upon U.S. arrival, immigrants of all ages usually have L1 as their only or dominant language, these recent findings indicate that younger arrivals generally switch their dominant language from L1 to L2 whereas older arrivals generally maintain L2 as their dominant language.

The theme of dominant language switch or maintenance raises both theoretical and applied questions, the answers to which can deepen our understanding, not only of the arrival age effect on long-term L2 attainment, but also of the context in which immigrants of different ages become bilinguals. What are the ongoing processes of dominant language switch or maintenance? Why do younger arrivals in general switch to L2 as their dominant language and older arrivals in general maintain their L1 dominance? Would going through the different processes expose younger and older arrivals to different learning condi-

tions, and if so, what are the differences? As the long-term attainment studies only capture a snapshot of bilinguals' language proficiency and environment after years of L2 immersion, a more suitable approach to addressing these questions would involve a longitudinal design tracking the dominant language switch or maintenance processes as they unfold over time. As a preliminary attempt to develop such an approach, we designed the current longitudinal study using multiple research methods including language tasks to measure proficiency changes, as well as interviews and observations to assess the learning context of 10 native Chinese speakers during their first 3 years in the United States.

#### LANGUAGE PREFERENCE

L2 learners are not deterministic input–output machines, but rather intentional beings with feelings associated with their linguistic experiences. These feelings may well influence how they approach a language and how well they learn it. Many researchers have long paid attention to various sociopsychological variables, such as motivation, self-consciousness, and cultural identification, that can influence L2 acquisition (e.g., Brown, 1987; Gardner & Clement, 1990; Lambert, 1967). In the current study, we emphasize another psychological variable, language preference, which is intricately related to the sources and outcomes of L2 acquisition. Language preference can be shaped by sociopsychological factors, and it can also influence language use and proficiency. Although language preference has not been frequently discussed in the field of L2 acquisition, researchers in health education have long used it as a primary indicator of immigrants' acculturation levels (e.g., Bell & Alcalay, 1997; Epstein, Dusenbury, Botvin, & Diaz, 1994). However, much remains to be understood about language preference in relation to immigrants' L1 maintenance (or loss) and L2 acquisition. For example, do immigrants with different arrival ages show similar patterns of language preference? Why might immigrants have different language preferences? Do language preferences change over time? How are language preferences related to language use and language proficiency? In the current study, we recorded language preferences of our participants at various points during L2 immersion, examined whether their language preferences were consistent with their language use, and analyzed why certain preferences existed. Such information can lead to a better understanding of the role played by language preference in immigrant children and adolescents' L1 maintenance (or loss) and L2 acquisition.

#### LANGUAGE ENVIRONMENT

Most earlier long-term attainment studies focused primarily on a limited set of variables such as arrival age and length of residence as possible predictors of L2 proficiency (e.g., Asher & Garcia, 1969; Johnson, 1992; Johnson & Newport, 1989; Oyama, 1976, 1978; Patkowski, 1982). Inspired by long-existing theories of environmental, social, and attitudinal influences on L2 acquisition (e.g., Gardner & Lambert, 1959; Lambert, 1967), researchers recently have examined and identified more predictors of long-term L2 attainment (Birdsong &

Molis, 2001; Flege, Yeni-Komshian, & Liu, 1999; Jia & Aaronson, 2002; Jia et al., 2002). For example, more media input in L2 (e.g., movies, videos, TV, and radio), stronger motivation to learn L2, years of education in the United States (Flege et al., 1999), and higher L2 proficiency of family members (Jia & Aaronson, 2002; Jia et al., 2002) were all significantly associated with higher L2 proficiency.

However, methodologies involved in long-term attainment studies have led to a limited view of the roles of such environmental variables in L2 acquisition. More specifically, in long-term attainment studies, information about language environment can only be elicited through retrospective self-report and only at one time point. To address this issue, in addition to a self-report measure, the current study also utilized direct observations of and detailed interviews with participants and their parents. The longitudinal design also facilitated an exploration of temporal changes in language environment. As our participants arrived in the United States at different ages, the study further allowed us to explore environmental differences across arrival age, thus shedding light on the long-term L2 attainment decline phenomenon.

## METHODS

### *Participants*

The participants in the study were 10 Chinese children and adolescents (5 girls, 5 boys) who were 5–16 years old when they immigrated to the New York City area. In this article, participants' pseudonyms are specified with their gender and arrival age in parentheses. These 10 children and adolescents were Anna (f5), Betty (f6), Carl (m7), Dianna (f8), Eric (m9), Frank (m9), Gary (m12), Hua-lei (f12), Jing-lan (f15), and Kang-da (m16). Seven of them were from Mainland China and three were from Taiwan. Although 7 spoke only Mandarin as their native language, Betty (f6), Dianna (f7), and Gary (m12) knew both Mandarin and another Chinese dialect. Nine of the 10 participants lived with both parents and 1 lived with only his mother. Eight of the 10 participants were single children and the other 2 were sisters. Although the participants' parents had varied occupations in the United States, including lab technicians and factory, restaurant, hotel, and health care workers, all held relatively low-level positions in their fields at the early stage of immigration, which is typical for recent Chinese immigrants. All of the parents had college degrees from China, 6 held a master's degree (2 from China and 4 from the United States), 1 had a doctoral degree (from China), and 3 had a professional medical degree (from China). The parents all knew English to different degrees, and such differences existed evenly across participants of different ages.

Five participants came to the United States in the summer of 1995 and the other five in the summer of 1996. English immersion started in September when the participants went to school, and the study started 3 months later. In this article, *immersion* broadly refers to the experience of L2 acquisition while living in a predominantly L2-speaking country, rather than the immersion programs in educational settings. Eight participants were recruited by advertisements in a

Chinese newspaper and two through personal contacts. In the current study, all L1 tasks and interviews were conducted in Mandarin Chinese. However, for simplicity, the term Chinese will be used when referring to these tasks and interviews.

### *Procedure*

The study was conducted mainly during home visits to the participants in the first 3 years of their residence in the United States. Each participant was visited once a month during Year 1 of the study, once every 3 months during Year 2, and twice during Year 3. This yielded 13 visits per participant and 130 visits for the whole group. Each home visit lasted about 4 hr and consisted of five basic sections: language tasks, child interview, parental interview, questionnaires, and observations. During the interviews, the interviewer switched between L1 and L2 to ensure that speech samples of both languages were gathered. All oral performance on the language tasks and part of the conversations were audiotaped, and information about the rest of the conversations, as well as observations, were recorded in notes either during the visit or immediately afterward. All the visits were conducted by the first author, who is a fluent Chinese–English bilingual.

Transcripts of the taped interviews were made by the first author and two transcribers and then double-checked by another transcriber. All transcribers were fluent Chinese–English bilinguals with college or graduate degrees who were trained to do the transcriptions.

### *Outcome measures*

*Language preference.* Information on the language preferred for both speaking and reading was obtained for each participant at the end of each year. This created 60 data points (10 Participants  $\times$  Two Language Aspects  $\times$  3 Years). Such information came primarily from interviews with participants, and was supplemented by direct observations of their language choices in various situations. A typical question about language preference was “Do you like to speak English more or Chinese more?” After an answer was given, participants were asked to further explain their language preferences. For 56 of the 60 data points, participants gave definite answers to these questions, which were recorded directly as reported. For the 4 cases with ambiguous answers, a few typical language speaking or reading scenarios were presented and participants were asked to choose the language they preferred to use in these specific situations. The language chosen for the majority of the situations by the participant was coded as the preferred language.

*Language environment.* Participants’ language environment was evaluated by parental questionnaires, child and parent interviews and interviewer observations. At the end of each year, all parents filled out a written Chinese questionnaire to report their children’s language use in various situations over the previ-

ous year. Parents reported (a) the number of hours of TV their children watched in each language during each week (separately for each of two school semesters and the summer and winter breaks), (b) the number of books they read in each language during each school semester and the two breaks, (c) the number of friends they had who spoke predominantly one language during the entire year, and (d) the percentage of time that they spoke each language at home during the year. To provide comparable measures for all four environmental aspects, the total number of TV watching hours and books read for the year were summed over the component time units.

As the proportions of L1 or L2 used were most relevant to the issue of dominant language switch or maintenance, a percentage score of L2 used out of the total amount of language use was obtained for each of the four measures. For measures (a)–(c) above, for each participant, the number of L2 TV-watching hours, the number of L2 books read, and the number of predominantly L2-speaking friends were each divided by the respective L1 + L2 totals to yield percentages. For each participant, these three percentage scores, together with the percentage of L2 spoken at home directly reported by the parents, were averaged to yield an L2 environment composite score. A higher score indicates a richer L2 environment and a poorer L1 environment.

More detailed information on language environment was obtained through verbal interviews with participants and their parents. During these interviews, participants and their parents provided detailed information such as the specific books participants read, the TV shows and movies they watched, and the types of activities they engaged in with their friends. This information was further supplemented by direct observations during the home interviews and some field trips. The interviewer observed the language materials, including books, newspapers, and videos, that were available and used by participants; the types of TV programs watched; and participants' language use with their parents and visiting peers. Field trips included visits to libraries, stores, tourist spots, theaters, restaurants, or parties with the participants. These occasions allowed the interviewer to observe the participants' language use in social settings other than the home.

The L2 environment composite scores based on parental questionnaires were used in the data analysis because these quantitative data were highly consistent with data obtained from child interviews and observations. Such consistency was due to the fact that all of the parents, regardless of family structure and economic situation, paid close attention to their children's learning and language use while monitoring their academic performance and social interactions. In addition, when filling out the questionnaires, parents frequently arrived at their answers through discussions with their children. For example, to provide the number of friends who spoke predominantly either language, parents and children often verbally listed the names of each friend and the degree of their interactions before a response to this questionnaire item was made.

One measurement issue was the objective availability of L1 and L2 input in the participants' lives. For example, not every participant had cable TV or a VCR that made watching videos or certain TV channels possible. However, such differences existed evenly across participants of different ages.

*Language proficiency.* Participants' L2 and L1 proficiency was measured with multiple language tasks. In this article, only some selected measures administered at the end of each year are reported. The L2 measures described next are a grammaticality judgment task and a translation task, and the L1 measure is parental ratings of participants' L1 proficiency changes.

**L2 (ENGLISH) GRAMMATICALITY JUDGMENT TASK AND MATERIALS.** Participants made a grammaticality judgment for each of 36 written English sentences that tested their knowledge on nine grammatical structures (see Appendix A). Each participant's score on this task is the percentage of correct judgments for the total of 36 sentences. The sentences were selected from 40 sentences that were pilot tested with eight adult monolingual English speakers. Only when a sentence was unanimously judged to be grammatical or ungrammatical by all eight informants was it selected for the study. There were 31 ungrammatical sentences and five grammatical fillers. The sentences tested nine grammatical structures, including plurals, past tense, (present/past) progressive form, third person singular present, predicate structure, pronominalization, articles, *wh*-questions and word order. Each structure was tested with from three to six sentences. The sentences had high frequency English words, and sentence lengths varied from 3 to 8 words with an average of 5.3 words.

**L1 TO L2 TRANSLATION TASK.** As an additional measure of L2 proficiency, participants translated 36 orally presented Chinese sentences into English. For each participant, scores on the translation task are the total number of grammatical errors on each sentence, summed over all 36 sentences. Only grammatical errors were scored; lexical-semantic errors, which were very rare, were not scored. A lower score indicated better performance on that task. If the same types of errors appeared in different locations of a sentence or in different sentences, they were each counted as individual errors. These sentences were the Chinese translations of the grammatically correct versions of the 36 English sentences in the grammaticality judgment task (mean length = 9.3 Chinese characters; range = 5–14 Chinese characters). The translation task was always conducted first and was separated by at least 40 min of conversation from the grammaticality judgment task. Practice trials were used to make sure that the participants fully comprehended the task demands. No feedback was given to the participants during the translation task except "okay" to indicate the start of the next sentence. Therefore, the translation task would not have sensitized participants to the grammatical structures tested in the grammaticality judgment task. As the sentences used high frequency words to depict scenes and events or ideas that were familiar even to the youngest participants, participants of all ages had no problem in understanding the meanings of the Chinese sentences. Therefore, English production problems scored to indicate L2 production accuracy were not likely due to L1 comprehension problems.

**PARENTAL RATINGS OF L1 PROFICIENCY CHANGES.** At the beginning and end of the study, all parents rated the absolute level of their children's Chinese

proficiency in listening, speaking, reading, and writing using a 4-point scale (1 = *not at all*, 2 = *a little*, 3 = *some*, 4 = *fluent*). In addition, at the end of each year, parents evaluated their children's changes in Chinese abilities in listening, reading, speaking, and writing on an 11-point scale, from -5 to 5 relative to their proficiency at the beginning of the year (5 = *the greatest improvement I could expect*, 0 = *no change*, and -5 = *the greatest decline I could expect*). Therefore, positive ratings indicated growth and negative ratings attrition.

## RESULTS

Results are organized into language preference, language environment, and language proficiency changes over time. Age differences in these domains were analyzed and discussed in two complementary ways. First, Pearson bivariate correlation analyses between arrival age and each of the outcome variables were conducted to show age trends. In this case, arrival age was treated as a continuous variable. Second, age differences were also analyzed by classifying participants into a younger and older group based on their arrival ages. The younger arrivals were the six children with arrival ages of 9 or younger, and the older arrivals were the four adolescents with arrival ages of 12 or older. In this case, arrival age was treated as a discrete variable, and group differences were analyzed with the Mann-Whitney *U* test, a nonparametric rank-order test. This test determines whether participants from the younger and older groups were randomly ordered or somewhat rank-ordered from the lowest to the highest values of a variable. The advantage of doing both types of analyses was that, given the small sample size involved in the analyses, nonsignificant correlation coefficients that indicated a certain age trend could be further evaluated with the Mann-Whitney *U* test. In addition to these quantitative analyses, some qualitative data are also provided and discussed in order to more fully characterize the linguistic and sociocultural context in which these participants became bilinguals.

### *Language preference*

Table 1 presents participants' language preferences for speaking and reading measured at four time points: at the start of Year 1 (3rd month), and at the ends of Year 1 (12th month), Year 2 (24th month), and Year 3 (36th month). Overall, younger arrivals reported a preference shift from L1 to L2 whereas older ones maintained their preference for L1 across all 3 years of study. At the beginning of Year 1, all 10 participants reported preferring to speak and read in Chinese. They all attributed their L1 preference to their existing L1 proficiency, although the 6- and 7-year-olds were just starting to read in Chinese. However, by the end of Year 1, participants started to show considerable age differences in their language preferences. All participants aged 8 and younger switched their preference to L2 for speaking and reading except Anna (f5) who had not started reading in either language at the beginning of Year 1. In contrast, all participants age 12 and over reported a clear preference for speaking and reading in Chinese. The two 9-year-olds showed a transition between the first two groups: although

Table 1. Language preferences reported by participants in the beginning of the study (3 months) and at the end of Year 1 (12 months), Year 2 (24 months), and Year 3 (36 months)

Participants	Speaking Preference				Reading Preference			
	3 Months	12 Months	24 Months	36 Months	3 Months	12 Months	24 Months	36 Months
Anna (f5)	L1	L2	L2	L2	—	L2	L2	L2
Betty (f6)	L1	L2	L2	L2	L1	L2	L2	L2
Carl (m7)	L1	L2	L2	L2	L1	L2	L2	L2
Dianna (f8)	L1	L2	L2	L2	L1	L2	L2	L2
Eric (m9)	L1	Both	Both	Both	L1	L2	L2	L2
Frank (m9)	L1	Both	Both	L2	L1	L2	L2	L2
Gary (m12)	L1	L1	L1	L1	L1	L1	L1	L1
Hua-lei (f12)	L1	L1	L1	L1	L1	L1	Both	Both
Jing-lan (f15)	L1	L1	L1	L1	L1	L1	L1	L1
Kang-da (m16)	L1	L1	L1	L1	L1	L1	L1	L1

(—) Data not obtained.

both preferred to read in English, they felt equally comfortable in speaking either language and stated no preference. The same pattern of language preferences persisted at the ends of Years 2 and 3 with only one change. Hua-lei (f12) stated no language preference in reading, differing from her preference for L1 reading during Year 1.

#### *Language environment*

*Language spoken at home.* Table 2 lists the percentage of time for which participants spoke L2 at home, as reported by their parents. Correlation analyses showed no significant age differences for Year 1 and Year 2, but during Year 3, a younger arrival age significantly predicted more L2 speech at home,  $r(8) = -.82, p < .01$ . During Year 1, all participants spoke L2 less than 15% of the time. During Year 2, all participants spoke L2 less than 30% of the time. However, during Years 2 and 3, all the younger children increased the percentages of L2 speaking time at home whereas the older ones maintained a very low level of L2 speaking at home. These trends were consistent with the language preference transitions reported by the participants and those observed by the interviewer.

*Language spoken in school and neighborhood.* All participants attended public schools in New York City or New Jersey, except that Eric (m9) transferred to a public school in Seattle during Year 3. All participants were in mainstream English classes from the beginning and also attended English as a second language classes for 1–3 years. All schools were multiracial with 10–15% ethnic Chinese students. The difference in participants' language environments outside home arose mainly from their language use with friends in school and in the neighborhood. Numerous conversations with friends occurred during activities in school, after school, on weekends, and during vacations (e.g., doing homework, playing games and sports, chatting, visiting stores, going to parties and movies). Friendship choices created chances for speech input and output and also affected participants' attitudes toward L2 use and motivation for improving L2 speech.

Table 2 presents the percentage of the number of predominantly L2-speaking friends that the participants had during each year, based on parental reports. In general, participants' language use with friends differed with age: during all 3 years of the study, a younger arrival age predicted a larger proportion of L2-speaking friends,  $r(8) = -.83, p < .01$  for Year 1;  $r(8) = -.91, p < .001$  for Year 2; and  $r(8) = -.95, p < .001$  for Year 3.

Further, as shown by Figure 1, although younger and older arrivals had almost the same total number of friends in each year, over the 3 years, younger arrivals as a group dramatically increased the average number of L2-speaking friends (1.8 in Year 1, 6.0 in Year 2, and 6.2 in Year 3), and they maintained similar low numbers of L1-speaking friends (1 in Year 1, 0.7 in Year 2, and 0.5 in Year 3). In contrast, older arrivals as a group had low numbers of L2-speaking friends (0.1 in Year 1, 1.3 in Year 2, and 2.3 in Year 3) but consistently high numbers of L1-speaking friends (4.3 in Year 1, 6.3 in Year 2, and 5.5 in Year 3).

Table 2. Percentage of L2 use in four situations during Years 1, 2, and 3

Participants	Speaking at Home				Friends	Books	TV				
	10	15	40	67							
Anna (f5)	10	15	40	67	100	57	100	94	61	63	76
Betty (f6)	0	0	35	75	100	82	99	92	100	100	100
Carl (m7)	12	30	60	67	100	80	91	92	97	100	91
Dianna (f8)	1	5	25	67	71	67	100	100	100	100	100
Eric (m9)	10	20	10	67	100	75	87	100	93	87	100
Frank (m9)	0	1	20	0	71	100	94	100	100	100	100
Gary (m12)	10	0	0	33	12	25	31	49	22	85	100
Hua-lei (f12)	0	1	0	25	33	50	13	5	19	52	79
Jing-lan (f15)	10	1	0	0	0	22	7	7	3	50	100
Kang-da (m16)	10	13	1	0	22	0	60	35	0	100	92

*Note:* Speaking at home, percentage of L2-speaking time at home for a year; friends, percentage of number of predominantly L2-speaking friends out of the total number of friends for a year; books, percentage of books read in L2 out of the total number of books read for a year; TV, percentage of hours of L2 TV watching out of the total number of hours of TV watched in a year.

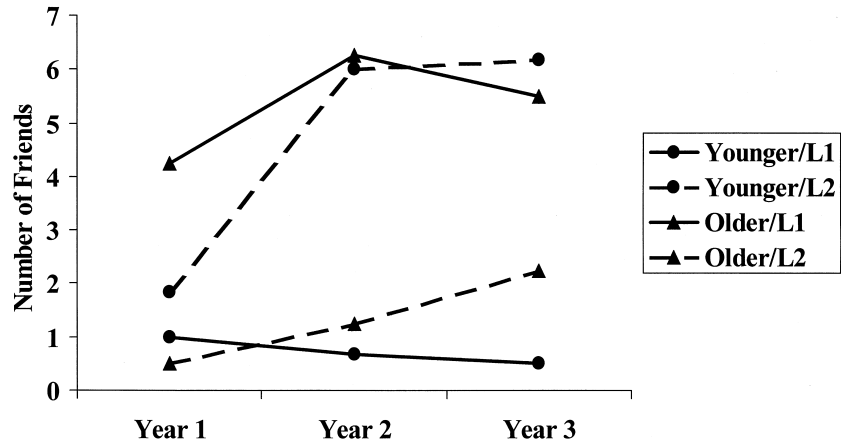


Figure 1. The average number of predominantly L1- or L2-speaking friends of participants in the younger and older groups for Years, 1, 2, and 3.

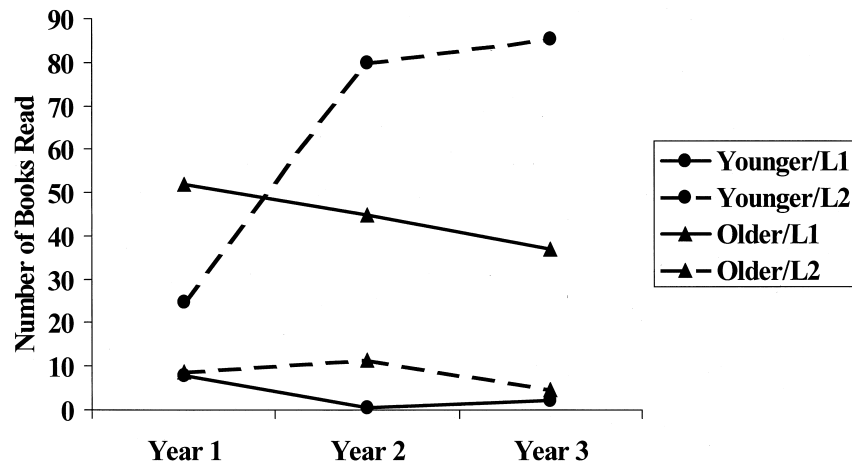


Figure 2. The average number of books read in the L1 and L2 by participants in the younger and older groups for Years 1, 2, and 3.

*Leisure reading.* Participants read books and newspapers in addition to their required school reading. Leisure reading (that not required by school) was a good indicator of the level of intrinsic interest in reading in a particular language. There were significant age differences in the percentages of books read in L2 (Table 2). A younger arrival age predicted a significantly higher percentage of L2 book reading,  $r(8) = -.54, p = .09$  for Year 1;  $r(8) = -.85, p < .01$  for Year 2; and  $r(8) = -.91, p < .001$  for Year 3.

Further, as shown by Figure 2, the average number of L2 books read by the

younger group increased dramatically from year to year (24.7 for Year 1, 80 for Year 2, 85.3 for Year 3), but the average number of L1 books read by this group decreased to almost zero (7.8 in Year 1, 0.5 in Year 2, and 2.2 in Year 3). In contrast, the average number of L2 books read by the older group remained consistently low (8.8 in Year 1, 11.5 in Year 2, and 4.5 in Year 3) and the average number of L1 books read remained steadily high (52 in Year 1, 44.8 in Year 2, and 37 in Year 3).

Over the 3 years, English increasingly became the predominant reading language for the younger arrivals whereas the older ones continued to do most of their leisure reading in Chinese. This was consistent with reading language preferences reported by the participants, as well as their parents' ratings of their L1 reading proficiency levels.

*Language listening at home: TV watching.* Table 2 lists the percentage of time (hours) that participants watched TV in L2 during the 3 years, based on parents' reports. Regardless of age, participants watched mostly English TV, and the proportions showed no age-linked trends. However, the younger group watched more hours of TV in L2 than the older group during Years 1 and 2: an average of 493 and 292 hr, respectively, for the younger and older groups in Year 1, and an average of 615 and 388 hr, respectively, for the younger and older groups in Year 2.

*Composite score for language environment.* As previously mentioned, to obtain a general picture of participants' L1 and L2 environments, one composite score for the L2 environment was calculated for each participant by taking the average of the four separate percentage scores: the number of predominantly L2-speaking friends, the number of books read in L2, of hours of TV programs watched in the L2, and the L2 spoken at home. A higher composite score indicates a richer L2 environment and a poorer L1 environment. Significant age differences in L2 and L1 environments existed in all 3 years (Figure 3): a younger arrival age predicted a significantly richer L2 environment, and thus a poorer L1 environment,  $r(8) = -.72, p < .05$  during Year 1;  $r(8) = -.87, p < .001$  during Year 2; and  $r(8) = -.94, p < .001$  during Year 3.

#### *Factors contributing to language preference and environment*

The quantitative data described earlier indicate that over a short time period, younger arrivals dramatically switched their language preference and use from L1 to L2 whereas older arrivals tended to maintain their L1 preference and usage (Tables 1 and 2). A substantial amount of qualitative data indicated that complex interactions among initial L1 abilities and cognitive, social, cultural, and psychological factors provided some of the underlying causal mechanisms for the language switch or maintenance phenomenon.

*L1 Proficiency.* Age differences in the feelings of relative difficulty or ease of L1 use led to age differences in participants' different attitudes and motivations

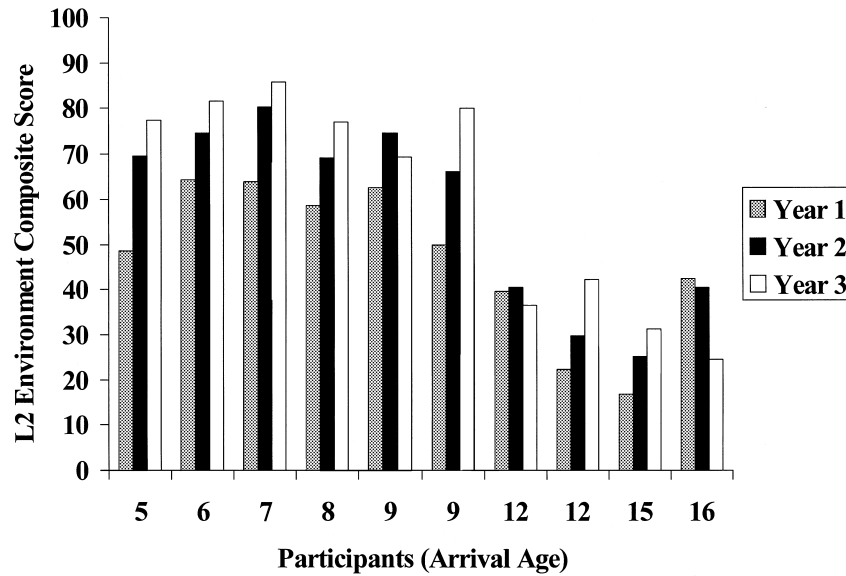


Figure 3. The L2 environment composite scores (average of percentage scores of number of predominantly L2-speaking friends, books read in L2, hours of L2 TV watching, and L2 spoken at home) for each participant for Years 1, 2, and 3.

toward L2 use and learning, and then to a significantly richer L2 environment for younger arrivals in comparison to older arrivals.

For example, when asked if, and why, she preferred speaking English over Chinese, Betty (f6) replied, based on her knowledge that single English words often require more than one Chinese character, “Yeah, because it [English] go [*sic*] faster. Yeah, you don’t have to say two words [*sic*] in, in one. . . . Like ‘friend,’ you don’t have to say Peng2-You3. Two word [*sic*] in only one word. That’s easier.” When asked if, and why, he found Chinese more difficult than English, Frank (m9) complained about the substantially greater number of homophones in Chinese than in English.

The younger arrivals, who had limited L1 reading abilities in the beginning of L2 immersion, almost started their literacy in the L2. In contrast, the older participants arrived in the United States as fluent Chinese readers, with a knowledge of between 2,000 and 5,000 Chinese characters. Consequently, soon after exposure to English reading and writing instructions and demands, the younger arrivals started to report a lack of interest in further developing their Chinese reading and writing skills. For example, Frank (m9) felt that the Chinese logographic writing system was harder than the English alphabetic system, “Chinese is like harder to write,” he said, “English is easier to write . . . because you just have to know ABCDEFG, the 26 letters. But in Chinese, you have to draw a lot of stuff to get it.”

These and related points were voiced by most of the younger arrivals during

the interviews, soon after their exposure to English reading and writing instructions. In contrast, the older arrivals all felt that Chinese was easier than English due to their superior L1 skills, and they subsequently continued to prefer and use Chinese.

*Peer preferences and social abilities.* Interactions among peer preferences, social abilities, and age-related pragmatics also fostered a relatively richer L2 environment for younger arrivals and a richer L1 environment for older arrivals. According to the child and parental interviews, as well as direct observations, participants of various ages showed different peer preferences. Children younger than nine had friends with diverse cultural and language backgrounds, including European, Hispanic, and Asian. Their friends were from readily available sources, such as the same class and neighborhood. They predominantly spoke English with each other. Participants in the middle age range (12–13 years) made mostly Chinese- and Korean-speaking friends; they spoke Chinese with the former and English with the latter. Their friends were from both the same and different classes. The two oldest participants, Jing-lan (f15) and Kang-da (m16), were the most selective. During the first 2 years of L2 immersion, they had almost exclusively L1-speaking friends who came from the same region of China as they did.

These different peer choices subsequently influenced their language use. For example, among the younger participants, the motivation to be similar to their peers made them feel “irregular” if they could not speak L2 fluently. However, when their L1 had stopped developing or had been lost, they did not feel uncomfortable speaking L2 with their Chinese peers. When asked how she felt about speaking English but not Chinese with her peers, Betty (f6) replied, “I feel regular . . . I’m not embarrassed or something. I feel regular.” Importantly, younger children’s strong motivation to use L2 was not completely caused by language proficiency. For example, when asked about her language preference, Dianna (f8), who explicitly acknowledged that her Chinese was better, replied, “I like to speak English a little tiny bit more because I want to. Usually I was talking in English with my friends . . . I don’t like to talk with Cathy, because she doesn’t know how to speak a lot of English.”

Age-related differences in mobility and in social abilities also contributed to age-based differences in peer interactions. The highly developed social abilities of the adolescents enabled them to find L1-speaking friends from various social settings and somewhat distant geographic areas. In contrast, the younger children’s limited social abilities and parental restrictions on mobility meant that they made friends with others who happened to be physically close, such as children in the same class or those living on the same block.

Different levels of social and cognitive abilities also led to different understandings of constraints on language choice during peer interactions. Younger children felt socially obligated, as if by “majority rule,” to speak only English in school, whereas older ones felt that they had control over that aspect of their environment. When asked whether she spoke Chinese with peers in school, Anna (f5) stated “Oh, there is [*sic*] a lot of Chinese people [in school], but . . . they don’t speak Chinese . . . They can’t speak Chinese in school . . . because

nobody speaks Chinese in school. It's an English school." In contrast, Hua-lei (f12) reported that she preferred to speak Chinese with peers in school because "there's [*sic*] so many Chinese in the school."

*Cultural preference.* Based on child and parental interviews and interviewer observations, older participants' preference for their native culture and younger participants' preference for American culture also shaped their language use for peer interactions, TV watching, and leisure reading. Although the older participants were linguistically capable of dealing with L2 speakers, they preferred to interact with peers from the same culture. By doing so, they were able to talk about familiar Chinese movies and songs, to exchange CDs and information related to their favorite Chinese movie stars and singers, and to go to Chinese restaurants. In contrast, younger children who had fewer native cultural experiences to share with others from the same background were more curious about the broader popular American peer culture, such as baseball games and TV shows. For example, Eric (m9) reported that he watched TV a lot just to learn about popular TV shows and baseball games, so that he could join his classmates in relevant conversations. All of the younger children watched cartoons, movies, and TV shows that were popular among typical American children of their age, such as *Batman*, Disney cartoons, Fox 5 Kids (New York City only), *Hercules*, *Power Rangers*, *Xena*, *Pokemon*, and the movie *Titanic*. Cultural preference also influenced participants' reading activities. Younger children's English reading included book series such as Disney stories, *Babysitters Club*, and *Goosebumps*. Older participants' Chinese reading included Chinese classics, as well as news about China and Chinese movies and popular singers.

#### *Language proficiency*

*L2 Proficiency changes measured by language tasks.* Participants' English proficiency varied when they initially arrived in the United States. None of the 6 younger arrivals had any previous exposure to English. The two 12-year-olds and the 13-year-old had had 1–2 years of English classes in Taiwan and Mainland China. Jin-lan (f15) and Kang-da (m16) also had had three and four years, respectively, of previous classroom English instruction. These data need to be considered when interpreting the L2 proficiency results.

Table 3 presents individual participants' scores on the grammaticality judgment and translation tasks. The bivariate correlations between arrival age and performance scores on the grammaticality judgment task showed no significant age differences at the end of either Year 1 or Year 2, but there was a trend for a younger arrival age to be related to a higher score at the end of Year 3,  $r(8) = -.43$ ,  $p = .21$ . This trend was found to be significant with a Mann–Whitney  $U$  test,  $U$ ,  $U'$  (4, 6) = (3, 16),  $p < .05$ .

Similarly, the bivariate correlation between arrival age and performance scores on the translation task showed no significant age differences at the end of either Year 1 or Year 2, but there was a trend for a younger arrival age to be related to

Table 3. Performance on the grammaticality judgment and translation tasks for Year 1 (12 months), Year 2 (24 months), and Year 3 (36 months)

Participants	Grammaticality Judgment (% Correct)			Translation (No. of Mistakes)		
	12 Months	24 Months	36 Months	12 Months	24 Months	36 Months
Anna (f5)	—	94	100	20	1	1
Betty (f6)	50	100	88	20	5	4
Carl (m7)	72	72	94	16	10	9
Dianna (f8)	100	100	94	1	1	2
Eric (m9)	75	92	89	6	2	3
Frank (m9)	67	83	86	18	7	2
Gary (m12)	44	92	83	20	9	13
Hua-lei (f12)	39	89	81	26	9	6
Jing-lan (f15)	100	100	86	3	1	5
Kang-da (m16)	69	89	94	3	1	10

(—) Data not obtained.

a higher score at the end of Year 3,  $r(8) = .54$ ,  $p = .11$ . This trend was found to be significant with a Mann–Whitney  $U$  test,  $U, U' (4, 6) = (2, 22)$ ,  $p < .05$ .

Therefore, during the first 2 years of L2 immersion, these participants showed no significant age difference in their abilities to detect morphosyntactic violations in L2 sentences or to produce grammatical L2 sentence components during translation. However, a trend started to emerge during the third year, which showed that a younger arrival age was associated with better performance on the tasks, and younger arrivals as a group outperformed the older arrivals. This indicates that the arrival age effects obtained from long-term L2 attainment studies may have a gradually emerging time course. The data on language preference and environment sheds light on this dynamic process, as indicated in the Discussion section.

*L1 Proficiency changes as reported by parents.* Table 4 presents parents' ratings of their children's absolute L1 proficiency in listening, speaking, reading and writing at the beginning of the study (3rd month) and at the end of the third year (36th month). Table 5 presents parents' ratings of their children's L1 proficiency changes in each year. According to Table 4, participants arrived in the United States with little difference in L1 listening and speaking abilities but quite different levels of L1 reading and writing proficiency. A younger arrival age predicted significantly lower L1 reading abilities,  $r(8) = .98$ ,  $p < .001$ , and writing abilities,  $r(8) = .97$ ,  $p < .001$ .

Participants' L1 proficiency changes as rated by parents showed a mixed pattern (Table 5). Parents reported mostly L1 attrition, some termination of L1 development, and some improvement, depending on participants' age and the aspects of language proficiency involved.

First, for all participants, more severe L1 attrition occurred in reading and writing than in listening and speaking. As indicated by the sum of the ratings for auditory and visual language modes, only 3 out of the 10 participants showed attrition in speaking and listening, whereas 7 out of the 10 showed attrition in reading and writing. Second, in comparison to older participants, the younger ones were reported to have suffered more severe L1 attrition in reading and writing. For example, five of the six younger arrivals were reported to have L1 attrition mostly in reading and writing across all 3 years of study, whereas only Hua-lei (f12) and Kang-da (m16) of the older group showed L1 attrition to a lesser extent during Year 2. As the younger ones started with limited reading and writing abilities, these numbers did not indicate that the younger ones had lost more reading and writing abilities than the older ones in an absolute sense. Rather, the numbers show that the younger ones, not only stopped the development of their L1 reading and writing proficiency, but also lost the limited amount acquired in their native countries.

Some parents also reported that certain aspects of L1 abilities remained the same across the years, mainly listening and speaking, for example, Carl (m7), Dianna (f8), Jing-lan (f15), and Kang-da (m16). Some participants also improved their L1. For example, the youngest child, Anna (f5), was reported to have improved her Chinese speaking and listening abilities in Year 1 and Year 2, and reading and writing abilities in Year 1 and Year 3. Betty (f6) also im-

Table 4. Parental ratings of L1 proficiency at the beginning (3 months) and end (36 months) of the study

Participants	Listening		Speaking		Reading		Writing	
	3 Months	36 Months	3 Months	36 Months	3 Months	36 Months	3 Months	36 Months
Anna (f5)	3	4	3	4	0	1	0	1
Betty (f6)	3	4	3	4	1	0	1	0
Carl (m7)	3	3	3	3	1	0	1	0
Dianna (f8)	4	4	4	4	1	0	1	0
Eric (m9)	4	4	4	4	2	0	1	0
Frank (m9)	4	4	4	3	2	0	1	0
Gary (m12)	4	4	4	4	3	4	3	4
Hua-wei (f12)	4	4	4	4	3	3	3	2
Jing-lan (f15)	4	4	4	4	4	4	4	4
Kang-da (m16)	4	4	4	4	4	4	4	3

Note: 0 = not at all, 1 = a little, 2 = some, 3 = fluent, 4 = native-like.

Table 5. Parental ratings of LI proficiency changes at the end of Year 1 (12 months), Year 2 (24 months), and Year 3 (36 months)

Participants	Listening			Speaking			Reading			Writing		
	12	24	36	12	24	36	12	24	36	12	24	36
	Months	Months	Months	Months	Months	Months	Months	Months	Months	Months	Months	Months
Anna (f5)	5	3	0	4	3	0	1	0	2	1	0	1
Betty (f6)	-1	4	0	0	4	0	-2	0	-3	-2	-1	-2
Carl (m7)	0	0	0	0	0	0	-1	-2	-2	1	-1	-4
Dianna (f8)	0	0	0	0	0	0	-1	-2	-5	-2	-3	0
Eric (m9)	0	1	3	0	1	3	-1	-1	-2	-2	-2	-1
Frank (m9)	0	0	0	0	0	-2	-1	-4	-2	-2	-5	-3
Gary (m12)	0	0	0	0	3	0	3	3	2	1	1	-1
Hua-lei (f12)	0	0	1	0	0	0	-1	2	0	-2	-1	-1
Jing-lan (f15)	0	0	0	0	0	0	0	1	0	0	0	0
Kang-da (m16)	0	0	0	0	0	-1	0	0	0	0	-1	0

Note: 5 = the greatest improvement, 0 = no change, -5 = the greatest decline.

proved in speaking and listening in Year 2. Gary (m12) improved in reading and writing in L1.

The overall picture was of a dynamic trend of L1 growth termination and attrition among younger arrivals but L1 maintenance among older arrivals. Consequently, at the end of the third year, according to parental reports of absolute L1 proficiency (Table 4), a younger arrival age still predicted significantly lower L1 reading abilities  $r(8) = .86, p < .01$ , and writing abilities,  $r(8) = .81, p < .01$ .

## DISCUSSION

In this section, we summarize our findings and discuss how the dominant language switch or maintenance processes unfold in time in three related areas, language preference, use, and proficiency, and factors that influence L2 acquisition as manifested in these processes.

### *Time course of the dominant language switch or maintenance phenomenon*

*Stage of L1 dominance.* In the beginning of the study, the 10 Chinese children and adolescents all had L1 as their dominant language in terms of language preference, use, and proficiency. All participants preferred to speak and read (for those who could read) in L1, and all used predominantly L1. These tendencies were due to the fact that all participants were more proficient in L1 than in L2, with those of age 9 or younger knowing no English and the older ones knowing only a limited amount.

*Stage of emerging dominant language switch or maintenance.* The first 2 years of the study saw an emerging pattern of dominant language switch among younger arrivals and maintenance among older arrivals in language preference, use and proficiency.

By the end of the 1st year of US residence, younger arrivals had dramatically switched their language preferences from L1 to L2 whereas the older ones continued to prefer L1. Consistently, younger arrivals used significantly more L2 than the older ones did, as indicated by significant negative correlations between L2 environment indices and arrival age.

These language preference and use patterns were associated with L1 and L2 proficiency changes. While switching their language preference from L1 to L2, younger arrivals improved only slightly or not at all in L1 speaking and had systematic losses in their limited reading and writing abilities. In contrast, older arrivals generally maintained native level L1 proficiency. As for L2 proficiency, performance on the English grammaticality judgment and translation tasks indicated no proficiency differences between younger and older arrivals at the end of the first 2 years. However, as the younger ones started L2 immersion with lower L2 proficiency than the older ones, the findings suggest that the younger ones did catch up with the older ones in 12 months and the two groups maintained similar levels of L2 proficiency through the end of the second year.

Although these L1 proficiency changes need to be confirmed by future studies using more objective measures, the L2 proficiency changes are consistent with findings from previous research. Slavoff and Johnson (1995) found no age differences in the performance on an English grammaticality judgment task given to 107 Japanese-, Korean-, and Vietnamese-speaking children aged 7 to 12 years less than 3 years after the US arrival. In a study of 42 English speakers learning Dutch (L2) in the Netherlands, Snow and Hoefnagel-Höhle (1977, 1978) found that the older learners (age of immersion = adult and 12–15 years) initially had higher grammatical proficiency than younger learners (age of immersion = 8–10 years, 6–7 years, and 3–5 years), but that the advantage disappeared after 4–5 months.

*Stage of dominant language switch or maintenance.* The dominant language switch or maintenance processes exhibited a clearer pattern during the third year of the study. Continuing the trends of the first 2 years, the younger arrivals maintained their L2 preference and the older ones, their L1 preference. Consistently, the younger ones continued to use L2 significantly more than the older ones throughout the third year. The age-linked language preference is consistent with results from a recently completed long-term attainment study with 147 native Spanish speakers who immigrated to the United States: younger arrivals generally preferred speaking English whereas older arrivals preferred Spanish (Jia, Pantin, Alvarez, & Williams, 2002).

The L1 proficiency of younger arrivals continued to decrease, with reading and writing skills generally dropping to zero. Meanwhile, older arrivals continued to maintain near native-like L1 proficiency throughout the third year of the study. Regarding L2 proficiency, all participants improved during the third year, at the end of which the younger ones outscored the older ones on both the grammaticality judgment and translation tasks. Further, the same participants' production accuracy for two morphological structures (plurals and past/present progressive form) during two picture description tasks and a free speech task yielded similar results (Jia, 2002).

The above L1 and L2 proficiency changes are consistent with the arrival age-related L1–L2 proficiency crossover obtained from long-term attainment studies (e.g., Jia & Aaronson, 1999; Jia et al., 2002; Yeni-Komshian et al., 2000). Namely, after having lived in the L2-speaking country for at least 5 years, immigrants with older arrival ages have higher proficiency levels in L1 than in L2 whereas those with younger arrival ages show the opposite proficiency pattern. Whereas long-term attainment studies capture language proficiency patterns at one time point, the present longitudinal design permits us to see the dominant language switch and maintenance processes unfolding over time. The rapid L1 loss and halting of L1 development among younger immigrants have also been documented by a rich set of survey studies (see Krashen, 1996, for a review) and qualitative case studies (Kouritzin, 1999; Wong-Fillmore, 1991).

Taken together, dominant language switch or maintenance in the areas of language preference and use occurred earlier than in the area of language proficiency. During the first 2 years of US residency, although the younger and older participants were equally competent in detecting English grammatical mistakes

and producing grammatical sentences, the younger ones preferred to use L2 and subsequently used it more whereas the older ones preferred to use L1 and used it more. Other investigators have also noted this discrepancy between language proficiency and willingness to communicate in L2 among adult L2 learners (MacIntyre, Clement, Dornyei, & Noels, 1998). The stronger willingness to use L2 and the subsequent greater L2 use by younger rather than older L2 learners may partially explain the proficiency transition from the initial advantage of older learners (e.g., Snow & Hoefnagel-Höhle, 1977, 1978), to no age differences (e.g., Slavoff & Johnson, 1995) and then to the long-term advantage of younger learners (e.g., Flege et al., 1999). Across time, L1 and L2 environmental differences may accumulate and lead to language proficiency differences.

In the following section, we draw upon findings of the current study and others in the literature to show how cognitive, social, and cultural factors interactively shape immigrants' language preference and environments, as well as how language environments in turn influence learners' proficiency in both L1 and L2.

#### *Factors contributing to the dominant language switch or maintenance*

*Cognitive factors: Developing L1 proficiency.* As a function of age and previous education, younger arrivals on average start L2 immersion with lower levels of L1 proficiency than the older ones. A large body of research literature has documented continuing L1 development throughout childhood and adolescence (e.g., Braine et al., 1993; Gaddes & Crockett, 1975; Heath, 1999; Scott, 1984). This is also indicated by performance on a Chinese grammaticality judgment task by monolingual Chinese children and adolescents (Jia et al., 2002), as well as parental ratings of their children's absolute L1 proficiency at the beginning of L2 immersion in the current study. The current study provides clear evidence that L1 proficiency influences L2 acquisition in general through the influence of language environment. Different L1 abilities affect learners' *attitudes* and *motivations* toward learning L2 and expose them to different language learning environments. Older participants with higher L1 abilities at the time of arrival found it more comfortable to continue using L1, and younger arrivals with lower L1 abilities had less motivation to do so.

In addition, there is some preliminary evidence that L1 proficiency impacts L2 lexical acquisition. A series of studies has shown that for beginning adult L2 learners, words in L2 indirectly access concepts via words in L1, but advanced L2 learners have direct access to concepts for words in both languages (e.g., Kroll & Stewart, 1994; Sholl, Sankaranarayanan, & Kroll, 1995). These skill-related differences in L2 lexical acquisition are analogous to age-related differences found in the current study. Younger children had acquired fewer L1 words upon their arrival in the United States, and then learned new words for new concepts. For example, when starting to play piano after her US arrival, Anna (f5) learned to say "hit the key" in English. Both *hit* and *key* were the first lexical labels she learned for the related concepts because she had never learned the Chinese (L1) equivalents *tan2* for *hit* and *qin2-jian4* for *key*. There-

fore, she learned *hit* and *key* by directly mapping L2 words to concepts. Although *hit* and *key* were L2 words for Anna (f5), they were learned through processes similar to those for L1 acquisition (direct mapping between words and concepts), which allow younger learners to acquire L2 lexical items efficiently. This suggests that younger children's greater proficiency in L2 may be partially a consequence of a normal learning experience that is available only to them due to their less developed L1 proficiency.

*Social factors: Peer preferences, social abilities, and cultural preferences.* Age differences in peer preferences have been extensively documented in nonimmigrant populations (e.g., Damon, 1977; Selman, 1980). Younger children develop friendships based on concrete activities and thus choose playmates who are close by. In contrast, older children view friendship in terms of intangible factors such as similar interests and cultural identities, as well as mutual consideration and understanding. Therefore, they choose friends based on similarities in race, ethnicity, gender, and social class (Hartup, 1996; Kupersmidt, De Rosier, & Patterson, 1995). Consistent with these findings, in the current study, younger children had friends with diverse ethnic backgrounds and spoke English with each other, whereas older arrivals primarily made friends with those of the same cultural background and spoke Chinese with one another.

A commitment to different peer groups leads to different types of peer pressure and motivation, which shape language use. As reviewed in Hoff-Ginsberg (1997), different adolescent social cliques, such as Jocks and Burnouts, pronounced some vowel sounds differently from standard English. Black adolescents of Caribbean descent living in London switched to a Jamaican Creole speech in their teenage years as a consequence of the awareness of their cultural identity (Hewitt, 1987). In the L2 literature, motivation to communicate with other L2 speakers has been found to be an important causal factor of willingness to use L2 (see MacIntyre et al., 1998, for a review). In the current study, younger participants felt socially obligated to speak only English at school whereas older participants felt free to use Chinese with peers.

Although little psychological research has focused on age differences in the speed and degree of acculturation by immigrants, a large-scale anthropological study has dealt with this topic. Minoura (1992) studied a group of 73 Japanese children who immigrated to the United States at different ages. A younger arrival age was associated with faster and more thorough acculturation, and the years between ages 9 to 14 seemed to be a sensitive period for the incorporation of the meaning system of the host culture. Consistent with these findings, younger participants in the current study showed a preference for American culture and the older ones for their native culture. Further, these different cultural preferences were associated with corresponding trends of L1 or L2 use in various situations.

#### *Language environment influences language proficiency*

We propose that, in the current study, the quantitative and qualitative differences in L1 and L2 environments between the younger and older participants influenced their language proficiency. This proposal is consistent with a substantial

amount of research literature that has documented the facilitating role of language environment in language acquisition (see Krashen, 1994, for a review).

*Reading environment.* Research on both L1 and L2 acquisition has shown that increased reading leads to higher reading proficiency and general language proficiency (see Krashen, 1993, for a review). In the L1 literature, increased reading has been found to be an independent contributor to the development of verbal abilities (e.g., Cunningham & Stanovich, 1991), including the acquisition of a receptive vocabulary (Leseman & de Jong, 1998) and productive vocabulary (McKeown & Curtis, 1987). Similar gains have also been shown for L2 acquisition in bilingual reading research (Elley, 1991; Elley & Mangubhai, 1983). In the current study, the relative percentages of L1/L2 reading differed between the younger and older arrivals, as did the absolute amounts of L1/L2 reading. In addition to the differences in absolute reading quantity, younger children read almost entirely in L2 whereas older arrivals were able to switch between L1 and L2. This difference may have more strongly motivated younger children to achieve a comfortable level of L2 reading fluency. Further, older arrivals read L2 primarily for academic purposes (often involving substantial memorization) and younger arrivals read L2 broadly for more diverse purposes. Thus, the younger children may have developed a wider variety of effective reading strategies (e.g., skimming, searching, and reading for gist in addition to reading for complete retention) that led to greater L2 reading proficiency.

*Speaking and listening environment.* Many studies have demonstrated that natural conversations in L2 can facilitate L2 acquisition (e.g., Chesterfield, Hayes-Latimer, Chesterfield, & Chavez, 1983; D. Johnson, 1983). In our study the relative percentages of L1/L2 speaking and listening differed between the younger and older arrivals, and the absolute amounts of L1/L2 use differed as well. Although younger and older arrivals had almost the same total number of friends in each year, younger arrivals gained increasingly more predominantly L2-speaking friends from year to year whereas older arrivals consistently had low numbers of predominantly L1-speaking friends. Thus, the differences between age groups in the sheer number of hours of practice devoted to speaking and listening to L2 or L1 with friends were likely to be considerable. Further, in comparison to older arrivals, the younger ones not only spoke and listened to L2 more, but also had a greater ratio of L2 speech output to input. Although older arrivals received substantial L2 input during school instruction, they produced L2 output in only limited situations. The demand for L2 speech output during conversations increases attention to syntactic structures (Donato, 1994; Swain, 1995) and the ways in which meanings are expressed (e.g., Pica, Holliday, Lewis, & Morgenthaler, 1989). This subsequently helps learners to modify their own speech to achieve their communication goals (Swain, 1985).

Although younger arrivals did not watch more hours of L2 TV after the second year, they experienced a more effective L2 TV speech environment than the older ones because of the qualitatively different program materials. The cartoons and commercials watched by younger children contain linguistic redundancy and repetition of specific linguistic structures in a colloquial style with

simple syntax (Sharma, 1995). From watching TV, monolingual children learn object names and relationships, attributes, action words, and body parts. Verbal routines seen on TV are later used in children's play activities (Rice & Woodsmall, 1988). These results may well generalize to bilingual children. In contrast, TV programs watched by older arrivals were mainly sports programs and action dramas that contained more complex linguistic structures spoken at a faster rate. Interviews with the older arrivals showed that they largely processed the program information through their knowledge of sports and the routine plots, resulting in less L2 learning from watching TV.

Taken together, L2 acquisition during the first 3 years of L2 immersion by these 10 children and adolescents of different ages was shaped by the dynamic interactions of multiple factors involved in language acquisition. Cognitive, social, and cultural variables interacted with each other and shaped the immigrant children's and adolescents' language preferences, and hence language environments. These environmental differences in turn, at least partially, contributed to differential language proficiency changes among immigrants, thus leading to the dominant language switch among younger arrivals and maintenance among older arrivals.

These results justify a more cautious view of interpreting findings from long-term attainment studies. First, the finding of long-term L2 attainment decline seems to begin after a substantial delay following the initial L2 immersion. If we attribute the long-term L2 attainment decline to genetically preprogrammed and domain-specific neurobiological maturation of the language learning mechanism, then we need to explain why it takes some time for the neurobiological advantage of younger learners to show its effects even though the language environment works to the advantage of the younger learners. Second, in long-term attainment studies, language environment is often assumed to be indexed by length of residence in the L2-speaking country. As seen from the current study, the exact same length of time living in the United States involves L2 use in varying amounts and intensities for L2 learners of different ages. Therefore, length of residence is not an accurate indicator of language environment, and the repeated null finding that length of residence was not related to long-term L2 attainment studies (e.g., Johnson & Newport, 1989) does not negate the influence of language environment on L2 acquisition. Third, arrival age is a confounded indicator of neurobiological maturation because it covaries with environmental factors. Therefore, the negative correlation between arrival age and long-term L2 attainment is not necessarily evidence for a genetically preprogrammed and domain-specific critical period for L2 acquisition.

The current study provides a limited but fruitful start at describing and understanding mechanisms, other than neurobiological ones that underlie L2 acquisition in the immigration setting. Future research along this line should expand on the current study in the following ways. First, with sufficient research resources, the sample size of future longitudinal studies may be increased to obtain greater statistical power. Second, whereas we used objective measures of L2 grammatical proficiency but subjective measures of L1 proficiency, future studies can use more comparable L1 and L2 tasks that index more linguistic attributes such as phonology and vocabulary. Third, whereas the current study

was conducted primarily at participants' homes, future research might also involve direct school observations and interviews with teachers to capture a more comprehensive profile of an immigrant child's language learning context. Although longitudinal research along this line is time-consuming and minimizing participant attrition over a long period of time is difficult, it provides an invaluable tool for understanding the mechanisms underlying L2 acquisition.

#### APPENDIX A SENTENCES FOR THE GRAMMATICALITY JUDGMENT TASK

- \*1. I have many book. (plural)
- \*2. I watching TV when my mother came back. (past progressive form)
- \*3. I talk to my grandma last week. (past tense)
- \*4. I have toy like this one. (article)
- \*5. My mother work late everyday. (third person singular present)
- \*6. He is goes to school every day. (predicate structure)
- \*7. What we are going to eat today? (*wh*- question)
- \*8. I played with they. (pronominalization)
- \*9. I with my mom went to school today. (word order)
10. I want to paint a big house. (filler)
- \*11. Everybody has two hand. (plural)
- \*12. Look, he is talk to his teacher. (present progressive form)
- \*13. I learn a song yesterday. (past tense)
- \*14. Do you need pencil? (article)
- \*15. Jimmy like China. (third person singular present)
- \*16. Where my shoes are? (*wh*- question)
- \*17. She mother is a teacher. (pronominalization)
18. My mom tells me a story every night. (filler)
- \*19. I have some friend. (plural)
- \*20. Look, the cat sleeping! (present progressive form)
- \*21. The policeman catch the robber yesterday. (past tense)
- \*22. Chicken can never fly. (article)
- \*23. My dog eat dog food. (third person singular present)
- \*24. This bird is sing every morning. (predicate structure)
- \*25. When you will take me out? (*wh*- question)
- \*26. This book is my. (pronominalization)
- \*27. Daddy yesterday took me to the park. (word order)
28. I'm not going to school tomorrow. (filler)
- \*29. I went to hospital last night. (article)
- \*30. How long you will stay? (*wh*- question)
31. I like ice cream a lot. (filler)
- \*32. Mom, when you come home? (*wh*- question)
- \*33. The boy goes to school by herself. (pronominalization)
34. I like watching cartoons a lot. (filler)
- \*35. She is teacher I saw yesterday. (article)
- \*36. Which color you like? (*wh*- question)

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