Using Achievement Tests to Measure Language Assimilation and Language Bias among the Children of Immigrants

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A B S T R A C T

We measure the extent of language assimilation among children of Hispanic immigrants. Our identification strategy exploits test language randomization (English or Spanish) of Woodcock Johnson achievement tests in the New Immigrant Survey and lets us attribute test score differences solely to test language. Students scoring poorly may be tracked into nonhonors classes and less competitive postsecondary schools, with subsequent long-term implications. Foreign-born children score higher on tests in Spanish; U. S.-born children score higher in English. However, foreign-born children arriving at an early age or with several years in the United States do not benefit from testing in Spanish.

I. Introduction

Given the numerical dominance of Hispanic immigrants in the United States and that their U. S.-born children are an expanding portion of the population, understanding how well these second-generation children assimilate is important for policymakers as well as academics (Card 2005). Language assimilation is often a critical first step in this process, with negative long-term implications for

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those children who do not learn English. An estimated 8.4 percent of children in grades kindergarten through 12 are classified as Limited English Proficient and over three-fourths of these are Spanish language students (Zehler et al. 2003). Our study of the extent and rate of language assimilation among the children of Hispanic immigrants is motivated by two sources of concern about the future economic success of these children.

First, standardized testing is an integral component of academic progress and success. The overwhelming majority of limited English-proficient students are given standardized tests in English, and this makes it difficult to distinguish errors due to language proficiency from academic ability (Crawford 2004). Students who score poorly on achievement tests due to limited English proficiency may be tracked into nonhonors classes, less academically oriented schools, and less competitive postsecondary schools (Valdés and Figueroa 1994). Zehler et al. (2003) present evidence supporting this link as 76 percent of limited English-proficient third graders score "below" or "well below" grade level in English. The relationship is particularly important as Latinos are less likely to enroll in postsecondary education and are twice as likely to drop out of high school as non-Hispanic whites (Pew Hispanic Center 2002; Fry 2003). This tracking due to limited English proficiency (rather than a lack of motivation or intelligence) may have subsequent long-term implications.[1]

Second, numerous studies show that English proficiency is essential for labor market success (McManus, Gould, and Welch 1983; Kossoudji 1988; Tainer 1988; Bleakley and Chin 2004).[2] The potential for limited English proficiency among Hispanics combined with their overall lower human capital level is related to their future earnings potential and their possible need for means-tested public assistance (Blau 1984; Borjas 1985; Borjas and Trejo 1991; Trejo 1992; Borjas and Hilton 1996).[3] To the extent that immigrant children's English ability has been examined, many studies are limited to one geographic area or are qualitative, restricting their generalizability (Portes and Schauffler 1994; Rumbaut and Portes 2001; Golash-Boza 2005). An exception to this is Bleakley and Chin (2008, 2010) who find that age at arrival plays a key role in adults' and children's English skills. These points underscore the importance of understanding the extent to which the children of immigrants develop English proficiency.

In the current study, we explicitly measure the degree and speed of language assimilation among the children of Hispanic immigrants. To do this, we use the New

1. Research suggests a strong link between achievement test scores and later life outcomes (Murnane, Willet, and Levy 1995; Neal and Johnson 1996). Currie and Thomas (2001) use Britain's National Child Development Study and find achievement test scores at age seven are predictive of future labor market outcomes as well as future earnings for men and women. Duncan et al. (2007) show that early assessments of math and reading skills are the strongest predictors of later academic and occupational achievement.

2. Dustmann and van Soest (2002) also find evidence of the effect of host country language on earnings in Germany.

3. Further, there is worry that the high number of existing communities where large proportions of Hispanics already reside may facilitate the maintenance of Spanish language use to the point of English exclusion. These enclaves have become increasingly visible and are continually replenished, further heightening anxiety about the prospects for integration, both economic and social (Zhou and Logan 1989; McManus 1990; Chiswick and Miller 2005).

Immigrant Survey that includes Woodcock Johnson achievement tests that were randomly administered in either English or Spanish to these children. Our focus on children is unique as data limitations have led previous researchers to focus primarily on adult outcomes (Espinoza and Massey 1997; Dávila and Mora 2000; 2004). Our empirical identification strategy exploits this test language randomization (English or Spanish) allowing us to attribute any differences in test scores solely to test language. We demonstrate that being randomly assigned to take an achievement test in one's nondominant language results in lower test scores that are uniquely attributable to this factor, and we can quantify the child's language assimilation, which in this context is considered to be the transition to English dominance.

Our results reveal English dominance among U. S.-born children and a rapid assimilation to English among foreign-born children. Foreign-born children randomly assigned the test in English experience a test score disadvantage ranging from 0.71 to 1.50 standard deviations. However, children arriving in the United States at an early age or having spent more than three years in the United States do not benefit from taking the achievement tests in Spanish.

Standard language assimilation models argue that first-generation immigrants (foreign-born) are monolingual in their native language, second-generation immigrants (U.S.-born children of foreign-born parents) are bilingual in English and their native language, and third-generation immigrants (U.S.-born children of U. S.-born parents and foreign-born grandparents) are monolingual in English (Fishman 1972 for seminal work and Stevens 1992 and Alba et al. 2002 for empirical tests of the model). However, we find English dominance among the U. S.-born children of Hispanics rather than equal ability across both languages. Further, Lazear (1999) shows that incentives to learn a majority language depend on immigrant's ethnic and linguistic surroundings. As foreign-born Hispanics tend to live in ethnic enclaves (Iceland and Scopilliti 2008), their incentives to learn English may be weak. While this may be true for their parents, we find second-generation children of Hispanic immigrants are English-dominant, with results showing a one standard deviation disadvantage for U. S.-born immigrant children given tests in Spanish instead of English. This result could be due to different incentives faced by children of immigrants, many of whom are immersed in English at school, are likely more receptive to United States mass media, show general preferences for English, and tend to associate English proficiency with status (Portes and Schauffler 1994). Our approach improves on earlier studies as we use a continuous and more objective measure of language ability instead of commonly used self-reports and we are able to compare test scores in English and Spanish. Although our conclusions deviate from the studies by Alba et al. and Lazear, they are consistent with other studies indicating English proficiency and scores on tests administered in English increase with time in the United States and with generational status (Portes and Schauffler 1994; Glick and White 2003; Akresh 2006; Cortes 2006).

The remainder of the paper is organized as follows. Section II describes the New Immigrant Survey data and Woodcock Johnson achievement tests. Section III describes the empirical identification strategy and presents results and robustness tests. Section IV concludes.

II. Data and Empirical Setting

A. New Immigrant Survey Data

The data used in this study come from the New Immigrant Survey (NIS) 2003 cohort. The survey was originally pilot tested with a 1996 sample cohort of immigrants (refer to http://nis.princeton.edu for additional information). The sampling frame for the 2003 data was immigrants aged 18 and older who were granted legal permanent residency between May and November 2003, and the response rate was 69 percent (Jasso et al. In Press).[4] Interviews were conducted in the language of the respondent's choice as soon as possible after legal permanent residency was granted and individuals who were new arrivals to the United States, as well as those who had adjusted their visa status, were included in the sample (Jasso et al. In Press).[5]

Woodcock Johnson III tests were administered to all coresident biological, stepchildren, and adopted children of the sampled adult immigrants.[6] In order to assess any test score language bias due to limited English proficiency, children whose sampled immigrant parent was born in a Spanish-speaking country and whose first language was Spanish were randomly administered the test in English or Spanish. Of the 1,029 experiment eligible children who completed the tests, 924 are available for the majority of the analysis. One hundred and five observations cannot be used due to missing information on the country of birth, a key variable in the analysis.[7] Of the 924 children, 472 completed the tests in English and 452 completed the tests in Spanish. Forty-seven percent of the parents of the 924 children are from Mexico, 24 percent from El Salvador, 9 percent from Guatemala, and no other origin country accounts for more than 5 percent.

B. Woodcock Johnson III Tests

Four achievement tests were administered to age eligible children. The Passage Comprehension and Calculation tests were administered to children aged 6–12 inclusive (leaving 689 children available for these analyses). The Applied Problems and Letter Word Identification tests were administered to children aged 3–12 inclusive (using all 924 children). The Passage Comprehension and Calculation tests are designed to evaluate reading comprehension and vocabulary and mathematical and quantitative ability, respectively. The Applied Problems test measures aptitude in practical prob-

4. Illegal immigrants and others without legal permanent residency status were not included in the sampling frame.

5. There is substantial variation in the duration of U. S. experience since 85.5 percent of the analytic sample adjusted their status to legal permanent residence while already in the United States and 14.5 percent were granted legal permanent residency as new arrivals.

6. Biological children represent 97.3 percent of the coresident sample (899 children) and all results are consistent if the analysis is restricted to these children. Six stepsons (0.7 percent of the sample), 18 stepdaughters (1.9 percent of the sample), and one adopted child (0.1 percent of the sample) make up the remainder of the sample.

7. A *t*-test comparing the 924 children in the analysis and the 105 excluded children who are missing country of birth information reveals no statistically significant difference between the proportions administered the test in Spanish.

lem solving in mathematics, while the Letter Word Identification test evaluates symbolic learning and reading identification skills (Woodcock and Johnson 1989). As described by Johnson and Schoeni (2007), the Woodcock Johnson test is an easel test, where the answer book is placed in front of the respondent. The interviewer is instructed to place the easel at an angle that allows them and the respondent to view the pictures simultaneously. The order of question presentation is crucial as the easiest questions are presented first followed by increasingly harder ones. The starting point for the test is determined by the education level of the child.[8] The Woodcock Johnson Foundation normed the test scores by age based on U. S. national averages to have a mean of 100 and a standard deviation of 15.

The Batería is the Spanish language version of the Woodcock Johnson III (WJ III) tests. Tests for the Batería were either translated directly from English or were adapted from the WJ III English test. For the four tests administered in the NIS, Calculation was a direct translation while Applied Problems, Passage Comprehension, and Letter Word Identification were adapted for use with Spanish-speaking individuals. Adaptation was used when the key measurement concept was the same, but the items in the question were changed in some way. All Batería test translations and adaptations were carried out by or under the supervision of a team of professional certified Spanish translators (Schrank et al. 2005). Every effort was made to administer the tests to all children in the same manner with respect to language intensity.

One key assumption of our subsequent analysis is that the test scores for children administered the test in English can be reliably compared to the test scores for children who were administered the test in Spanish. Based on the Woodcock Johnson overview and technical supplement test manuals (Schrank et al. 2005), both the reliability and the validity of the Spanish Batería tests are comparable to the English WJ III versions. Specifically, "because the Batería III is equated to the WJ III, an individual's Batería III scores can be directly compared to his or her WJ III scores, if both instruments were administered" (Schrank et al. 2005, p. 9).

The sample used to calibrate and norm the Spanish-language items came from both within and outside the U. S. Data were obtained from 1,413 native Spanish-speaking individuals from a range of Spanish-speaking countries. In comparison, for the WJ III, normative data were drawn from a national U. S.-based sample of 8,782 individuals based on the 2005 U. S. Census; this provides the most current comparison to the U. S. population (McGrew, Schrank, and Woodcock 2007). Batería calibration data have been equated to the WJ III norms, making the scores on the English and Spanish tests directly comparable (Schrank, McGrew, and Woodcock 2001; Schrank et al. 2005).

8. For the administration of these tests to children in the New Immigrant Survey, the NIS administrators took into account the immigrant children's unique backgrounds. Because these children may not have received as much education as similar-aged nonimmigrant children, the starting level for their achievement tests was adjusted accordingly. Specifically, children in preschool through third grade began each test at the suggested level for one grade below their actual school grade. As the relationship between school grade and level of achievement test difficulty is not perfectly linear, children in Grades 4 and higher began the test at the suggested level for two grades below their actual school grade.

III. Identification Strategy and Empirical Results

A. Identification Strategy

Our identification strategy exploits the test language randomization (English or Spanish) of the four Woodcock Johnson III achievement tests to measure the amount and rate of language assimilation, as well as the potential costs of taking a test in one's nondominant language. Previous research that uses self-reported measures of English proficiency (Dávila and Mora 2000; Alba et al. 2002; Dávila and Mora 2004) or that allows individuals to choose their test language (Creel and Ferrer 2006; Hofferth 2006; Gormley Jr. 2007), make it difficult to interpret differences across test languages and to understand whether the differences are due to a deficit in language proficiency or in academic ability. The test language randomization allows us to address these potential biases and attribute any differences in test scores solely to the difference in test language. Our analysis proceeds in three steps. First, we confirm that the test language randomization was effectively administered. Second, we show that the test score differences by randomized test language for the overall sample mask significant heterogeneity and that the heterogeneous impact of test language by nativity status (U.S.-born versus foreign-born children) is critical for understanding immigrant language assimilation. Third, we explore the rate and arrival age at which children transition to English dominance.

To confirm that the randomization was effectively administered, in Table 1, we compare characteristics for children randomly administered the test in English with characteristics for those children randomly administered the test in Spanish. The final column presents the mean difference across test language as well as the standard error of the difference. For almost all characteristics, there is no statistically significant difference for those children who take the test in English or Spanish. The fraction of children who are born in the United States, the child's age at arrival, and the number of years spent in the United States are similar across the randomized test languages. Similarly, the child's years of education, years of education in the United States, age, and whether English is spoken at home do not significantly differ across the groups of children who were randomly given the test in English or Spanish. A higher proportion of Spanish language test takers are female, a difference that is statistically significant at the 10 percent level. To address this potential bias, in the regression analysis, we include controls for the child's gender and the results do not change. Finally, there are no statistically significant differences across parent characteristics, including parent's years of education, parent's English proficiency, parent's number of years of U. S. experience, or the proportion of children who have parents who adjusted their visa status (versus new arrivals).

B. Test Score Language Bias and Language Assimilation Results

We begin by exploring the test score language bias in the full sample and find that the differences in average test scores for the children taking the test in Spanish or English mask substantial heterogeneity that is important for measuring language assimilation. We then proceed to examine the heterogeneous impact of randomized test language broken down by where the child was born. In Panel A of Table 2, we

Table 1
Sample Characteristics for Experiment Eligible Children, By Randomized Test Language

	English (1)	Spanish (2)	Difference (1) − (2)
Fraction U. S.-born	0.803	0.781	0.022
	(0.398)	(0.414)	[0.027]
Child's age at arrival	1.479	1.533	−0.054
	(3.121)	(3.192)	[0.208]
Child's number of years in the United States	6.275	6.456	−0.181
	(3.536)	(3.684)	[0.238]
Child's years of education	3.673	3.825	−0.152
	(2.250)	(2.344)	[0.160]
Child's years of U. S. education	3.236	3.378	−0.142
	(2.332)	(2.432)	[0.172]
Child's age	7.752	7.987	−0.235
	(2.846)	(2.903)	[0.189]
English spoken at home (parent's report)	0.301	0.309	−0.008
	(0.459)	(0.463)	[0.030]
Female	0.466	0.529	−0.063*
	(0.500)	(0.500)	[0.033]
Parent's years of education	9.566	9.538	0.028
	(4.411)	(4.000)	[0.277]
Parent's English proficiency	0.272	0.256	0.016
	(0.021)	(0.437)	[0.029]
Parent's years of U. S. experience	9.350	9.884	−0.534
	(6.789)	(6.802)	[0.447]
Fraction of children with parents who adjusted their visa status (versus new arrivals)	0.860	0.850	0.011
	(0.347)	(0.358)	[0.023]
Number of children	472	452	

Notes: * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent. Standard deviations are in parentheses and standard errors are in brackets. Woodcock Johnson achievement tests were randomly administered in English or Spanish to children of Hispanic immigrants. Data source: New Immigrant Survey 2003.

compare mean test scores for each of the four achievement tests for the full sample of children who took the test in the different languages. Of the 689 children who took the Passage Comprehension and Calculation tests, 348 took the tests in English and 341 in Spanish. Panel A shows that mean scores for these tests are higher for those children who took the test in English and the differences are statistically significant at the one percent level. For the Applied Problems and Letter Word Identification exams, 472 children took the tests in English and 452 took the tests in Spanish. Panel A indicates that for the Applied Problems test there is no significant

Table 2
Average Test Scores by Randomized Test Language

	Test in English (1)	Test in Spanish (2)	Difference (1) − (2)
Panel A: Full sample			
Passage comprehension	80.559	74.384	6.175***
	(21.561)	(29.734)	[1.976]
Calculation	100.137	92.862	7.275***
	(20.185)	(31.782)	[2.024]
Applied problems	87.209	86.611	0.598
	(23.180)	(25.539)	[1.603]
Letter word identification	94.665	99.411	−4.746***
	(19.665)	(29.919)	[1.659]
Panel B: Foreign-born only			
Passage comprehension	70.128	80.837	−10.709***
	(25.397)	(26.486)	[4.002]
Calculation	98.810	93.226	5.584
	(15.437)	(28.533)	[3.728]
Applied problems	75.913	89.572	−13.659***
	(30.897)	(21.434)	[3.819]
Letter word identification	89.052	111.591	−22.539***
	(23.596)	(31.244)	[4.015]
Panel C: U. S.-born only			
Passage comprehension	83.328	72.174	11.154***
	(19.559)	(30.910)	[2.232]
Calculation	100.489	92.737	7.752***
	(21.278)	(32.873)	[2.390]
Applied problems	89.981	85.781	4.200**
	(19.952)	(26.544)	[1.728]
Letter word identification	96.042	95.995	0.0473
	(18.349)	(28.665)	[1.767]

Notes: Standard deviations in parentheses and standard errors in brackets. * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent. Woodcock Johnson tests were randomly administered in English or Spanish to children of Hispanic immigrants. Passage comprehension and calculation tests were given to children aged 6 to 12 and Applied Problems and Letter Word Identification tests were administered to children aged 3 to 12. Scores are normed by age based on national averages to have a mean of 100 and a standard deviation of 15. In Panel A, 348 children took the Passage Comprehension and Calculation tests in English and 341 took it in Spanish. There were 472 who took the Applied Problems and the Letter Word Identification tests in English and 452 in Spanish. In Panel B, for the foreign-born children, 73 children took the Passage Comprehension and Calculation tests in English and 87 in Spanish, while 93 children took Applied Problems and Letter Word Identification tests in English and 99 in Spanish. In Panel C for the U. S.-born children, 275 children took Passage Comprehension and Calculation tests in English and 254 in Spanish, while 379 children took Applied Problems and Letter Word Identification tests in English and 353 in Spanish. Data source: New Immigrant Survey 2003.

difference in average test scores based on test language. Finally, for the Letter Word Identification exam, children taking the test in Spanish performed on average 4.75 points better than children taking the test in English, and the difference is statistically significant at the one percent level.

To better understand these patterns, in Panels B and C we examine the test score differentials by nativity status, which leads to the identification of two distinct treatment effects: (a) the effect of taking the tests in English (versus Spanish) for U. S.-born children and (b) the effect of taking the tests in English (versus Spanish) for foreign-born children. This focus on a heterogeneous impact of test language guides the remainder of our analysis.

In Panel B of Table 2, we present average achievement test scores for first-generation (foreign-born) children who are randomly assigned to take the test in English (Column 1) or Spanish (Column 2). The language randomization indicates large differences between foreign-born children of Hispanic immigrants who take the tests in English compared to Spanish. For three of the four tests, foreign-born children taking the test in Spanish score 10.71 to 22.54 points (0.71 to 1.50 standard deviations) higher than those who take the test in English and the differences are significant at the one percent level. Only the calculation test shows no significant difference in mean test scores by language.

Panel C of Table 2 is analogous to Panel B but is restricted to second-generation (U.S.-born) children. The test randomization results for U. S.-born children are in stark contrast to those in Panel B in which foreign-born children taking the test in Spanish did significantly better than those taking it in English. U. S.-born children of Hispanic immigrants who take the achievement tests in English experience significantly higher test scores than those taking the tests in Spanish, suggesting English dominance within this group. Results are significant at the one percent level for the Passage Comprehension and Calculation exams, at the 5 percent level for the Applied Problems test, and are not statistically significant for the Letter Word Identification test.[9]

This reversal is a combination of U. S.-born Hispanic children scoring both higher on the tests in English (increased English proficiency) and lower on the tests in Spanish (reduced Spanish proficiency) compared to foreign-born Hispanic children. For the Passage Comprehension test, U. S.-born children randomly administered the test in English score almost a full standard deviation higher (13.20 points) compared to foreign-born children who take the test in English, while U. S.-born children randomly administered the test in Spanish score 8.66 points lower than foreign-born children taking the test in Spanish. Similar patterns hold for the Applied Problems and Letter Word Identification tests. U. S.-born children score respectively 14.07 and 6.99 points higher than foreign-born children when taking the test in English

9. In addition to the differences in means shown in Table 2, we also estimate the relationship between test language, nativity, and test score after controlling for several child and parent characteristics including child birth year dummies, child's years of education, child's years of U. S. education, child's gender, whether English is spoken at home (based on the parent's report), parent's years of education, parent's English proficiency, parent's years of U. S. experience, and parent's years of U. S. experience squared. Given the success of the test language randomization shown in Table 1, regression results including these additional controls yield similar results to those presented in Panels B and C of Table 2.

and respectively 3.79 and 15.60 points lower when taking the test in Spanish. Overall, these results indicate a substantial advantage for second-generation children of Hispanic immigrants who take the test in English and for first-generation children of Hispanic immigrants who take the test in Spanish, and a substantial disadvantage for U. S.-born children of Hispanic immigrants who are randomly administered the test in Spanish.

Having provided evidence that children of Hispanic immigrants experience a significant degree of English language assimilation, we next explore the rate and arrival age at which these children transition to English dominance. In Table 3, we present regressions examining the relationship between test scores, randomized test language, and the child's age at arrival in the United States (Panel A) and the child's years in the United States (Panel B).[10] We find that first-generation children who arrive in the United States at an early age or children who have spent more than three years do not benefit from taking the achievement tests in Spanish. Results in Panel A indicate that, for children who take the test in English, for each additional year older that the child came to the United States, test scores on the Passage Comprehension, Applied Problems, and Letter Word Identification are reduced by 2.20, 2.57, and 1.55 points respectively. Similarly, for children who take the test in Spanish, each additional year older that they arrive in the United States is associated with a 2.99 to 4.41 point test score gain. Panel B yields similar conclusions indicating that, for children given the test in English, each additional year the child is in the United States is associated with a 1.92, 1.50, and 1.46 point higher score on the Passage Comprehension, Applied Problems, and Letter Word Identification tests, respectively. For each additional year the child is in the United States, test scores for children randomly administered the test in Spanish decline by 2.67, 2.86, and 3.02 points respectively for these same three tests.

To further examine how quickly children of Hispanic immigrants transition to English dominance and to look at the entire distribution of the relationship as opposed to only the mean effects, we explore the nonparametric relationship between achievement test scores, test language, and characteristics measuring the child's length of U. S. exposure. In Figures 1 and 2, we estimate kernel weighted local polynomial regressions of test scores, broken down by randomized test language, on the child's age at arrival in the United States and years in the United States, respectively. The figures and Table 3 include all children, both U. S.-born and foreign-born, and U. S.-born children are then subsequently treated as having arrived in the United States at age zero. Results are similar if only foreign-born children are used in the figures and Table 3. Figures 1a to 1d indicate a nonlinear relationship between age at arrival and average test scores in English and Spanish. Children who arrive in the United States at younger ages experience a test score advantage when given the test in English, while those who arrive at older ages generally experience a strong disadvantage if randomly given the test in English. Figure 1a indicates a crossover in scores by test language at approximately age seven such that children who come to the United States prior to this age experience an advantage when taking

10. Results are qualitatively similar in regressions using the proportion of the child's life spent in the United States.

Table 3
OLS Regressions of the Determinants of Test Scores, by Age at Arrival in the United States and Years in the United States

Dependent Variable:	Passage Comprehension	Calculation	Applied Problems	Letter Word Identification
Panel A: Age at arrival in the United States				
Test in Spanish	−12.350***	−7.810***	−5.038***	−1.925
	[2.277]	[2.374]	[1.783]	[1.913]
Age at arrival	−2.195***	−0.312	−2.567***	−1.550***
	[0.350]	[0.245]	[0.446]	[0.374]
Test in Spanish*age at arrival	3.394***	0.299	2.987***	4.406***
	[0.499]	[0.486]	[0.510]	[0.524]
Constant	84.495***	100.697***	91.006***	96.957***
	[1.220]	[1.261]	[1.054]	[0.972]
Number of children	689	689	924	924
Panel B: Years in the United States				
Test in Spanish	13.289***	−11.366***	17.596***	23.980***
	[4.530]	[4.334]	[3.112]	[3.394]
Years in the United States	1.920***	−0.076	1.503***	1.461***
	[0.339]	[0.268]	[0.357]	[0.258]
Test in Spanish*years in the United States	−2.674***	0.557	−2.860***	−3.020***
	[0.532]	[0.509]	[0.442]	[0.505]
Constant	66.640***	100.685***	77.775***	85.498***
	[2.806]	[2.134]	[2.776]	[1.974]
Number of children	689	689	924	924

Notes: Robust standard errors in brackets, clustered at the household level. * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. Woodcock Johnson achievement tests were randomly administered in English or Spanish to children of Hispanic immigrants. The Passage Comprehension and Calculation tests were administered to children aged 6 to 12 and the Applied Problems and Letter Word Identification tests were administered to children aged 3 to 12. Scores are normed by age based on national averages to have a mean of 100 and a standard deviation of 15. Data source: New Immigrant Survey 2003.

the Passage Comprehension test in English, while those arriving at older ages experience an advantage when the test is given in Spanish. Figure 1b suggests a similar crossover point for the Calculation test, although there is no subsequent drop in test scores for children who arrive at older ages and take the test in English. The Applied Problems (Figure 1c) and Letter Word Identification tests (Figure 1d) indicate that the distinction between taking the test in English and Spanish is less pronounced for children who arrive up to age four, at which point there is a clear Spanish language advantage. Children arriving after age four have a substantial advantage if

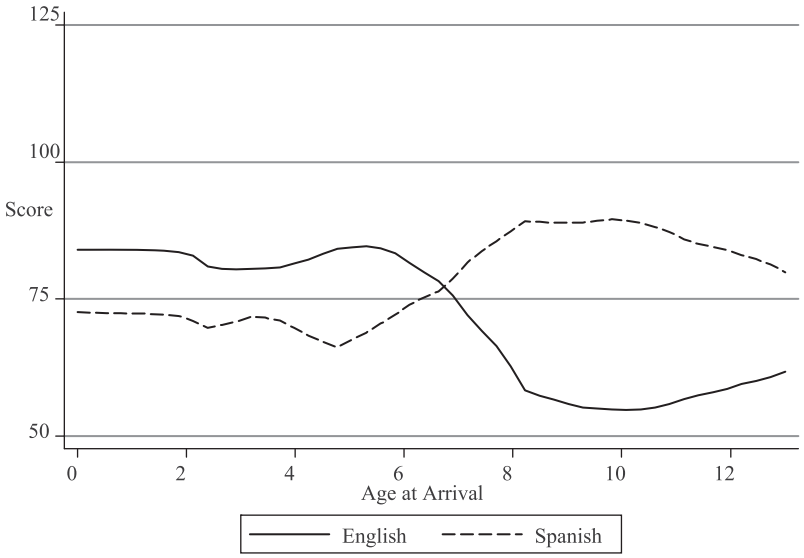

Figure 1a
Passage Comprehension Test Scores, By Age at Arrival in the United States and Randomized Test Language

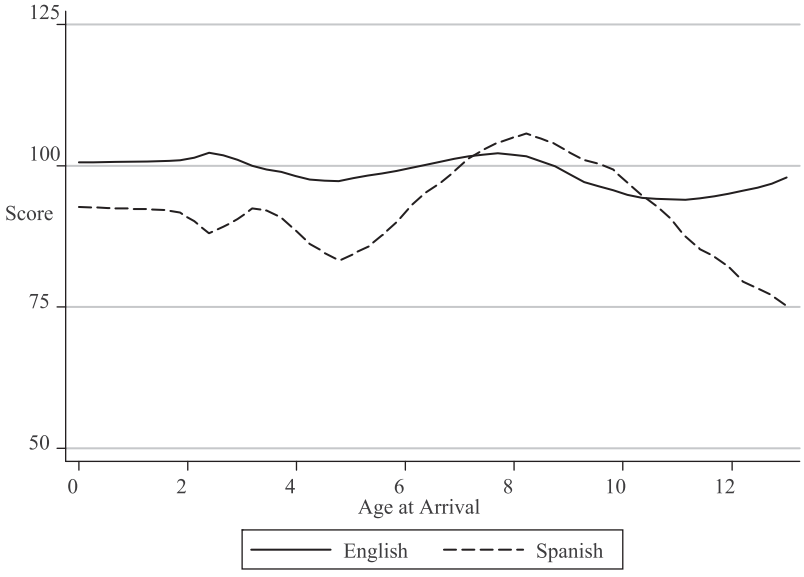

Figure 1b
Calculation Test Scores, by Age at Arrival in the United States and Randomized Test Language

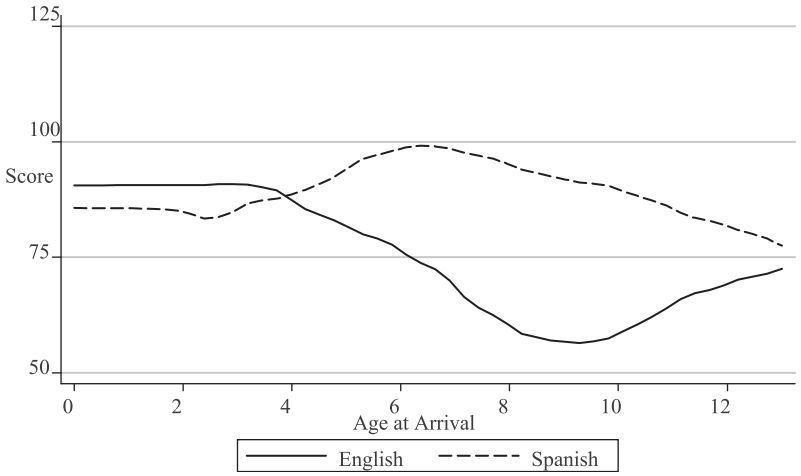

Figure 1c
Applied Problems Test Scores, by Age at Arrival in the United States and Randomized Test Language

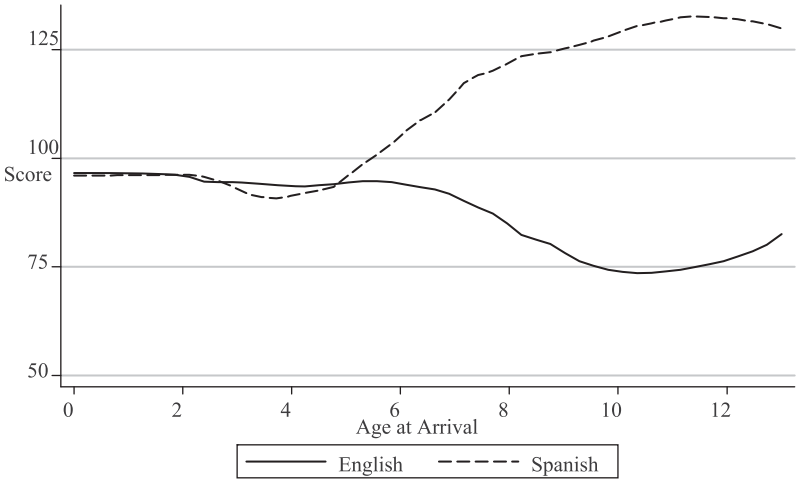

Figure 1d
Letter Word Identification Test Scores, by Age at Arrival in the United States and Randomized Test Language

Notes: Kernel-weighted local polynomial regression (using Epanechnikov kernel) of Woodcock Johnson achievement test scores on age at arrival in the United States. Tests were randomly administered in English or Spanish to children of Hispanic immigrants. The Passage Comprehension and Calculation tests were administered to children aged 6 to 12 and the Applied Problems and Letter Word Identification tests were administered to children aged 3 to 12. Scores are normed by age based on national averages to have a mean of 100 and a standard deviation of 15. Data source: New Immigrant Survey 2003.

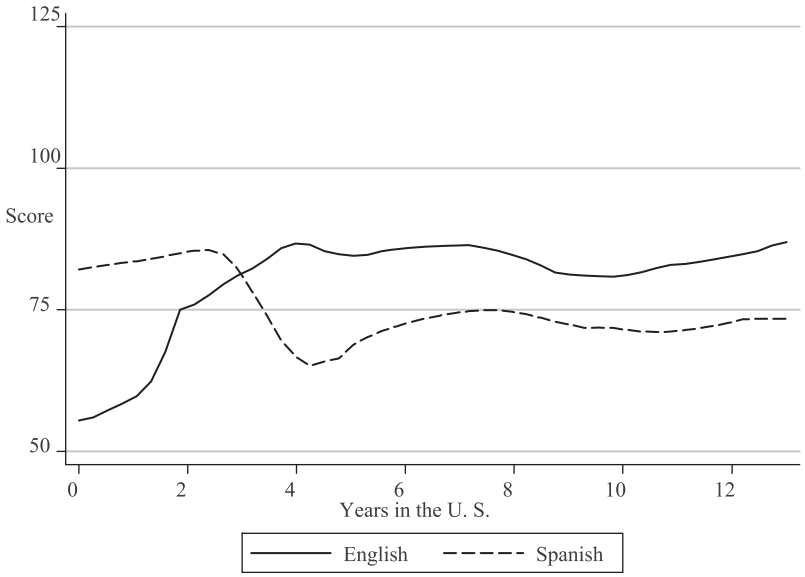

Figure 2a
Passage Comprehension Test Scores, by Years in the United States and Randomized Test Language

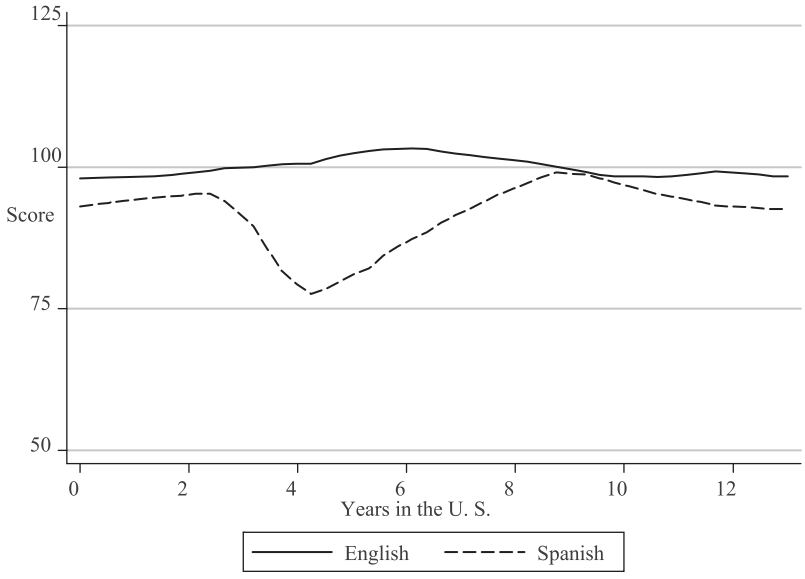

Figure 2b
Calculation Test Scores, by Years in the United States and Randomized Test Language

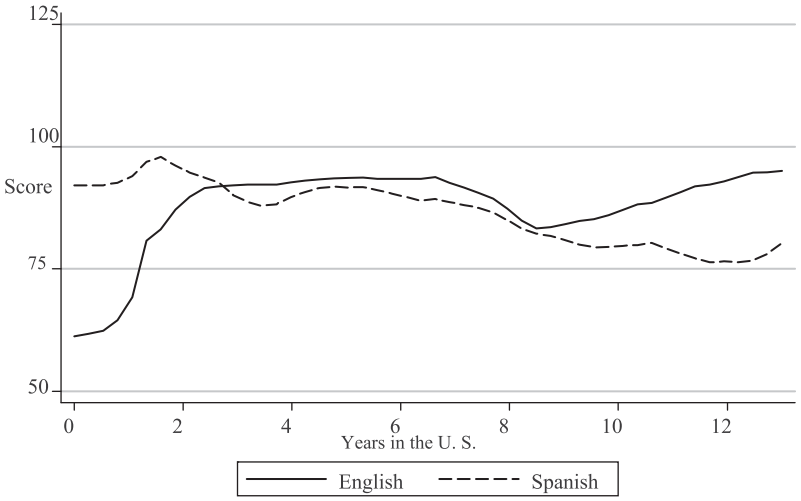

Figure 2c
Applied Problems Test Scores, by Years in the United States and Randomized Test Language

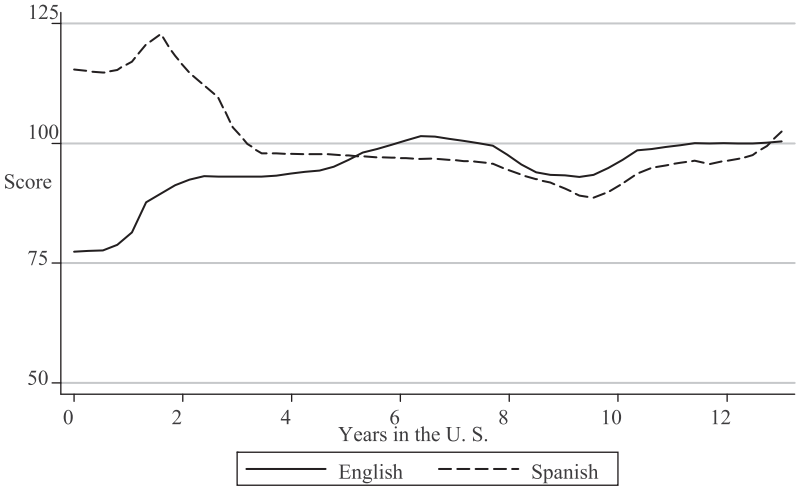

Figure 2d
Letter Word Identification Test Scores, by Years in the United States and Randomized Test Language

Notes: Kernel-weighted local polynomial regression (using Epanechnikov kernel) of Woodcock Johnson achievement test scores on years in the United States. Tests were randomly administered in English or Spanish to children of Hispanic immigrants. The Passage Comprehension and Calculation tests were administered to children aged 6 to 12 and the Applied Problems and Letter Word Identification tests were administered to children aged 3 to 12. Scores are normed by age based on national averages to have a mean of 100 and a standard deviation of 15. Data source: New Immigrant Survey 2003.

they take either test in Spanish or, conversely, a disadvantage if they are randomly given the test in English.[11]

Figures 2a to 2d display the nonparametric relationship between test scores and a child's years spent in the United States, broken down by the randomized test language, and show comparable patterns to those in Figure 1. Figure 2a displays a test score advantage for children who have been in the United States less than three years and were randomly administered the test in Spanish, while children of Hispanic immigrants who have been in the United States more than three years experience a substantial deficit if given the test in Spanish. The Applied Problems and Letter Word Identification tests display similar patterns, with children who have spent fewer years in the United States doing significantly better on the achievement tests if the randomized test language is Spanish and experiencing no advantage or even a small deficit if they have spent many years in the United States and the test language is Spanish. Consistent with the previous tables, the results for the Calculation test show no clear correlation between test scores and test language.

C. Robustness Checks

We undertake two additional sets of analyses in order to gain a deeper understanding of the observed language assimilation patterns. First, we estimate a quantile regression, and second we examine the relationship between test language and English proficiency. The former provides information on whether the observed relationship between test language and nativity is consistent across the entire test score distribution, and the latter examines whether nativity is simply a proxy for English proficiency. First, the quantile regression results indicate that, in general, at the lowest quantiles of the distribution, the impact of test language and birthplace are significantly larger. For instance (in results not shown), U. S.-born children in the 10th percentile on the Passage Comprehension test experience a 66.93 point disadvantage if given the test in Spanish; similar children experience a 49.47 and 20.52 point disadvantage on the Applied Problems and Letter Word Identification tests, respectively. The quantile regression results indicate that the significant differences shown in Table 2 in average test scores by randomized test language and nativity are in part driven by the tails of the distribution.

11. These figures indicate a large negative effect for children who arrive at an older age and are randomly administered the test in English, which appears to contradict the critical window of language learning ending at age nine shown by Bleakley and Chin (2010). However, part of this negative effect is driven by children who arrive at an older age and have spent less than one year in the United States. In additional figures (not shown), we attempt to disentangle age at arrival effects from time in the U. S. effects, and we restrict these figures to foreign-born children who have spent at least one year in the United States. The test language differences for three of the four achievement tests for children who arrive at an older age but have spent at least one year in the United States are more limited. Children arriving after age six still have significant language differences (Spanish scores higher than English scores) in the Letter Word Identification test, indicating that on some dimensions, the critical period of language learning ends at an earlier age than previously believed. In addition, if standardized achievement tests are administered to new immigrants during their first year in the United States, the significant negative language effects for children arriving at an older age could still have long-term impacts for these children by tracking them into lower level academic classes, even if eventually they learn English.

Second, the results from the previous analysis indicate that the impact of the randomly assigned test language is critically linked with a child's birthplace and whether the child is a first- or second-generation immigrant. In an attempt to disentangle the mechanisms explaining why birthplace matters for achievement test scores, in results not shown, we look at a sub-sample of 514 children for whom explicit information was collected on the child's English proficiency.[12] This allows us to determine if birthplace is simply a proxy for English ability. For English-proficient children (both foreign-born and U. S.-born) being randomly administered the Passage Comprehension, Applied Problems, or Letter Word Identification tests in English instead of Spanish generally yields a higher average test score. This differs from the results for the limited English-proficient children. For foreign-born, limited English-proficient children, results indicate lower average test scores for those taking the test in English instead of Spanish. This contrasts with U. S.-born limited English-proficient children whose test scores show no statistically significant difference if they are administered the test in English instead of Spanish. In summary, for both U. S.- and foreign-born children proficient in English, there is generally an advantage to being given the test in English. However, for limited English-proficient children, foreign-born children experience a significant disadvantage when taking the test in English, but U. S.-born children experience no significant difference if randomly given the test in English.[13] We interpret these results as evidence that, although these U. S.-born children may not yet have attained English fluency, their time in the United States and immersion in American society are imparting skills that translate into improved achievement test scores.[14]

IV. Conclusions

This is the first paper we are aware of that can explicitly measure the extent and rate of language assimilation among the children of Hispanic immi-

12. Only 514 children out of the 924 are available for these analyses as information on the child's English proficiency was only gathered for those children who were administered the complete child interview.

13. The notable exception to these English proficiency results again is in the Calculation test, where language is arguably less of a determining factor in quantitative reasoning.

14. An alternative explanation is that U. S.-born children with limited English proficiency simply lack proficiency in both languages. Although this is a possible explanation, we find it less likely for three reasons. First, although it is true that foreign-born, limited English-proficient children who took the test in Spanish scored higher than U. S.-born limited English-proficient children who took the test in Spanish, those test score differences are only significant at the 5 percent level for one of the four tests (Letter Word Identification). We interpret this as evidence that U. S.-born children with limited English proficiency do not have substantially lower proficiency in Spanish. Second, the U. S.-born limited English-proficient children who were given the test in English score significantly higher (statistically significant at the 1 percent level) than the foreign-born limited English-proficient children who were given the test in English for the Passage Comprehension, Applied Problems, and Letter Word Identification tests. We interpret this as evidence that U. S.-born children who self-report as being limited English-proficient have higher levels of English ability than foreign-born children who self-report as being limited English-proficient. Third, we find little support in the literature for the alternative explanation that U. S.-born children with limited English proficiency simply lack proficiency in both languages, and more support for the likelihood that second-generation immigrant children are transitioning to English dominance even if they consider themselves to still be limited English-proficient.

grants. Our identification strategy exploits the test language randomization (English or Spanish) of the four Woodcock Johnson III tests in the New Immigrant Survey and allows us to address potential biases that have hindered previous comparisons of educational achievement and allows us to attribute any differences in achievement test scores solely to the difference in test language. Although an initial comparison for the full sample of children of the test scores by randomized test language indicates that English language test takers score higher than Spanish language test takers on two of the tests, lower on one test, and did not significantly differ on the fourth test, these patterns mask substantial heterogeneity. A closer examination that incorporates birthplace as a mediating factor reveals several important findings for these children.

First, we present compelling evidence that the children of Hispanic immigrants both within and across generations quickly become English-dominant. We find English dominance among children born in the United States; they experience over a one standard deviation test score disadvantage when randomly administered the tests in Spanish. This contrasts with previous work examining adults (Lazear 1999) and suggests that children face a different incentive structure when presented with the decision to learn and use English.

Second, we show a rapid assimilation of English among the foreign-born. Children who arrive in the United States at an early age or who have spent more than three years in the United States experience no advantage associated with taking the tests in Spanish. Both of these patterns challenge previous work showing that Hispanic immigrants are learning English more slowly than previous immigrant waves and more slowly than other origin groups (Alba et al. 2002). Further, the stylized model tested by Alba et al (2002) does not predict English dominance until the third-generation, while we show this occurring even among second-generation Hispanics.

Third, we show that foreign-born children experience a test score disadvantage ranging from 0.71 to 1.50 standard deviations when randomly administered the test in English. If we consider this the bias of giving the test in English to foreign-born children, this suggests significant implications for long-run academic and lifetime achievement. Children with lower test scores due to this bias may be subsequently tracked into less academically oriented classes and set up for a lower likelihood of economic success later in life. This result is of particular importance as evidence indicates that in the majority of U. S. states, standardized tests are only offered in English. Although the No Child Left Behind Act explicitly allows for children who are learning English to have a three-year window during which they can take assessments in their native language, in practice most states do not do this. Further, even if states did allow for testing in native languages during this three-year window, for some achievement tests such as Letter Word Identification (shown in Figure 2d) this would not be sufficient as children given the test in English do not catch up to Spanish scores until the child has been in the United States for over five years. Given research demonstrating the positive correlation between early test scores and later academic and labor market outcomes, these findings provide key insight into a population that may face significant challenges.

Fourth, we show that for children of Hispanic immigrants born in the United States , there is a nativity effect that impacts achievement test scores beyond English proficiency. Limited English-proficient, foreign-born children experience a signifi-

cant disadvantage when taking the test in English, but U. S.-born children experience no significant difference if randomly given the test in English. We interpret this as evidence that for U. S.-born children, despite having limited English proficiency, their exposure to American society imparts a basic working knowledge of English or test taking skills that benefit them with the Woodcock Johnson achievement tests.

Finally, our findings yield important policy implications. First, the rapid assimilation of English should assuage some of the fears associated with the immigrant waves in the latter half of the twentieth century. In fact, our results for Hispanics suggest a rapid loss of Spanish language proficiency. Second, a back of the envelope calculation using results from Fryer and Levitt (2004) indicates that approximately 12.3 percent of the Hispanic-white test gap in math and 37.0 percent in reading can be explained by this test score language bias. These results point to the importance of English language instructional help, particularly for Hispanic children who arrive in the United States at older ages. These children are the ones most likely to suffer from a test score language bias and for whom targeted language assistance could yield critical economic gains.

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