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Trajectories of English Language Acquisition Among Foreign-born Children in Spanish-Language Households in the United States

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Abstract

The rapidity and extent to which immigrant non-English language children in the United States learn English has important short-term and long-term consequences for their immediate situation and for their future. In this paper I model trajectories of English language acquisition among foreign-born children living in Spanish-language households. The results show, as expected, that English acquisition increases with length of residence in the United States with the increases being largest during the first handful or so of years after arrival in the country. However, the results also show a clear trend by age at entry. The older children are when they enter the U.S., the less rapid their early progress in acquiring proficiency in English.

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Because of high rates of immigration from non-English language countries, the proportion of children in the United States living in minority language households is increasing rapidly. By 2000, about 14% of U.S. children lived in minority-language households and at least two-fifths of them have limited skills in English (Hakuta & Beatty 2003). The children living in minority-language households often encounter severe difficulties in the U.S. schooling system that stem from or are exacerbated by low levels of English proficiency. Minority-language children earn lower grades (Thompson et al. 2002) and are at higher risk of dropping out of school entirely (e.g., Rumberger & Larson 1998, White & Kaufman 1997). Those who do not become proficient in English during childhood face later difficulties in the labor force (e.g., Dávila & Mora 2001) and in gaining access to major societal institutions such as the healthcare system and the judicial system.

One of the most striking facts about second-language learning among children is the variability in outcomes: some children from minority-language backgrounds become proficient English language speakers while retaining proficiency in their home language, some become proficient English speakers, others have continuing difficulty in English, and a few are not proficient in any language (but see Mahoney & MacSwan 2004). The research presented here focuses on a potential source of the variation in the acquisition of English by minority-language background children: age at onset of English acquisition (as measured through age at immigration.) The focus on age at onset among children is

prompted by the continuing discussion in linguistic and psycholinguistic literature about the possibility of critical or sensitive periods in second language learning and more generally, by the variation in the effects of age at onset on second language learning.

This paper therefore describes trajectories of English acquisition during childhood according to the age at which immigrant children begin learning English. The results, based on 2000 U.S. census data, show clearly that the trajectories of English acquisition vary by age at onset of second language learning, here measured through age at immigration. In general, immigrant children become more proficient in English the longer they have been in the United States and they show the most rapid progress during the first handful or so of years after arrival, no matter what their age at arrival. However, the older the child at time of arrival, the lower the rate of improvement during the remainder of their childhood, here defined as age 18. The results have implications for design of programs targeted at minority language background children.

Age at Onset of Second Language Learning

One of the major issues in second language acquisition research concerns the possible effects of age at onset of second language learning. The interest in "age at onset," which is often measured through age at immigration among foreign-born second language learners, derives from the possibility of a critical or sensitive period in language acquisition. The basic hypothesis is that second language learners who start later in life are unable or are more limited in their ability to achieve "native-like" proficiency in the second language even after long periods of exposure in a naturalistic setting (Long 1990). Posited reasons for the disadvantage accruing to later learners include biological processes related to maturation in the brain (Pulvermuller & Schumann 1994), changes in

cognitive abilities (Newport 1990), different learning strategies (implicit versus explicit learning) used by children versus adults (DeKeyser 2000), or interference from the first learned language. The critical-period hypothesis is usually taken to bear on ultimate attainment in the second language proficiency and not on differences between child- and adult-learners in the *rate* of acquisition. In fact, studies sometimes show that the rate of acquisition is, at least initially, higher among older than among younger learners (Garcia-Lecumberri & Gallardo 2003, Krashen et al. 1979).

Because of the emphasis in this research on ultimate attainment, most studies evaluate some aspect of second language proficiency (e.g., syntax, phonology) among adults and then correlate the results with the putative age at onset of learning. Age at onset is often measured retrospectively, through age at immigration, which most scholars consider to be a valid measure of age at onset among immigrants (e.g., Birdsong 1992, Johnson and Newport 1989, Patkowski 1980). For example, in a classic study, Johnson and Newport (1989) asked a sample of foreign-born Chinese and Korean adults affiliated with the University of Illinois to judge the grammaticality of 276 sentences of which about half were ungrammatical. The results showed a clear relationship between the immigrants' age at arrival and their command of English syntax and morphology, even after the amount and timing of formal instruction in English were taken into account. Their results are redrawn in Figure 1.

Figure 1 shows a steady decline in level of English proficiency according to the subjects' age at immigration with wide variance among those immigrating after age 15 or so. Numerous other studies, using foreign-born speakers of other minority languages, other dimensions of language proficiency, or other means of testing, have replicated the

general pattern, i.e., a downward trend in a particular aspect of ultimate attainment in second language proficiency in adulthood that corresponds to age at onset of language learning (e.g., Birdsong & Molis 2001, DeKeyser 2000, Flege et al. 2003, Johnson & Newport 1989, Mayberry & Lock 2003, McDonald 2000) although details about the strength of the negative correlation, the timing of the decline, etc. vary. Social scientists using survey data have also demonstrated a downward trend in immigrants' levels of English proficiency that corresponds to age at immigration net of other factors, such as educational attainment and length of residence (Stevens 1999).

Johnson and Newport's (1989) study (and others of its kind) have been criticized on numerous grounds such as the details of the sample selection, the measure of second language proficiency, and the interpretation of the results (Bialystok & Hakuta 1994, Hyltenstam & Abrahamsson 2004). Kenji Hakuta and his colleagues (Hakuta et al. 2003), in particular, have argued that the results of these studies do not support the notion of a critical or sensitive period because there is no obvious discontinuity in the downward slope between age at immigration and the measure of proficiency in adulthood (but see Stevens 2004). Still, the body of evidence points to the conclusion that age at onset of second language acquisition is negatively associated with ultimate attainment in second language proficiency when assessed later in life, whether or not there exists an abruptly defined critical or sensitive period.

Age at Onset and Second Language Acquisition among Children

Almost all of the research investigating the possibility of a critical period (or sensitive period or maturational constraints) focuses on ultimate attainment in the second language (Birdsong 2004). This research is therefore generally restricted to immigrant

adults who have had an appropriate amount of time to learn the language (generally set to five or ten years) and the main issue lies in the contrast in ultimate attainment between those who began learning as children and those who began later in life. No (or very little) attention is paid to how quickly various respondents have learned the language, or how long they took to reach the current stage of language acquisition, or to variation in the pace of second language learning during childhood.

Linguists' research focusing on age-at-onset issues among children is much rarer than research on adults for several reasons. First, the presumption is that most children learning a second language are learning the language before the close of a sensitive period, if in fact, it exists. In addition, much of the research on children is driven by the pragmatic need to focus on the identification of children demonstrating low levels of second language fluency (Mahoney & MacSwan 2004), and the means through which they could best learn the second language. The designs of most studies investigating second language acquisition among children thus forestall an emphasis on contrasts between age-at-onset cohorts. The studies most relevant to the concerns here focus on a limited number of age-at-onset cohorts (e.g., Garcia-Lecumberri & Gallardo 2003) or one age (or school grade) cohort and so contrasts across age-at-onset cohorts remain very limited (e.g., Thompson et al. 2002).

Sociologists' studies of language acquisition among immigrant children are also limited in their ability to compare and contrast across age-at-onset cohorts. The Children of Immigrants Longitudinal Survey (CILS), for example, follows a sample of children aged approximately 14 at the time of the first wave of the survey. This study showed, in particular, strong and clear increases over the three or four years between the first and

second time points in the children's preferences for, and levels of proficiency in, English vis-à-vis their language. The longitudinal analyses thus strongly affirm the general tendency of children to become more proficient in the second language as length of residence increases but the study design forestalled direct comparison of how improvements in English proficiency during childhood vary by age-at-immigration cohorts.

While it is apparent that immigrant children, on average, become more proficient in English the longer they have lived in the United States, it is still unclear how age at onset, if occurring in childhood, is related to trajectories of second language acquisition *during* childhood. The critical period hypothesis implies that trajectories of second language acquisition should differ in childhood (and perhaps into adulthood) across age-at-onset cohorts in some patterned way. There are several different possibilities. The trajectories for age-at-onset cohorts could shift, presumably downward, at a specific age, say age 13, with the younger age-at-onset cohorts showing the same trajectories if the age at onset is before the putative "critical age" and the older age-at-onset cohorts showing slower or truncated trajectories. Or the upper asymptotes in the trajectories of second language learning could drift downward across age-at-onset cohorts.

Data and Analytic Strategy

Because modeling trajectories in childhood requires a large number of observations for different age-at-onset cohorts over time, this study relies on data from the 2000 U.S. census. The long form of the U.S. census, sent to about one in six households, included three questions on language usage and proficiency. The first question, asked of all household members aged 5 and over, inquired whether the household member spoke a

non-English language at home. If the answer was yes, the next question asked what that non-English language was, and the third question asked about the person's level of proficiency in speaking English. Information on a household member's proficiency in English was therefore not gathered if the person spoke only English. The possible responses to the question on proficiency in English were: "not at all," "not well," "well," and "very well." The long form of the 2000 census also allowed, for the first time, year-specific responses to the question on year of arrival to the United States.

The analysis sample consists of 7, 312 foreign-born children aged 5 to 18 inclusive, living in a household with two foreign-born parents in which Spanish was spoken, although not necessarily by the child. To ensure that all observations were independent, only one child was selected from each household. Age at arrival in the United States and length of residence in the United States were calculated from the child's birth date and year of arrival. Children who were reported as speaking only English (and thus were not asked to describe their level of proficiency in English) were considered to speak English "very well." (Excluding these children from the analysis sample would have effectively truncated the sample on the dependent variable.)

The census question on levels of English proficiency yields information on the proportions of children speaking each of the four different levels ("very well," "well," etc.) with children who speak "only English" being coded with those who speak English "very well." The analysis relies on two measures. The results presented in this paper use the proportion of children speaking English "very well" or "only English" as the main measure of the children's proficiency in English to take advantage of the fact that the response of "very well" at the top of the scale is the most reliably reported (Kominski

1989). (However, analyses based on using the average level of proficiency in English with "very well" being coded as '4' and the lowest level, "not at all," being coded as '1,' were very similar to those reported here.)

Because the data are cross-sectional rather than longitudinal, it was necessary to construct synthetic age-at-arrival cohorts. This strategy assumes that annual increases in levels of proficiency between the year of arrival and the year 2000, although allowed to vary across age-at-immigration cohorts, are stable across time. Thus, for example, the difference between levels of English proficiency among 6 year olds in 2000 who have lived in the U.S. for one year and 7 year olds in 2000 who have lived in the U.S. for two years is assumed to equal the difference in levels of English proficiency among 6 year olds in 1999 who have lived in the U.S. for one year and 7 year olds in 2000 who have lived in the U.S. for two years. One way to assess the validity of this assumption is to check for decreases in levels of proficiency across age within each synthetic age-of-immigration cohort. Of the 174 data points, each based on about 30 children in the array of age-at-immigration by length of residence, there was only 12 instances in which average levels of English proficiency significantly decreased between ages 'x' and age 'x+1'.

Curves were then fitted for all age-at-immigration cohorts and then for each age-at-immigration cohort with the dependent variable, the percentage of children speaking English "very well" or speaking only English being considered as a function of the number of years the children had lived in the United States as of 2000. For each age-at-entry cohort, English proficiency was best predicted by the natural logarithmic curve although the parameters of the curve varied by cohort.

Results

Figure 2 displays hypothetical curves showing increases in average levels of English proficiency for each age-at-onset cohort on the assumption that there are no differences in trajectories of English acquisition according to age at onset (as measured through age at arrival). The parameters (intercept, slope) of the curves are identical because they were derived from fitting the equation to all of the age-at-immigration cohorts. The first data point for each curve shows the age at which the cohort entered the United States. (The curves are extrapolated for the data points below age 5.) For each age-at-onset cohort, levels of English proficiency increase as the children live longer (and grow older) in the country. While children aged 10, for example, have different levels of English proficiency according to the age at which they entered the country, the differences are entirely attributable to the fact that the children within each age cohort who entered early in life, say at age 5, have had more time (five years) to learn English than those who entered later, say at age 7.

Figure 3 shows the trajectories produced when the curve-fitting is done separately for each age-at-immigration cohort. Each of the curves starts at age 5 or later because the first data point on each curve refers either to the first age for which the census gathered information, i.e., either age 5 or the age at entry for each cohort. The curves for the youngest arriving cohorts (those arriving before age 5) converge quite rapidly and lie almost on top of one another by the time the cohort has matured into middle adolescence, about age 15. Those curves representing children arriving in middle childhood, from age 6 to 9, also rise quite rapidly. But the curves begin to droop among those arriving around

age 10 and it is especially noticeable for those arriving after age 12. The curves for the latest age-at-immigration cohorts are almost flat.

Figure 4 shows a more formal representation of the variation in trajectories in English acquisition across age-at-entry cohort. It is a graph of the slopes representing the effects of length of residence on English proficiency by age at immigration. There is a clear downward trend in the slopes by age at immigration. Because the U.S. schooling system is heavily age-graded, immigrant children arriving in the United States are typically placed in an age-appropriate grade. The dotted bars on the graph show that children arriving before or during elementary school fare quite well in terms of the rates at which they become proficient in English, those arriving during middle school fare less well and those arriving in high school are the slowest to become more proficient in English.

The approach followed here, which relies on the construction of synthetic cohorts, relies on the assumption of constancy in the relationship between age at onset and English proficiency across time. This assumption is false if immigration streams involving children with Spanish-language backgrounds have shifted over the 1990s in terms of characteristics that are relevant to children's English proficiency at the time they entered the U.S. or to their second language acquisition. It is possible, for example, that a downward shift in the socioeconomic characteristics of adult immigrants over the late 1980s and 1990s, as apparently happened in the 1970s and 1980s (Carliner 2000), could be reflected in the lesser preparation of their children to learn English in the American context.

Table 1 presents the coefficients from logistic models that show the effects of length of residence, age at entry, and household income on the probability that the children speak English only or speak English "very well." The results in model 1, table 1 show that the slope for length of residence is, as shown in figures 2 and 3, strongly positive and that the slope for age at entry is negative. Model 2 includes an interaction term between age at entry and length of residence, thus allowing the slope for length of residence to vary across age-at-entry cohorts. The coefficient for the interaction term, which is negative in valence and statistically significant, shows that the rapidity with which children become fluent speakers of English slows down the older their age at entry. Figure 5, which was produced using the coefficients in model 2, shows the variation in predicted trajectories of English acquisition for age-at-entry cohorts. The curves are laid on top of one another so that it is easy to compare the rapidity with which the older entering cohorts of children become proficient in English with those entering earlier in life. The curves also suggest that the older entering children start out with slightly higher levels of English proficiency than the earlier entering children although this may a product of the extrapolation of trajectories for children who enter early in life, i.e., at ages earlier than five. (Finally, the curves for the older age-at-onset cohorts are extrapolated beyond childhood. For example, the curve for the oldest age-at-onset cohort which entered the United States at age 17, shows the predicted trajectory of English acquisition for 17 more years when the cohort would be aged 34. The extrapolation, which extends well beyond the observed age range in this analysis and is thus highly speculative, is accord with the oft-observed lower average levels of ultimate attainment in

second language proficiency observed among adult immigrants who immigrated later in childhood.)

The final model in Table 1 controls for household income. As expected, children in households with more financial resources are significantly more likely to be proficient speakers of English than other children in Spanish-language households. However, the results with respect to age at entry and length of residence remain largely unchanged.

Possible Data Problems

The analysis results thus suggest that age at entry significantly affects the rapidity with which immigrant children in Spanish-language households learn English. Those who enter later in life are doubly disadvantaged: they have less time during childhood and adolescence to become proficient in English, and during that time span, they are slower learners. Literature based on adults suggests that those beginning to learn a second language in childhood achieve higher levels of ultimate attainment in adulthood, perhaps because of maturational constraints or a critical period. The results here are in accord with the idea that the disadvantage begins quite early in childhood and cumulates throughout childhood and well into adolescence.

Perhaps, however, the sample is inadvertently biased. The pattern of results is partly the result of adolescent immigrant children who arrived a few years before the time of the census exhibiting what appears to be small improvements in English relative to more recently arriving adolescents. But other research shows that immigrant adolescent children with relatively poor skills in English are likely to drop out of school and at least some move out of their parental home. These adolescents are not included in this analysis because the criteria for inclusion included only those foreign-born children living with

their parents. It seems highly likely that the analysis, which excludes adolescents in the analysis who are not living with their parents, is excluding foreign-born adolescents who are among the least likely to be fluent in English. Moreover, when the analysis is restricted to children less than 14, the results parallel those reported here. (Results available on request).

There is also a possible problem with the main independent variables, age at entry and years lived in the United States. Both of these were calculated by relying on the responses to the census question "When did this person come to the United States to stay?" Redstone and Massey's (2004) analysis of adult respondents in the New Immigrant Survey Pilot show that the responses to this question over-estimate years lived in the United States for many respondents and under-estimate years lived in the United States for others. They also demonstrate that the errors of measurement are more frequent among those respondents who have made frequent trips to the United States.

It seems very likely that there are errors in the measurement of the year of arrival for immigrant children as well as for immigrant adults. However, the possible errors in the measurement of year of arrival are much less in amplitude among children than among adults because of the limited age range of possible arrival ages among children. In addition, because childhood is full of very salient events tied to specific ages, such as entering primary school or entering high school, large errors in assigning the age of arrival among those who came and stayed in the United States seem relatively unlikely. Still, as among adults, it may be difficult to assign a single year that children "came to stay" in the country if they have made frequent trips between their home country and the United States. However, if considering errors in the measurement of year of arrival for

each age cohort, then it is clear that that the more frequent error is likely to be one of under-estimating the length of experience in the United States because there is an automatic cap on length of residence among children, especially the younger children. The possible ages at arrival (and years of residence in the U.S.) for 7 year olds, for example, run from 0 up through 7 while the possible ages at arrival for 14 year olds run from 0 up through 14. The main risk in the analysis is thus of under-estimating how long the older children have lived in the United States. Moreover, because errors are often correlated with observed values (even if randomly distributed about the true values) on a variable, the under-estimation is likely to be more extreme for children who report short periods of residence in the United States. Yet the analysis shows that it is the most recent arrivals among the older children at the time of the census who tend to have lowest levels of English acquisition.

The opposite errors (overestimating the length of experience in the United States and thus assigning too young an age at arrival) could, of course also occur, and given the general rapidity of second language acquisition in childhood, even a 2-year error could skew results. Since length of residence is strongly associated with increases in second language proficiency, these errors would produce a pattern in which children, especially those who apparently arrived early in life, appear to be relatively slow in learning English. However, on average, the results suggest that the children who ostensibly arrive early in life rapidly increase their proficiency in English between age at arrival and the time of observation in 2000.

Finally, there may be concerns with the measurement of the dependent variable, level of proficiency in English, which is a global measure and, for most children, reported

by their parents or other adults in the household. Global measures such the one used by the census lack the nuances of more objective measures of proficiency obtained from tests or direct observation. However, research shows strong correlations between global measures such as these and objective measures of proficiency in a second language among adults (e.g., Birdsong 1992, Hakuta & D'Andrea 1992). Moreover, the pattern of errors would have to be quite complex in order to produce the strong relationships between length of residence, age at entry, and income observed in the analyses here.

Conclusions

Previous research has demonstrated that immigrant children become more fluent in a second language the longer they have lived in the destination country. Thus among single-year age or birth or grade cohorts, those who immigrated earlier in life (and have had therefore had more time), are more proficient in the language. The results presented here, which are based on foreign-born children living with two foreign-born parents in a Spanish-language households, confirm the importance of length of residence in the United States and also show that age at immigration, a measure of age at onset of second language learning, is strongly associated with the *rate* of second language acquisition. Those who enter the U.S. before the beginning of formal schooling do best for two reasons. By the time they reach high school age, they have had a relatively long time in which to learn English and during that time span, they learn English more quickly than children beginning to learn English later in childhood.

So the timing of immigration matters, not just for ultimate attainment in a second language (as has been shown by numerous studies showing the relationship between age at immigration and adults' ultimate attainment in a second language) but during the

earlier stages of second language acquisition if occurring in childhood. The question is: why? There are several possibilities. First, a sensitive (or cluster of sensitive periods) may close in early adolescence or perhaps, for some children, before adolescence or even in early childhood (Shim 1995). A more general perspective is that neurological or cognitive changes occurring in childhood are associated with how children learn a second language or how quickly they make progress in second language learning at various ages. A more nuanced version of this perspective argues that the causality is multi-dimensional and that early language learning produces neurological changes that may interfere with learning of a second language later on.

Second, a child's development of linguistic competency is a function of the languages he is encouraged to learn and of the activities and contexts in which the children interact with others (Ochs & Schieffelin 1995) and these activities and contexts vary strongly by children's age. The relationship may therefore reflect grade-specific differences within the U.S. educational system with the intermediate and higher grades being more poorly designed for teaching English language learners. It seems very plausible that the social and cultural expectations in these contexts are operating differently in ways that are less likely to foster second language learning among older immigrant children than among younger children.

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Figure 1. Test Scores Showing English Language Proficiency (ELP) among Adult Immigrants by Age at Immigration. (Redrawn from Johnson & Newport, 1989).

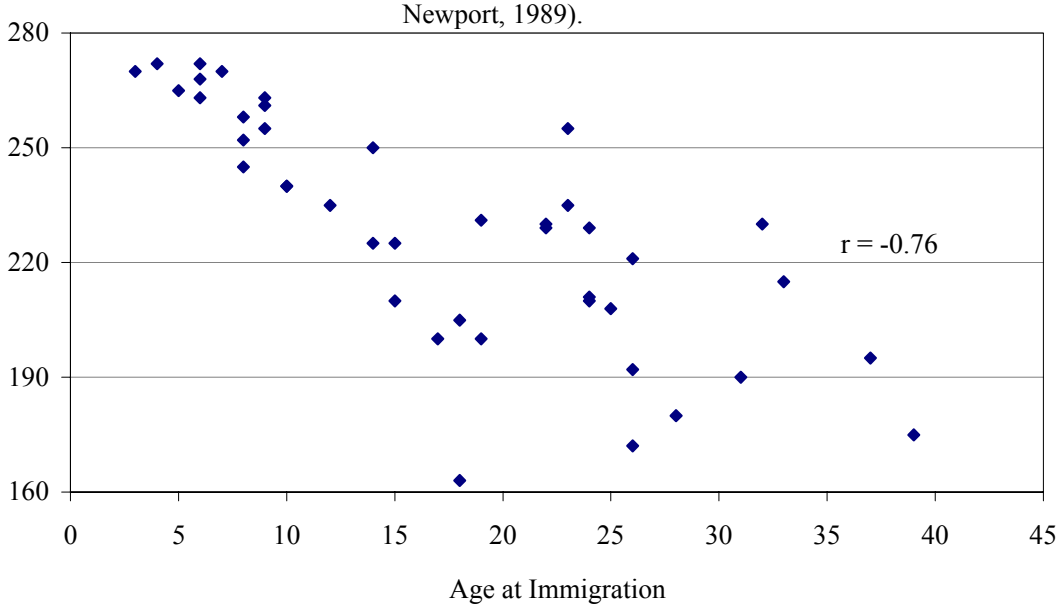

Figure 2. Hypothetical Trajectories of Levels of English Proficiency by Age for Age-at-Entry Cohorts

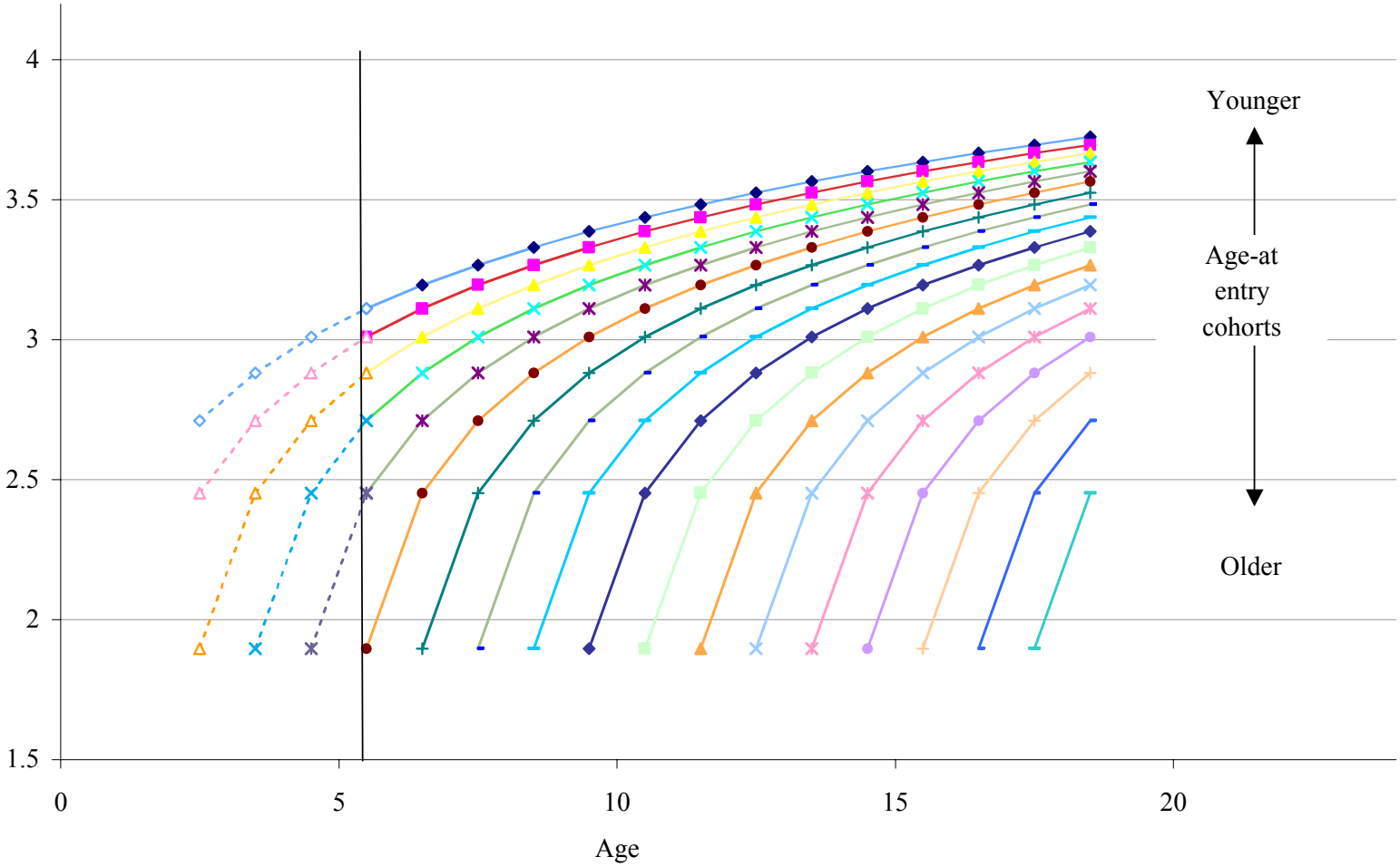

Figure 3. Trajectories in English Proficiency by Age for Age-at-Entry Cohorts:
Foreign-born Children in Spanish-Language Households

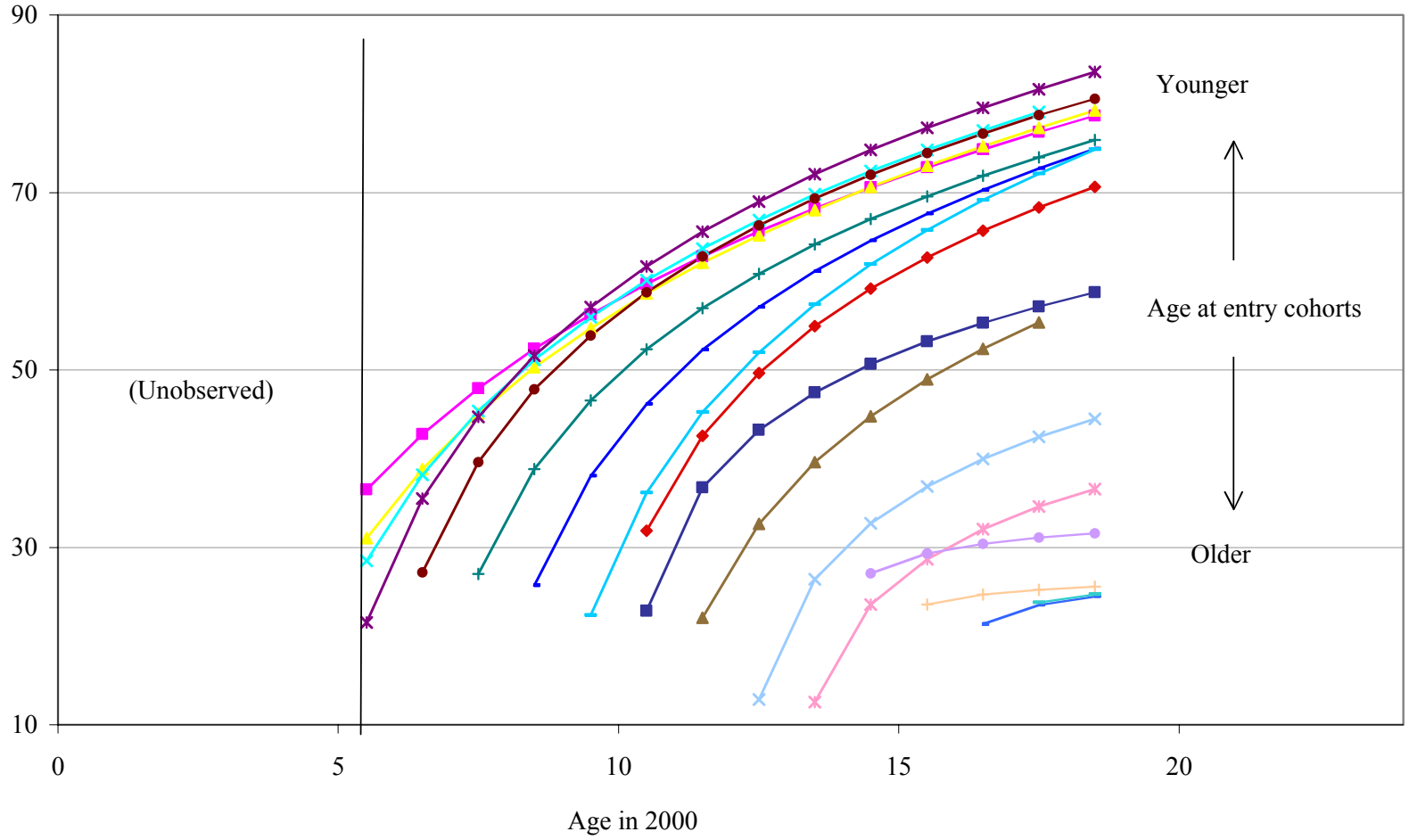

Figure 4. Slope Coefficients for Effects of (ln) Length of Residence on Percent Speaking English "Very Well" for Age-at-Entry Cohorts: Foreign-born Children in Spanish-Language Households

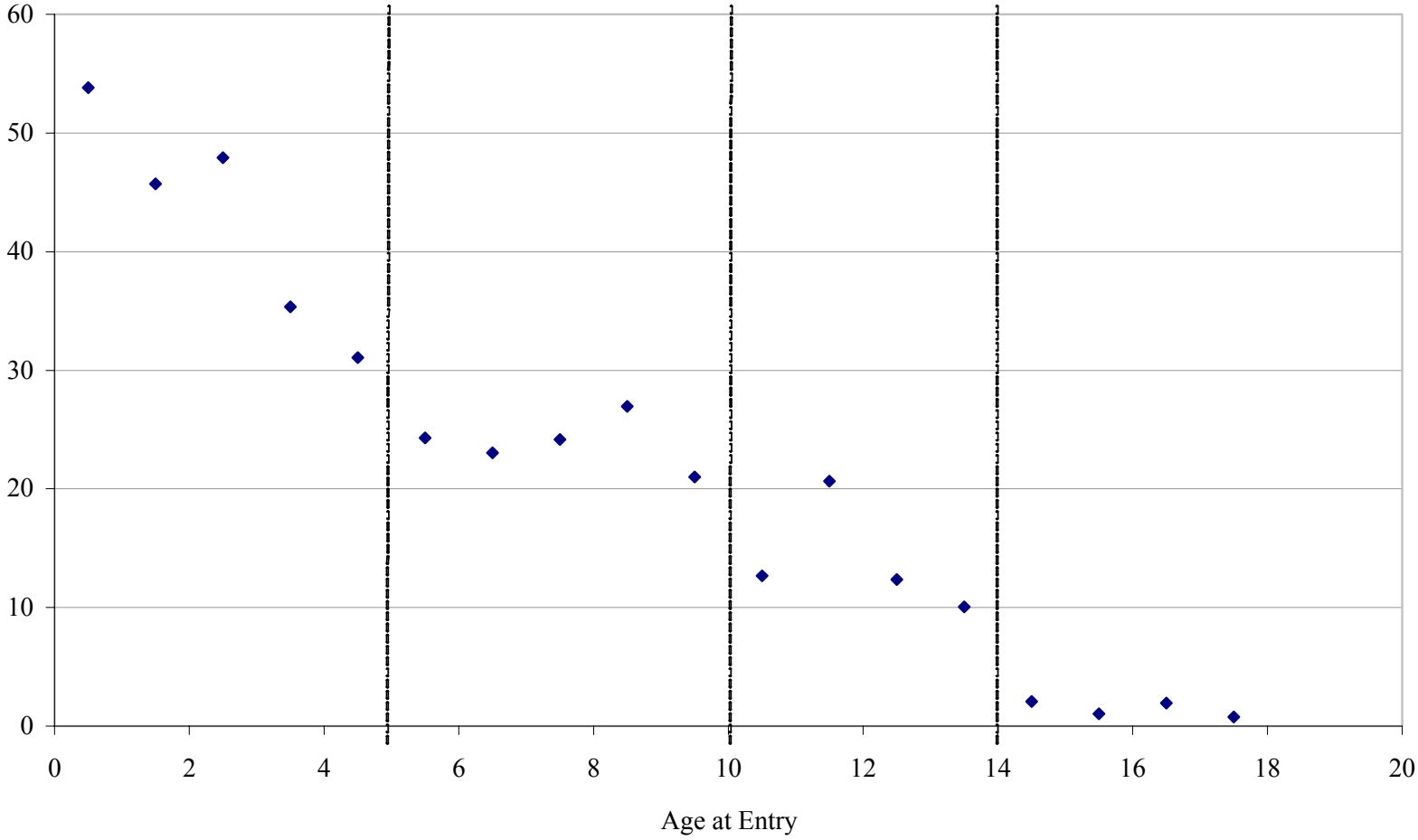

Figure 5. Relationships between Length of Residence and English Language Proficiency for Different Age-at-Immigration Cohorts

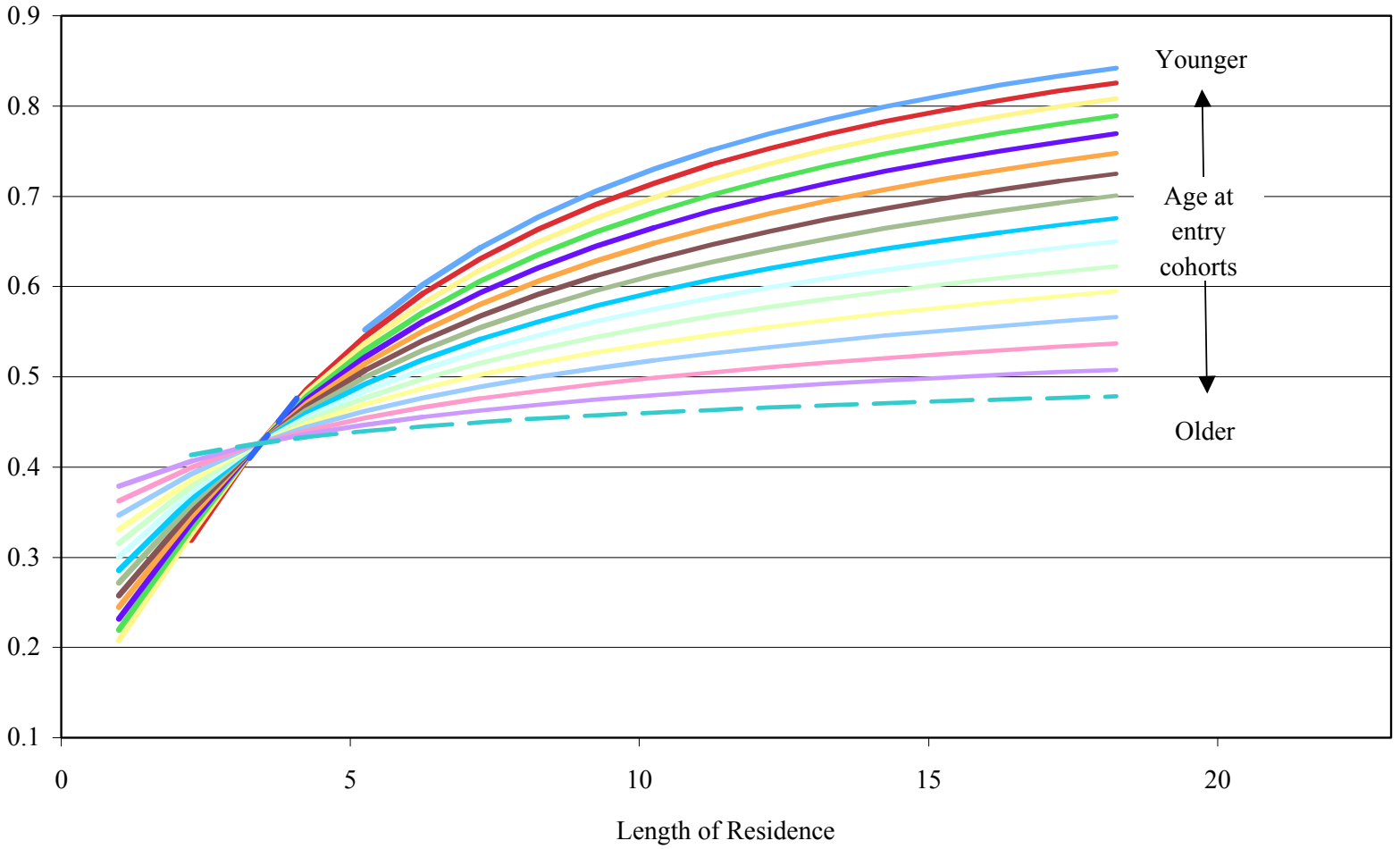

Table 1. Coefficients in Logistic Regression Models Predicting the Probability that Foreign-born Children in Spanish-Language Households Speak Only English or English "Very Well."

	Model 1	Model 2	Model 3
Constant	-.278	-1.871	-2.585
Length of Residence (LOR)	.474	1.281	1.258
Age at Entry (AE)	-.043	.086	.082
LOR*AE		-.070	-.069
Household Income (ln)			.077
-2 log likelihood	9,319	9,074	9,045

Note: All coefficients are statistically significant at the .0001 level.