ISSN 2279-9362

Collegio Carlo Alberto

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No. 534
December 2017

Carlo Alberto Notebooks

www.carloalberto.org/research/working-papers

# BILINGUAL CHILDREN'S ADVANTAGE IN ACADEMIC PERFORMANCE

Ainhoa Aparicio Fenoll*

## ABSTRACT

This paper tests if the academic performance of bilingual children is better than that of comparable monolingual children. This study is novel in three ways: (1) it uses a large and representative sample of children of Latino immigrants living in the US; (2) it focuses on widely-used standardized test scores; and (3) it takes into account home and school inputs in addition to demographic and socioeconomic characteristics. I find that bilingual children outperform their monolingual counterparts. Although the largest differences are found in language-related tests (above half standard deviation), there are also sizable differences in math-related tests (slightly below one-third standard deviation).

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The author is grateful for useful suggestions made by Daniela del Boca, Vicente Cuñat, Chris Flinn, Libertad González, Esteban Jaimovich, Zoe Kuehn, Giovanni Mastrobuoni, Mario Pagliero, Barbara Petrongolo, Aleksey Tetenov, and participants at the WOLFE workshop at York, the CHILD internal seminar, the Spanish Economic Association conference in Bilbao, and the Alp Pop conference at La Thuile.

## INTRODUCTION

More than half of the world's population can speak two or more languages (Grosjean, 2010). According to the American Community Survey 20% of US residents were bilingual in 2012. The idea that bilingualism can shape our brain has sparked much research, especially in the fields of psychology, neuroscience, and education. There exists some consensus that bilingualism has an impact on executive function and theory of mind (Barac et al, 2015). These two dimensions of cognitive ability have in turn been shown to be positively associated to academic achievement (Best, Miller, and Naglieri, 2011, and Lecce et al, 2014). In this paper I estimate the magnitude and statistical significance of differences in academic performance between bilingual and comparable monolingual children as measured by standardized reading and mathematics tests.

If bilingualism improves academic performance, this could explain some of the positive effects of home language proficiency on the labor market outcomes and social integration of immigrants (Bleakley and Chin, 2004; Bleakley and Chin, 2010). Conversely, a negative impact of bilingualism on cognitive skills could help to explain native-immigrant gaps in cognitive skills (Jensen and Würtz Rasmussen, 2008).

In my analysis I employ information on a representative sample of children of Latino immigrants living in the US provided by the New Immigrant Survey (NIS). This survey includes information on language proficiency and test scores obtained from standardized Woodcock Tests administered to children aged 3 to 12. Woodcock Tests are widely used by public schools as a measure of academic performance and to qualify children for gifted or special education services. This test presents a series of positive traits: (i) it is not limited to a specific grade level so that children performing below or above their grade level can be assessed, (ii) it accommodates all learning styles so that children coming from other educational systems can be assessed (e.g., pictures are extensively used), (iii) each subtest measures children's proficiency in only that area (e.g., delayed readers can still do well with applied math problems because the problems are read to the child).

The richness of the NIS allows me to compare bilingual and monolingual children who are otherwise similar in many dimensions. Available information includes family and individual characteristics, parents' labor market outcomes, home and school inputs, and parenting behaviors. Finally, the design of the NIS includes an experiment in which the language of the test is assigned randomly. I use this feature to both compare the performance of bilingual and Spanish monolingual children on tests in Spanish, and to compare the performance of bilingual and English monolingual children on tests in English. This comparison is useful to ensure that all children have sufficient command of the language of the test. Moreover, as shown by Hoff (2012) and Core, Hoff, Rumiche, and Señor (2013), bilingual children typically know fewer words in either of their vocabularies than their monolingual counterparts know in their one vocabulary (although bilingual children know a comparable number of words in total). As a result, my comparison of bilingual to monolingual children's performance in the language of the monolingual provides lower bounds for the bilingual academic advantage.

Results show that bilingual children significantly outperform monolingual children in language-related tests. Bilingual children also do better in mathematics-related tests. The latter differences are smaller but still statistically significant. Performance is also better but statistically indistinguishable for most advanced mathematic tests.

The current paper is the first to test differences in standardized test scores between bilingual and monolingual children using a representative sample of children of Latino immigrants in the US and controlling for a vast array of characteristics and inputs. However, it may still be the case that bilingual and monolingual children differ in terms of unobservable characteristics and that some of these characteristics influence academic performance. The fact that our reference population is relatively homogenous (children of immigrants who were granted permanent residency in the US at the same moment in time) can explain why results do not change when we control extensively for characteristics and inputs. It also suggests that results may remain invariant if we could control for unobservables. However, further research is needed in order to fully address the causal impact of bilingualism on academic performance.

## METHODOLOGY

From the methodological point of view, serious concerns have been raised about the robustness and reliability of some of the reported cognitive effects of bilingualism (Paap, Johnson and Sawi, 2015). Some scholars have argued that the positive association between bilingualism and executive control found in many previous studies is the result of “malpractice” in the design of behavioral tests. In a recent study, Paap, Johnson and Sawi make an exhaustive list of these critiques (Paap, Johnson and Sawi, 2015).

In this Section, I first explain how I identify bilingual, Spanish and English monolingual children. Then, I detail how my approach addresses each of the criticisms raised by Paap, Johnson and Sawi (2015). I provide the details of the estimation of the average test scores of bilingual and monolingual children in the Appendix.

### Characterizing bilingual children

One of the key challenges that arise in the study of differences between bilingual and monolingual individuals is the characterization of bilinguals. As in Mouw and Xie (1999), I classify children as bilingual if they are proficient in their native language and English. Non-bilingual children are classified as English (Spanish) monolingual if they are more proficient in English (Spanish) than Spanish (English). In particular, the NIS contains self-reported information regarding how well children understand, speak, read and write English and Spanish. Each aspect of language proficiency is coded as: very well, well, not well and not at all. I average all four aspects to obtain an index of average language proficiency and consider proficient children those who know the language well or very well.

### Avoiding malpractice in analyzing the bilingual advantage

Following Paap and coauthors malpractice list, I now explain how my approach addresses such criticisms so as to avoid estimating bilingual advantages where none exist or where disadvantages should be found:

1. Paap and coauthors note that positive effects tend to be found in small samples but disappear when large samples are used. I use data from the New Immigrant Survey, which includes information on a large and representative sample of children of Latino immigrants living in the US. While the studies reviewed by Paap and coauthors rarely include more than 100 subjects, my sample includes 1,604 children. The characteristics of my sample allow for estimating even small significant differences.

2. Many studies fail to control for demographic factors, which could lead to erroneous estimations of differences between monolingual and bilingual individuals when their demographic characteristics differ. This happened in the case of the replication of a study of Bialystok, Craik, Kelin and Viswanathan (2014) by Morton and Harper (2007). The latter replicated the former study, but additionally used information on parent’s educational levels, family income, ethnicity and immigrant status to make bilingual and monolingual individuals comparable. Paap and coauthors highlighted immigrant status and cultural differences as particularly important aspects to take into account (Paap, Johnson and Sawi, 2015). They argue that the identification of bilingualism with immigrant status could explain the results reported in

some papers (Bialystok, Craik and Freedman, 2007). The institutional setup in which children reside is another potentially important confounder. In the study by Engel de Abreu et al. (2012) bilingual children resided in Luxembourg, whereas the monolingual children resided in Portugal.

The richness of the NIS data allows me to account not only for the demographic (origin, gender, age, etc.) and socioeconomic (parents' labor market status, education level, wages, etc.) characteristics of the children, their parents and siblings, but also for potentially relevant factors that are rarely available to researchers, such as parents' language use and proficiency, home inputs (e.g., parenting style, proxied by behavior towards children: controlling, helping, getting involved,…) and school inputs (e.g., subjects offered, meritocratic vs. egalitarian approach, etc.). The complete list of controls can be found in Table 1 of the Appendix. These factors jointly account for a sizeable part of the variation in children's language proficiency (81% as measured by the R-square of an OLS regression of a bilingual child dummy on all these factors). Within the sample, I can clearly distinguish between children born in the US and immigrant children, and although immigrant children are less likely to be monolingual English-speaking, there are sizeable groups of bilingual and monolingual Spanish and English speakers in both groups (see Figure 1). All children reside in the US, hence differences in the institutional context in which bilingual and monolingual subjects live do not drive my results.

3. Bilingual and monolingual individuals often perform differently on tasks that do not have demonstrated convergent validity, i.e., the measures obtained from those tasks do not relate to one another as predicted by the theory. According to Paap and coauthors, "many of the standard measures of inhibition (or monitoring) obtained with nonverbal interference tasks do not correlate with one another." Hence, they "may reflect task-specific mechanisms and not domain-free executive function abilities" (Paap, Johnson and Sawi, 2015). Some examples of tasks used in this type of study include: block design (Bialystok and Majumder, 1998), the Flanker task

(Yang et al., 2011; Costa et al., 2008), theory of mind tasks (Goetz, 2003; Kovacs, 2009), the Simon task (Martin-Rhee and Bialystok, 2008), task switching (Prior and MacWhinney, 2010), and attention tasks (Colzato, 2008).

In this paper, I measure academic skills using the results of four Woodcock Johnson Tests: Letter Word Identification measures symbolic learning and reading identification skills, Applied Problems evaluates aptitude in practical problem solving in mathematics, Passage Comprehension assesses reading comprehension and vocabulary, and Calculation determines mathematical and quantitative ability (Woodcock and Johnson, 1989). The first two tests were administered to children aged 3 to 12 while the latter two were given to children aged 6 to 12. Scores on standardized evaluations like the Woodcock Johnson Tests are considered to provide a comprehensive picture of children's cognitive abilities. Many schools use them to evaluate students, some with the aim of placing those with poor scores in non-honors classes or shifting them to less competitive schools (Akresh and Akresh, 2011).

4. Many studies do not use statistical tests to determine whether differences between monolingual and bilingual children are statistically relevant (Abutalebi, 2012), other studies use the wrong tests or baselines. The large sample size in this study allows me to test for differences in tests scores between monolingual and bilingual children using standard t-tests where the null hypothesis is that the difference in coefficients is zero.

## DATA

The New Immigrant Survey (NIS) was conducted among US immigrants who were granted permanent residence between May and November of 2003, including both new arrival immigrants as well as so called adjustee immigrants who were already living in the US on temporary nonimmigrant visas (or, in some cases, illegally). The sample of immigrants asked to take part in the survey was selected based on administrative records from the US Immigration and Naturalization Service (INS) such as to be nationally representative of new arrival and adjustee immigrants. The first wave of the survey was conducted in 2003 (NIS-2003-1) and had a response rate of 69 percent (Jasso et al., 2005). Follow-up interviews took place between June 2007 and December 2009 (NIS-2003-2).[1] The sample consists of 12,500 adults and 1,241 children, of which 363 participated in both waves.

**RESULTS**

The results of my estimation of average test scores across three subgroups of children (bilingual, Spanish monolingual and English monolingual) are presented in bar graphs. The vertical lines over the bars represent 10% confidence intervals and t-statistics for the differences of means are reported in the footnotes. Scores are normalized to have a zero mean and a standard deviation of one so that differences are measured in standard deviations.

Figure 2 reports raw average scores for bilingual and English monolingual children on cognitive tests in English. Bilingual children significantly outperform monolingual English-speakers on all four tests. In fact, bilingual children perform above the population average while monolingual English-speakers perform more poorly than the average child in the US. Differences between the scores of bilingual and English monolingual children are all statistically highly significant (p-values lower than 0.003). The observed differences range from one-fourth to one standard deviation score. A similar picture is portrayed in Figure 3 where bilingual children who took the test in Spanish are compared to monolingual Spanish-speakers. Consistent with results in the literature, bilingual children perform worse when tests are administered in Spanish (Akresh and Akresh, 2011). However, they still outperform their Spanish monolingual counterparts, with

[1] NIS data can be downloaded at http://nis.princeton.edu/. I use the restricted access version of the data which includes detailed information on country of origin and state of residence.

statistically significant differences on the various tests (very significant for Letter-Word Identification and Passage Comprehension and significant at 6.3% for Calculation). The only exception is Applied Problems, where bilingual children perform below the population average and the performances of bilingual and monolingual children are statistically indistinguishable. The magnitude of the observed differences is lower than that for the test in English and ranges from one-fifth to 0.85 standard deviation. However, these differences could be due to differences among the three groups of children in terms of variables other than language proficiency.

To this regard, I then control for the broad set of variables mentioned above. The resulting conditional averages are shown in Figures 4 and 5. Figure 4 shows that bilingual children outperform monolingual English-speaking children, and that all differences are statistically highly significant (p-values below 0.017). The magnitudes of the estimated differences stay stable with respect to those shown in Figure 2. These results mirror those for the test in Spanish presented in Figure 5, although differences in the Applied Problems and Calculation tests are imprecisely estimated for tests in Spanish. The similarity between Figure 4 and Figure 5 is consistent with previous literature showing that the effects of bilingualism on executive control do not depend on the specific languages spoken (Barac and Bialystok, 2012). Across all cases, the largest differences are found in Letter-Word Identification and Passage Comprehension (above half standard deviation) as compared to Applied Problems and Calculation (below one-third standard deviation). Overall, results highlight the existence of a significant advantage in being bilingual, as captured by academic tests.

## CONCLUSION

Many decades after the bilingual advantage was first documented, and in the face of substantial additional evidence in favor of bilingualism, debate over whether bilingualism can enhance aspects of cognitive function continues. Educational and clinical practitioners routinely advise parents to "simplify" their children's linguistic environments when there are signs of academic struggle, and language professionals prescribe optimal timetables (and methods) for introducing languages to children to minimize the inevitable confusion. Some linguistic experts consider that these views are “often based on fear and anecdote” (Bialystok, Craik and Luk, 2012). This negative perspective on bilingualism has provided support for the English-only movement (Marschall, Rigby and Jenkins, 2011; Wiley and Wright, 2004), which has thus far not had any proven positive effects on the labor market or the social integration of immigrants (Lleras-Muney and Shertzer, 2015). Moreover, some psychologists embrace the opinion that "bilingual advantages in executive functioning either do not exist or are restricted to very specific and undetermined circumstances" (Paap, Johnson and Sawi, 2015).

In contrast, in this study I show that bilingual subjects outperform their monolingual counterparts on comprehensive academic tests taken in the language of the monolingual test-takers. This is true even when comparing bilingual to monolingual children with similar individual and family socio-demographic characteristics, as well as similar upbringing and schooling. My findings, together with the fact that speaking a language other than English (especially one as prevalent as Spanish) can allow children to bond with older family members and potentially increases their opportunities in the labor market, suggest that raising bilingual children may be advisable. Further research is needed to address whether there is a causal effect of bilingualism on academic achievement.

Bilingualism in the United States is often associated with low socioeconomic status. Indeed, legislation referring to bilingual education is included in federal programs for disadvantaged students (Wiese and García, 2010). Although I capture differences in socioeconomic status through controls, there may be other unobserved negative features associated with low socioeconomic status such as low self-esteem, behavioral problems, etc. that work against the performance of bilingual subjects on cognitive tests. In this sense, my results represent the lower bounds of the bilingual advantage on academic performance.

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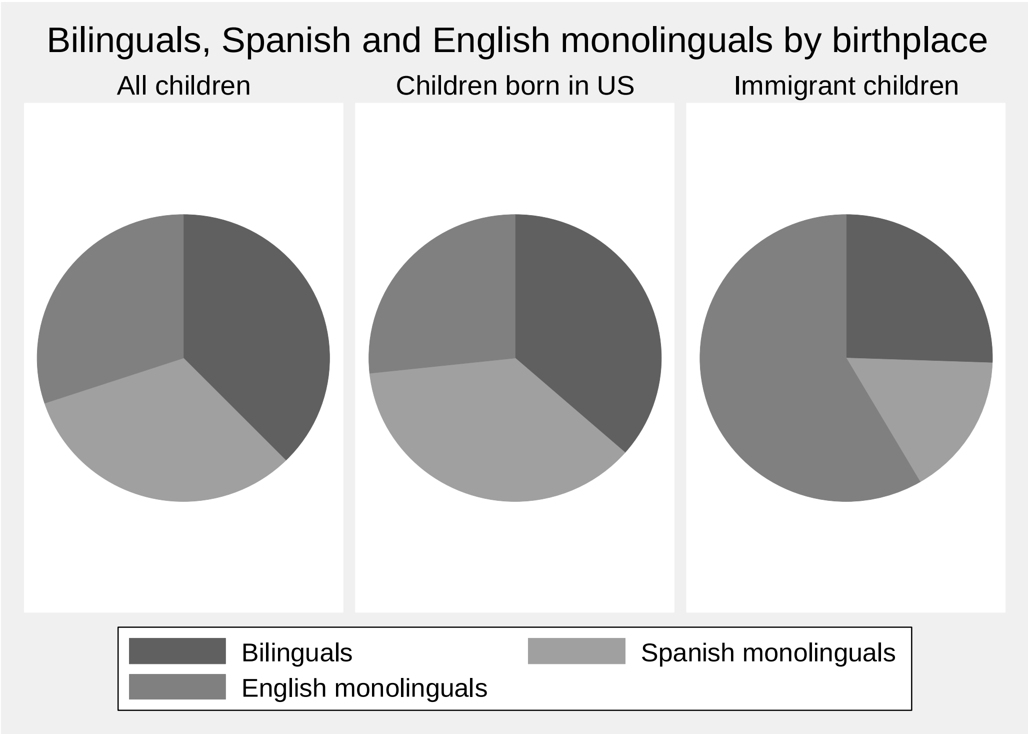
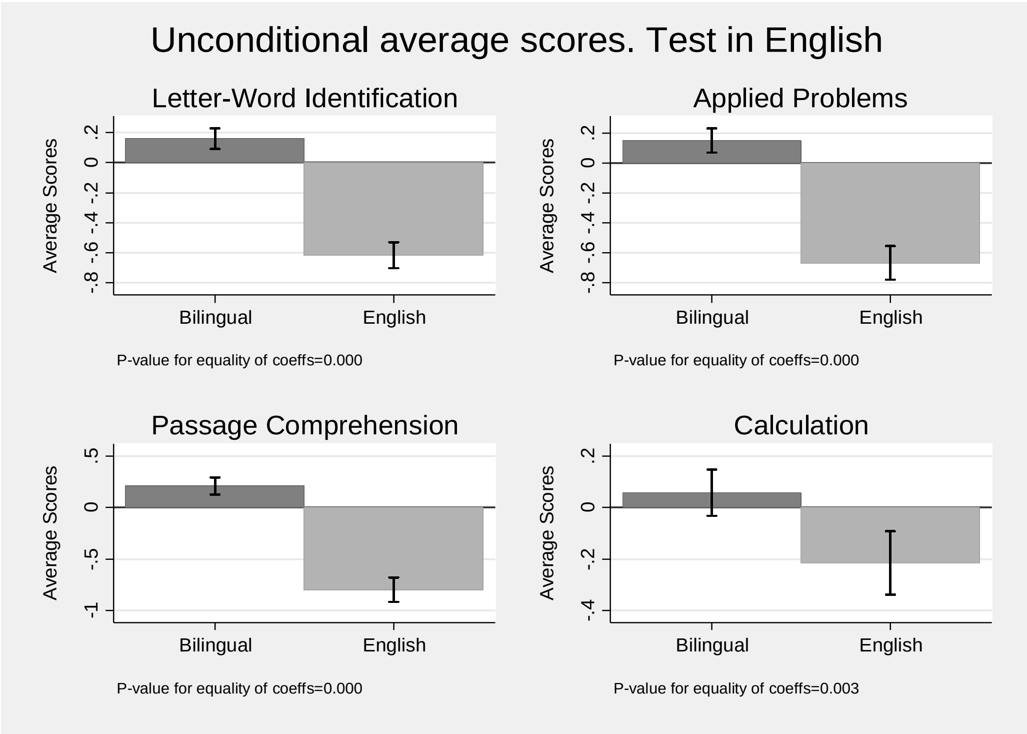
**FIGURES**

**Figure 1**: **Shares of bilingual, Spanish monolingual and English monolingual children by country of birth.**



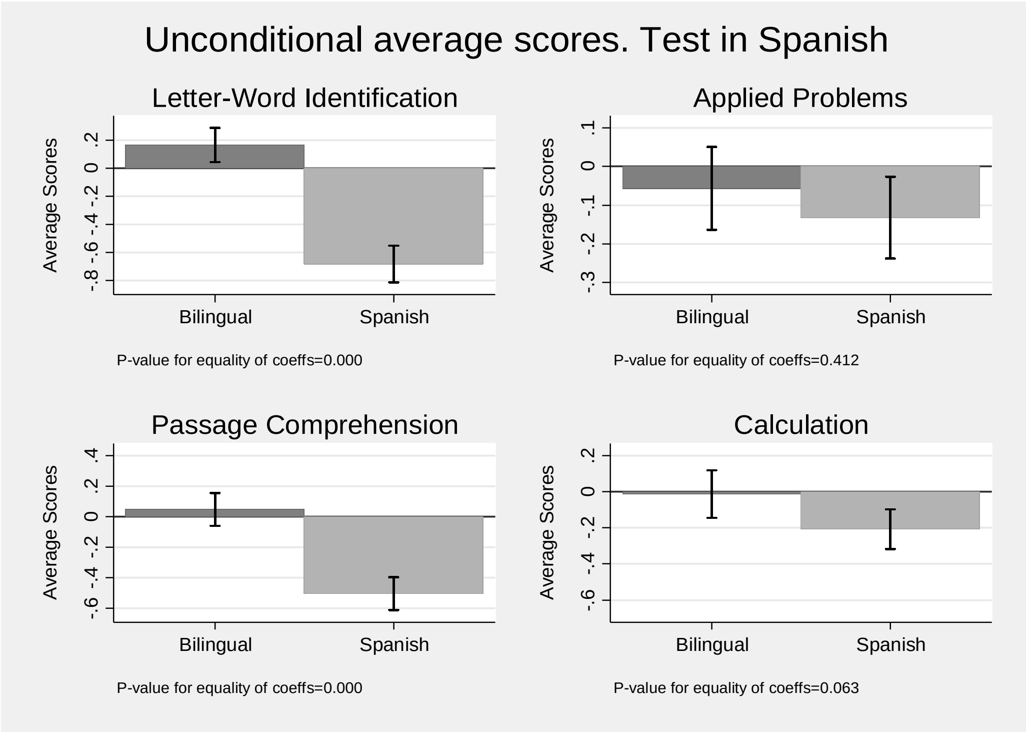

These figures represent the composition of the sample in terms of children that are proficient in English and Spanish, only in Spanish or only in English. Two subgroups are defined according to whether the children were born in the US or abroad.

**Figure 2: Unconditional average test scores for bilingual and English monolingual children**.



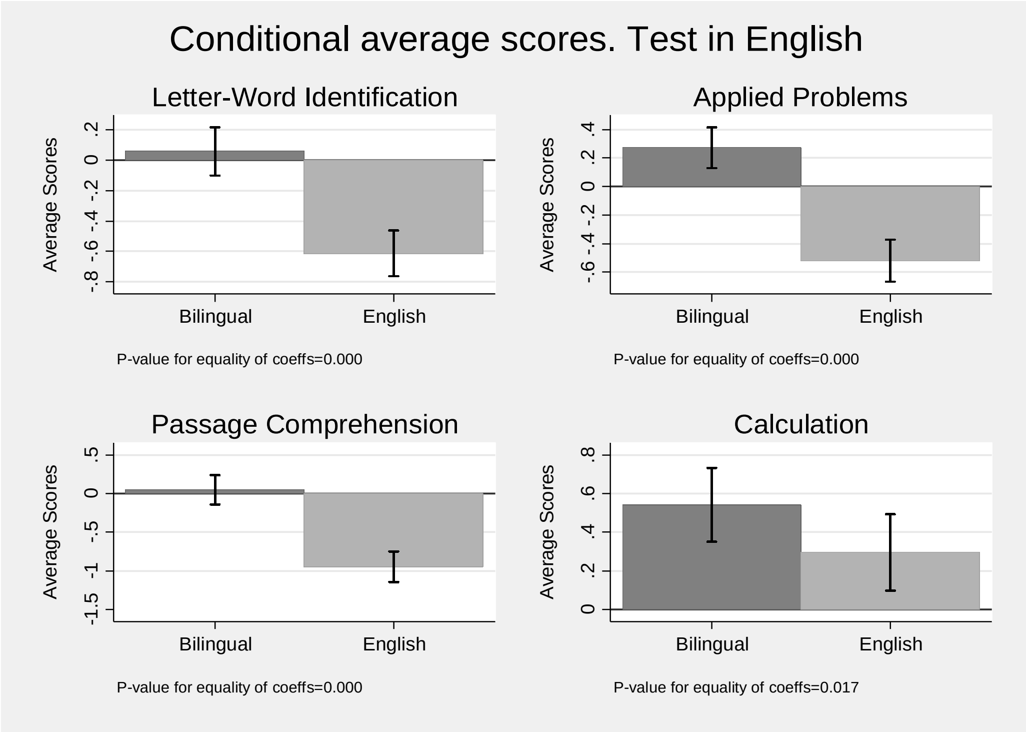

The bars represent the average values of test scores obtained by estimating Equation (1) as specified in the Appendix. The left bar represents bilingual children taking the test in English (coefficient $\alpha_1$) and the right bar refers to monolingual English-speakers taking the test in English (coefficient $\alpha_2$).

**Figure 3: Unconditional average test scores for bilingual and Spanish monolingual children**.



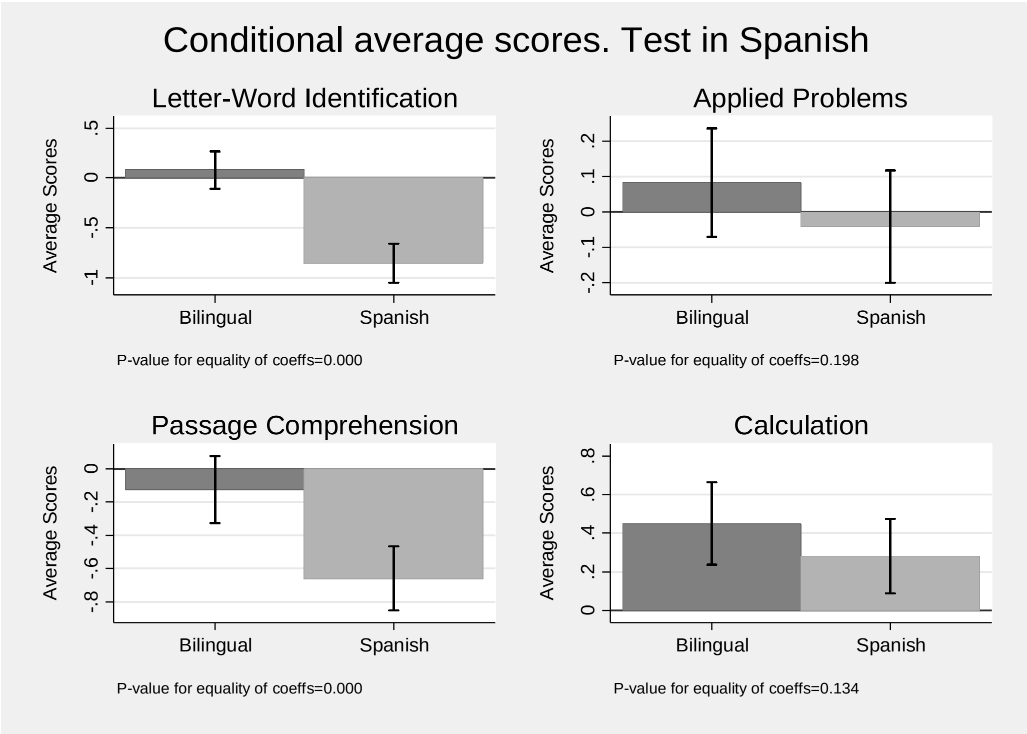

The bars represent the average values of test scores obtained by estimating Equation (1) as specified in the Appendix. The left bar represents bilingual children taking the test in Spanish (coefficient $\alpha_4$) and the right bar refers to Spanish monolingual children (coefficient $\alpha_6$).

**Figure 4: Conditional average test scores for bilingual and English monolingual children**.




The bars represent the average values of test scores obtained by estimating Equation (2) as specified in the Appendix. The left bar represents bilingual children taking the test in English (coefficient $\beta_1$) and the right bar refers to English monolingual children taking the test in English (coefficient $\beta_2$).

**Figure 5: Conditional average test scores for bilingual and Spanish monolingual children**.




The bars represent the average values of test scores obtained by estimating Equation (2) as specified in the Appendix. The left bar represents bilingual children taking the test in Spanish (coefficient $\beta_4$) and the right bar refers to Spanish monolingual children (coefficient $\beta_6$).

## APPENDIX

### Estimation strategy

I obtain the unconditional average test scores of three groups of children (bilingual, Spanish monolingual and English monolingual) by means of the following linear specification that I estimate by Ordinary Least Squares:

$$S_{it} = \alpha_1 \cdot B_{it} \cdot T^E{}_{it} + \alpha_2 \cdot E_{it} \cdot T^E{}_{it} + \alpha_3 \cdot S_{it} \cdot T^E{}_{it} + \alpha_4 \cdot B_{it} \cdot T^S{}_{it} + \alpha_5 \cdot E_{it} \cdot T^S{}_{it} + \alpha_6 \cdot S_{it} \cdot T^S{}_{it} + \varepsilon_{it} \quad (1)$$

where S is one of the four test scores for child i who took the test at time t, B is a binary variable that takes the value one if the child is bilingual, E is an indicator variable equal to one for children who are proficient only in English, S is a dichotomous variable with value one for Spanish monolingual children, $T^E$ is an indicator for the test in English, $T^S$ is the corresponding indicator for the test in Spanish and ε is the error term. Including separated indicators for monolingual Spanish-speakers and English-speakers takes into account that monolingual English-speakers speak the language of the country of residence (and hence the language of instruction at most schools).

In order to estimate cognitive differences among children who are similar in many dimensions except for the language spoken at home, I obtain the conditional mean test scores for the three groups of children. To do this, I expand the equation above as follows:

$$S_{it} = \beta_1 \cdot B_{it} \cdot T^E{}_{it} + \beta_2 \cdot E_{it} \cdot T^E{}_{it} + \beta_3 \cdot S_{it} \cdot T^E{}_{it} + \beta_4 \cdot B_{it} \cdot T^S{}_{it} + \beta_5 \cdot E_{it} \cdot T^S{}_{it} + \beta_6 \cdot S_{it} \cdot T^S{}_{it}$$
$$+ \beta_7 \cdot C_{it} + \beta_8 \cdot I_{it} + \vartheta_{it} \quad (2)$$

where, in addition to the variables defined above, I control for a vector of individual and family characteristics denoted by C and the set of home inputs I. The complete list of controls can be found in Table 1. Finally, $\vartheta$ stands for the resulting error term.

**Data description**

Table 1 shows the corresponding descriptive statistics from NIS. The majority of children in my sample are girls, and they are ten years old and tend to have one younger sibling. Slightly less than a half of the sample took the test in Spanish. The large majority of interviews (66%) were carried out in 2003 and the remaining 34% took place in 2009. Around 40% of children are bilingual, 40% are Spanish monolingual and the remaining 20% are English monolingual.

Regarding parental variables, mothers and fathers are on average around 36 and 39 years old. Only 22% of all fathers and 20% of all mothers are employed, and average hourly wages are around 24 US$. The survey includes the following educational categories: 0 no education, 1 primary education, 2 secondary education, 3 high-school diploma, 4 associate's degree, 5 bachelor's degree, 6 master's degree, 7 PhD, 8 Juris Doctor or Medical Doctor, and 9 other degree. Most mothers and fathers in my sample have an associate's or a bachelor's degree.

Regarding parental language use and proficiency, slightly more than half of all parents speak and understand English well or very well, despite the fact that the vast majority, 85%, did not speak English at the age of 10. The exclusive use of English is much more common at the workplace (27%), compared to social contexts with friends (9%) or at home (4.5%), while other languages tend to be spoken much more frequently at home (58%) or with friends (60%) than at work (39%).

The NIS includes a vast array of variables related to home and school inputs. I carry out a factor analysis to determine the relevant factors for my analysis which are displayed in Panel D.

**Table 1: Descriptive statistics**

**Panel A: Individual characteristics of children**

| VARIABLES | (1) mean | (2) sd | (3) min | (4) max |
|---|---|---|---|---|
| Letter-Word score | -0.0662 | 1.054 | -5.120 | 2.836 |
| Applied Problems score | -0.128 | 0.933 | -3.979 | 5.762 |
| Passage Comprehension score | -0.120 | 0.920 | -4.516 | 3.068 |
| Calculation score | -0.0747 | 0.902 | -4.355 | 2.965 |
| Male | 0.260 | 0.439 | 0 | 1 |
| Age | 10.38 | 2.942 | 6 | 17 |
| Number of siblings | 1.418 | 0.850 | 0 | 5 |
| Mean age of siblings | 8.274 | 4.064 | 0 | 18 |
| Second wave | 0.339 | 0.473 | 0 | 1 |
| Bilingual – test in Spanish | 0.185 | 0.388 | 0 | 1 |
| Spanish monolingual – test in Spanish | 0.204 | 0.403 | 0 | 1 |
| English monolingual – test in Spanish | 0.0960 | 0.295 | 0 | 1 |
| Bilingual – test in English | 0.212 | 0.409 | 0 | 1 |
| Spanish monolingual – test in English | 0.209 | 0.407 | 0 | 1 |
| English monolingual – test in English | 0.0945 | 0.293 | 0 | 1 |

**Panel B: Parental characteristics**

| VARIABLES | (1) mean | (2) sd | (3) min | (4) max |
|---|---|---|---|---|
| Father’s year of birth | 1,965 | 4.317 | 1,921 | 1,980 |
| Mother’s year of birth | 1,968 | 4.115 | 1,950 | 1,982 |
| Father employed | 0.222 | 0.318 | 0 | 1 |
| Mother employed | 0.198 | 0.322 | 0 | 1 |
| Father unemployed | 0.0156 | 0.0687 | 0 | 1 |
| Mother unemployed | 0.0569 | 0.178 | 0 | 1 |
| Father’s wage | 2.525 | 13.05 | 0 | 122.8 |
| Mother’s wage | 2.386 | 12.38 | 0 | 97.50 |
| Father’s degree | 4.636 | 0.664 | 1 | 9 |
| Mother’s degree | 4.273 | 0.694 | 0 | 9 |
| Parents coming from different country | 0.0835 | 0.277 | 0 | 1 |

**Panel C: Parental language use and proficiency**

| VARIABLES | (1)<br>mean | (2)<br>Sd | (3)<br>min | (4)<br>max |
|---|---|---|---|---|
| Parent English and other lang. at age 10 | 0.0588 | 0.130 | 0 | 1 |
| Parent only English at age 10 | 0.00790 | 0.0282 | 0 | 1 |
| Parent only other language at age 10 | 0.845 | 0.183 | 0 | 1 |
| Parent English and other lang at home | 0.331 | 0.298 | 0 | 1 |
| Parent only English at home | 0.0447 | 0.0660 | 0 | 1 |
| Parent only other language at home | 0.581 | 0.315 | 0 | 1 |
| Parent English and other lang at work | 0.303 | 0.314 | 0 | 1 |
| Parent only English at work | 0.271 | 0.239 | 0 | 1 |
| Parent only other language at work | 0.386 | 0.341 | 0 | 1 |
| Parent English and other lang with friends | 0.268 | 0.260 | 0 | 1 |
| Parent only English with friends | 0.0872 | 0.112 | 0 | 1 |
| Parent only other lang with friends | 0.602 | 0.318 | 0 | 1 |
| Parent understands English | 0.465 | 0.305 | 0 | 1 |
| Parent speaks English | 0.385 | 0.285 | 0 | 1 |

**Panel D: Home and school inputs**

| VARIABLES | (1)<br>mean | (2)<br>sd | (3)<br>min | (4)<br>max |
|---|---|---|---|---|
| Parents show interest in school | -0.0502 | 0.617 | -2.741 | 1.250 |
| Reading material at home | 0.0156 | 0.477 | -3.010 | 1.581 |
| Technology at home | -0.0829 | 0.481 | -1.755 | 2.414 |
| School offers language support | 0.00395 | 0.577 | -0.983 | 4.346 |
| School characteristics | 0.0330 | 0.272 | -3.441 | 0.879 |
| Parents impose limits | 0.0507 | 0.500 | -2.343 | 2.076 |
| Calculator &dictionary at home | 0.0102 | 0.503 | -3.530 | 1.633 |
| Home country school charact. | 0.0370 | 0.425 | -6.251 | 1.334 |

Data source: New immigrant survey. The sample is composed by all the children included in the estimations.