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IZA DP No. 11685

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ABSTRACT

Do You Speak My Language? The Effect of Sharing a Teacher's Native Language on Student Achievement

A large body of research has found that, by being better able to serve as cultural translators and role models, demographically-similar teachers can increase students' achievement. These studies have tended to focus on the role of race and gender similarities between student and teacher. This study is the first to examine the role of native language similarity. Using a nationally representative dataset from the United States which allows each student to be matched with two of his subject teachers, this study exploits variation in contemporaneous test scores and whether the student shares the same native language as the teacher across two different academic subjects, within-student, to identify the effect of being assigned to a linguistically-similar teacher. The effect is examined separately for students who are native Spanish-speakers and students who are native English-speakers. It finds that, unconditional on teacher ethnicity, assignment to a native Spanish-speaking teacher reduces the achievement of native Spanish-speaking students, particularly in Science and English. However, once differences in teacher ethnicity are controlled for, a native Spanish-speaking student does no worse or better on his test score when assigned to a native Spanish-speaking teacher than when assigned to a non-native Spanish-speaking teacher. For native English-speaking students, assignment to a linguistically-similar teacher has no impact on achievement. This finding applies regardless of whether teacher ethnicity is controlled for.

JEL Classification: I21, J15

Keywords: native language, student achievement, student fixed effects

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1 Introduction

Rising international migration and the increased enrolment of children who are not native speakers of English in U.S. public schools has led to a renewed focus on the role of native language in classroom instruction. Many schools which have chosen to adopt the bilingual instruction route, offering bilingual education to their English learner students, have in recent years, struggled to find enough bilingual teachers for these programmes (O'Connor, 2015; Mitchell, 2016). One response to this bilingual teacher shortage has been to extend the recruitment search abroad (Mitchell, 2016). This has led some to question whether this overt attention to native language is justified (Chin, 2015; Barrow and Markman-Pithers, 2016).

More generally, without restricting the focus to only English learners, linguistic similarities (or differences) between students and teachers may matter for how well students perform academically for a number of reasons. Firstly, students may be able to comprehend the course material better when they receive instruction from teachers who share the same native language. For students who are non-native speakers of the host-country language, having a teacher with the same native language may make the course content more accessible since teachers can potentially communicate the content to students in a language they are familiar with. That is, these teachers have the potential to act as language and cultural translators (Egalite et al., 2015). Meanwhile, to the extent that teachers who are non-native speakers of the host-country language are less proficient in the language of instruction or have accents which impede student understanding, having a teacher who is a non-native speaker of the host-country language may make the course content less accessible for students who are native speakers[1]. Secondly, teachers who speak the same native language may potentially serve better as role models for students. This "role model" effect may spur students to become more motivated, and hence higher-achieving, when they share the same native language as the teacher (Dee, 2004; Paredes, 2014). Thirdly, teachers may consciously or unconsciously prefer students that speak the same native language as them. This "teacher bias" effect implies that teachers may have higher expectations for students who speak the same native language as them, and this could translate eventually into higher student achievement (Dee, 2004; Paredes, 2014).

[1] Having such a teacher could also make the course content less accessible for students who are non-native speakers of the host-country language.

Although research assessing the effect of teacher language is scant, issues of teachers' native language and how best to deal with them, have nevertheless, found their way into policy debates. For instance, until 2011, Arizona's Department of Education had a practice of evaluating the English language fluency of teachers who taught limited English proficient (LEP) students[2]. Teachers who were deemed not to be fluent in English or who spoke English with a heavy accent were required to be temporarily reassigned away from classes for LEP students, while schools worked with them to address these "imperfections" (Jordan, 2010; Lacey, 2011; Hanna and Allen, 2013). The practice was motivated by the state's Department of Education beliefs that teachers who were not fluent in English or who spoke English with a heavy accent could be impeding the learning progress of students.

This paper contributes to the debate on the role of teachers' native language and how it affects student achievement in the United States, by examining whether the assignment of students to a teacher with the same native language influences their academic achievement, both for students whose native language is English and for students whose native language is Spanish.

To this end, I use data from the United States National Education Longitudinal Study of 1988 (NELS 1988), which provides me with, among other things, subject-specific test scores for 8th grade students in 2 academic subjects as well as information on the native language of their teachers in those 2 subjects. Variation in test scores and native language of teachers across the 2 subjects *within-student* is exploited to identify the effect of having a linguistically-similar teacher.

I find that, unconditional on teacher ethnicity, assignment to a linguistically-similar teacher has no effect on the achievement of native English-speaking students but has a negative impact on the achievement of native Spanish-speaking students. The effect on Spanish-speaking students varies, however, depending on the subject of instruction: while negative effects are found for Science and English, no statistically significant effects are found for Mathematics and Social Studies. These results change dramatically once controls for teacher ethnicity are included. More specifically, conditional on teacher ethnicity, assignment to a linguistically-similar teacher is found to have a small and statistically insignificant effect on the achievement of native Spanish-speaking students. This change suggests that the results from specifications which do not control for teacher ethnicity are, in fact, capturing the effects

[2] The terms "limited English proficient / LEP students" are used interchangeably with "English learners".

of teacher ethnicity rather than native language. In other words, the reason we find that assignment to a linguistically-similar teacher hurts the achievement of native-Spanish speaking students is not because of native language per se but because White teachers (who tend to be native English speakers) are more effective than Hispanic teachers (who tend to be native Spanish speakers) at teaching native Spanish-speaking students[3]. Once we control for teacher ethnicity, however, a student who is assigned to a teacher with the same native language does no worse or better than if he were assigned to a teacher with a different native language.

While studies assessing the impact of assignment to demographically-similar teachers have largely considered the roles of race and gender (Dee, 2004, 2005, 2007; Carrell et al., 2010; Egalite et al., 2015; Antecol et al., 2015; Lim and Meer, 2017; Penney, 2017), no study I am aware of has considered the role of native language. This study adds to the growing body of literature on demographically-similar teachers by being the first to evaluate whether native language similarities between students and their teachers influence how well students perform.

Because reliable identification of causal effects hinges on the assumption that, within schools, students are not systematically assigned to linguistically-similar or dissimilar teachers across subjects based on their subject-specific propensities for achievement, results from tests which examine how likely this assumption could be violated will also be presented.

[3] The estimated coefficients on the teacher ethnicity dummies in specifications which control for teacher ethnicity indicate this.

2 Literature Review

Researchers have sought to understand various aspects relating to students' home language use and how it interacts with language development programmes and teacher characteristics. Two questions have chiefly dominated this literature: (1) Does an achievement gap exist between English learners (also known as LEP students) and English proficient students? (Fry, 2007, 2008; Chin, 2015; Barrow and Markman-Pithers, 2016) and (2) how best should schools educate English learners? (Chin, 2015; Barrow and Markman-Pithers, 2016). That is, do English learners learn better under programmes in which at least some instruction is provided in the student's native language (henceforth known as bilingual education programmes) or programmes which use only English (henceforth known as English-only programmes)[4]?

While the first question has thrown up largely consistent findings, with the majority of studies supporting the notion that English language learners in the United States lag considerably behind their English-proficient counterparts in terms of core academic skills and educational attainment (Fry, 2007, 2008; Chin, 2015; Barrow and Markman-Pithers, 2016), answers to the second question are less definite. Part of the reason for the lack of agreement on programme effectiveness is due to the fact that different studies have used different identification strategies (most have relied on observational data, though more recent studies have attempted to exploit random variation in assignment to bilingual education and English-only programmes, using actual experiments or quasi-experimental methods[5]), data from different states and schools, examined different outcomes (some evaluate the effect on English / native language proficiency while others evaluate the effect on acquisition of core academic skills), looked at outcomes over different time horizons (some focus on assessing the short-term impact while others look at longer-term impact), and defined bilingual education differently. Indeed, even within the broad categories of bilingual education and English-only programmes, a number of sub-categories are available, and some in the same broad category

[4] Under the United States Civil Rights Act of 1964 and the Equal Educational Opportunities Act of 1974, public schools are required to support the needs of LEP students. In practice, this has largely meant offering additional instructional services to LEP students in the form of either bilingual education or English-only programmes, both of which are designed to help these students achieve English language proficiency.

[5] Selection of LEP students into bilingual education and English-only programmes is not random. Students who participate in bilingual education programmes are likely to differ systematically from those who participate in English-only programmes in observable and unobservable ways. As such, achievement differences between students in both types of programmes cannot be relied on to reveal causal effects.

could be quite different from others. For instance, there might be a fair bit of variation in how much of the student's native language is actually used even among programmes classified as "bilingual education". Since some subcategories of programmes may be more prevalent in some states than in others, the compositional difference in programmes across states might explain some of the difference in findings across studies. Also, not all bilingual education programmes are similar in quality. Heterogeneity in the quality of programmes across schools might offer yet another explanation for the difference in findings across studies.

Despite the lack of firm conclusions regarding the effectiveness of different programmes for LEP students, results from recent studies based on experimental and quasi-experimental approaches (specifically, regression discontinuity designs), seem to suggest that while assignment to bilingual education programmes (relative to English-only programmes) might hurt LEP students' English language skills somewhat in the short-term, LEP students in these programmes eventually catch up, so that bilingual education is neither better nor worse (than English-only programmes) for improving the English language skills and achievement of LEP students in the long-run (Matsudaira et al., 2005; Slavin et al., 2011; Chin et al., 2013).

Most of the debate surrounding student home language has focused on LEP students. However, a strand of this literature has examined the case for native English-speakers. In particular, these studies ask (3) whether assignment to non-native (i.e. immigrant) teachers matters for the academic achievement of native students. Findings from this strand of literature have varied considerably, from studies which find that non-native teachers have a positive effect on native student achievement (Fleisher et al., 2002) to those which find either neutral (Asano, 2008; Seah, 2018), or negative effects (Borjas, 2000). The overwhelming majority of these studies have examined student experience at the undergraduate level. They ask: do immigrant professors and teaching assistants (or do professors and teaching assistants who are non-native speakers of the host-country language) have an impact on the achievement of native undergraduates? The lack of consensus among these studies largely stems from the fact that the data used by different studies come from different universities (Seah, 2018). Since universities differ in their staff hiring practices, with some universities potentially having more stringent recruitment requirements than others (so that only the most effective immigrant / non-native language applicants make the cut in some universities), the results from these studies possess limited external validity. The only known study which focuses on the experience of younger students – specifically 8th grade students in the United States – is Seah (2018). That

study finds that native students assigned to immigrant teachers do no worse on achievement tests compared to native students assigned to native teachers.

Despite efforts to answer questions (1), (2), and (3), no study I am aware of has assessed the impact of having a linguistically-similar teacher on student outcomes. While questions (2) and (3) are closely related to this question, they are nonetheless distinct. As noted in footnote 4, under the Civil Rights Act of 1964 and the Equal Educational Opportunities Act of 1974, schools are required to offer additional help to LEP students, and in practice, this has meant that LEP students participate either in bilingual education or English-only programmes, both of which are designed to improve the English language proficiency of these students. As such, studies which answer question (2) have mainly compared students from these two types of programmes – bilingual education and English-only – to evaluate which works better for LEP students. Because LEP children might receive instruction from non-native English-speaking teachers who speak the same native language as them under both types of programmes and because the estimated effectiveness of one type of programme over the other does not only reflect differences in the usage of the student's native language across those programmes but also differences in various other organizational aspects such as the kinds of peers students are exposed to, differences in student performance across bilingual and English-only programmes are not indicative of the achievement effect of having a linguistically-similar teacher[6].

Hence, while question (2) is one that seeks to understand which type of instruction is better for LEP students, the aim of the current paper is to understand whether assignment to a linguistically-similar teacher has an effect on students' academic achievement (regardless of whether the student is limited English proficient). In particular, the impact of assignment to a linguistically-similar teacher is evaluated for native English-speaking students, non-native English-speaking students, and in some cases, even for non-native English-speaking students who are English-proficient (i.e. non-native English-speaking students who are non-LEP).

Question (3) is similarly distinct from the one studied in this paper. While question (3) asks whether immigrant / non-native language speaking teachers have an effect on native

[6] Indeed, bilingual education and English-only programmes do not only differ in their usage of the student's native language but also in other ways such as peer exposure. For instance, because part of the instruction in bilingual education programmes is delivered in students' native language, students in such programmes tend to be grouped into self-contained classes with other students who share the same native language (Chin, 2015). Under bilingual education, therefore, LEP students have less exposure, on average, to native English-speaking students (compared to LEP students in English-only programmes). Therefore, the difference in effectiveness between bilingual and English-only programmes could partly be reflecting the effect of isolation of LEP students in bilingual programmes to peers who share the same native language.

students' achievements, the question examined in this paper asks whether having a linguistically-similar teacher matters for student achievement. Since immigrant teachers / teachers whose first language is not the host-country's language are a broad category of individuals, comprising teachers who speak a variety of native languages, the question posed in this paper, being one which emphasizes the exact native language used, is conceptually different.

Apart from the abovementioned strands of literature, this paper is also closely related to the literature that examines the effects of having a demographically-similar teacher on student outcomes. Studies in this literature have looked at the impact of assignment of students to a teacher of the same race and gender, with the majority finding that having a demographically-similar teacher has neutral to positive impacts on student achievement, students' perceptions of the subject, and teachers' evaluations of the student (Dee, 2004, 2005, 2007; Carrell et al., 2010; Egalite et al., 2015; Antecol et al., 2015; Lim and Meer, 2017; Penney, 2017).

3 Data

The data used in this study is from the National Education Longitudinal Study of 1988 (henceforth known as NELS 1988). NELS 1988 is a nationally representative, longitudinal study, which began in 1988 with a sample of 24,599 8th grade students from 1,052 schools across the United States. The study followed the sample of students from their secondary years through to their post-secondary lives (years 1988, 1990, 1992, 1994, 2000).

NELS 1988 was based on a two-stage sampling design. First, schools were selected with probabilities proportional to their estimated eight-grade enrollment. Next, within each school, approximately 26 students were randomly selected to be in the sample.

NELS 1988 fielded questionnaires to students and their parents, to collect information on a variety of demographic (e.g. ethnicity, gender) and family-related characteristics (e.g. family income, number of people living in the student's home, educational attainment of the mother and father) as well as the student's past achievement in each academic subject (e.g. whether the student received mostly A's, B's, C's, D's or below D's in each subject – Science, Mathematics, English, and Social Studies – from grade 6 up till the survey date)[7]. Importantly, the base year (i.e. 1988) student questionnaire posed a series of questions on language use, allowing one to identify each student's native language. Specifically, each student was asked the following: (a) "Before you started going to school, did you speak any language other than English?" Students could either respond "Yes" or "No". If they answered "Yes", they were asked a follow-up question (b) "What was the first language you learned to speak when you were a child?". 13 options were given: "English", "Spanish", "Chinese", "Japanese", "Korean", "Filipino", "Italian", "French", "German", "Greek", "Polish", "Portuguese", or "Other Language"[8]. A student is classified as a native-speaker of English if he or she answered "No" to question (a) or chose the option "English" to question (b). Otherwise, the student is classified as a native-speaker of the language chosen in (b).

Because one of the main objectives of NELS 1988 was to evaluate how school attributes and various elements of the educational system were related to academic achievement, students

[7] Each student had to answer the student survey. One parent of each student – the parent who was most familiar with the student's school situation – was asked to respond to the parent survey. Questionnaires were fielded to students in all study years (1988, 1990, 1992, 1994, 2000) and to parents in the base year and the second follow-up (1988, 1992).

[8] "English" was offered as an option since the student may have learned another language before starting school, even though English was the first language he/she learned to speak as a child.

had to complete a series of curriculum-based cognitive tests that measured their ability in four subject areas – Science, Mathematics, English, and Social Studies[9].

To provide contextual information, teachers were surveyed along with students. However, not all teachers for a given student were surveyed. Instead, in any study year, only 2 teachers were sought for each student. Selection of teachers was based on random assignment of schools to one of four subject area groupings: (i) English and Mathematics (ii) English and Science (iii) Social Studies and Mathematics (iv) Social Studies and Science. Each student's teachers in the 2 designated subject areas were then contacted for the survey. The teacher questionnaire elicited detailed background information on the teacher, including demographic (e.g. gender, ethnicity) and professional characteristics (e.g. type of teaching certification, educational attainment, subject of instruction, whether the teacher majored in the subject of instruction, years of teaching experience, employment status). Importantly, the base year (1988) teacher questionnaire posed the following 4 questions, which allow one to identify the teacher's native language. Specifically, each teacher was asked: (c) "Are you proficient in any language(s) other than English?" Teachers could either respond "Yes" or "No". If they answered "Yes", they were asked: (d) In what language(s) are you proficient? 13 options were given: "Spanish", "Chinese", "Japanese", "Korean", "A Filipino Language", "An Indochinese Language", "Italian", "French", "German", "Greek", "Polish", "Portuguese", or "Other Language"; teachers had to circle all that applied. Following this, the teacher was asked to (e) write the name of the non-English language in which he or she was *most proficient* in and to indicate if the following statement was true: (f) "I am a native speaker of the language". A teacher is classified as a native-speaker of English if he or she answered "No" to question (c) or if he or she did not indicate being a native speaker of the non-English language. Otherwise, the teacher is classified as a native-speaker of the language indicated in (e).

Since the non-English language options provided to students and teachers were identical (apart from the extra option of "An Indochinese Language" offered to teachers), I am able to tell if the native language of the student matches exactly that of the teacher[10].

[9] The English test consisted of five short passages followed by comprehension and interpretation questions. The Mathematics test consisted of quantitative comparisons and other questions assessing knowledge in Mathematics. The Science test consisted of questions assessing scientific reasoning ability and knowledge in Science. The Social Studies test consisted of questions that assessed knowledge of United States history, civics, and government.

[10] One exception where I cannot tell if the native language of the student matches that of the teacher is if the student reports "Other Language" as his/her native language: In the case that the student's teacher reports a specific native language, we will be able to tell if the student and the teacher have a different native language.

Because the language questions were posed to students and their teachers only in the base year of 1988, this paper uses only data from that year. Since each student's current and past academic achievements, teachers, and classrooms are available for two different subjects that year, NELS 1988 effectively provides one with a panel dataset, where each student's achievements, teacher traits and classroom characteristics are observed in two different subjects. The only difference is that, whereas a traditional panel dataset provides observations on the same student at various points in time, here, we have observations on the same student in two different subjects instead.

I restrict my sample to only students with no missing information on test scores and native language, and who had teachers in both designated subjects that provided information on their native languages. This restriction resulted in a final dataset consisting of 19,319 students and 38,638 matched-pair observations (each student appears twice in the dataset).

<Insert Figure 1 here>

<Insert Figure 2 here>

Although it would be insightful to analyze how having a teacher with the same native language affects outcomes separately for each student language group (since there is no reason why this effect should be the same across all student language groups), this is not possible in practice because of the small number of students who spoke languages other than English and Spanish (the number of students who spoke Chinese, Japanese, Korean, Italian, French, German, Greek, and Polish in the dataset was 156, 32, 105, 32, 72, 54, 18, and 11 respectively[11]). To provide a clearer picture of the distribution of students' first languages[12], Figure 1 shows the share and number of native English-speaking students to non-English native-speaking students in the sample while Figure 2 shows the share and number of students speaking each language among students who speak a non-English native language. Because of

But we will not be able to tell if the student and the teacher share the same native language, since even in the case where the teacher reports speaking "Other Language" as well, their native languages might still differ. Given this paper's objective of evaluating the effect of assignment to linguistically-similar teachers, only students that report a specific native language other than "Other Language" would constitute useful observations. Hence, I drop all students if their native language is "Other Language".

[11] I removed students whose native languages were Portuguese because there were no native Portuguese - speaking teachers in subject 2 (English and Social Science). I also removed students whose native language was Filipino because while teachers were given the options of "A Filipino language" as well as "An Indochinese language", students were given only the option of "Filipino language". Since it is unclear how the "Filipino language" option provided to students is related to the "*A* Filipino Language" and "An Indochinese language" options provided to teachers, students who identified themselves as speaking the "Filipino language" were removed.

[12] The terms "first language" and "native language" are used interchangeably.

the small numbers of students who spoke languages other than English and Spanish, I analyze the effect of having a linguistically-similar teacher only for students from the two dominant language groups – English and Spanish[13].

<Insert Table 1A here>

<Insert Table 1B here>

Do students who share the same native language as their teacher perform differently from students who do not? Panels A of Tables 1A and 1B compare the subject test scores of students taught by teachers with the same native language and students taught by teachers who had a different native language, separately for native Spanish-speaking students (Table 1A) and native English-speaking students (Table 1B). All test scores in this paper are normalized, by subject, to a mean of 0 and a standard deviation of 1. Interestingly, the comparisons reveal that native Spanish-speaking students perform worse in Mathematics and English when taught by teachers with the same native language. The test score gaps are large, approximately 0.16 of a standard deviation for Math and 0.18 of a standard deviation for English. These differences are statistically precise enough (at the 5% level) to rule out the hypothesis that these gaps are merely chance findings. The pattern of findings is, however, quite different for native English-speaking students. For this group, students perform better in Science and Mathematics when taught by teachers with the same native language (though the same cannot be said for English and Social Studies). The test score gaps are large as well, about 0.21 of a standard deviation for Science and 0.27 of a standard deviation for Mathematics, both statistically significant at the 1% level.

Although Panels A of Tables 1A and 1B indicate that students with same native language teachers perform differently from those with different native language teachers, at least part of the test score gap might be due to differences in student characteristics. This is evidenced by Panels B of Tables 1A and 1B, which show the average characteristics of students who do and do not have a teacher with the same native language, by subject. For instance, native Spanish-speaking students with native Spanish-speaking teachers are less likely to have parents who graduated from college and less likely to be from families with annual incomes of $35,000 or

[13] Teachers of native English-speaking students that do not share the same native language are native speakers of either Spanish, Chinese, Japanese, Korean, Filipino, Indochinese, Italian, French, German, Greek, Polish, Portuguese, or "Other Language". Teachers of native Spanish-speaking students that do not share the same native language are native speakers of either English, Chinese, Japanese, Korean, Filipino, Indochinese, Italian, French, German, Greek, Polish, Portuguese, or "Other Language".

more. Their families are also larger on average. For native English-speaking students too, we find that the average characteristics of those with native English-speaking teachers differ from those with non-English native-speaking teachers. However, how the characteristics differ depends on the subject being taught. For Science and Mathematics, those with native English-speaking teachers are more likely to have parents who graduated from college and more likely to be from families with annual incomes of $35,000 or more. Their families are also smaller. However, for English and Social Studies, those with native English-speaking teachers are actually less likely to have parents who graduated from college. In any case, because these student characteristics are likely to be correlated with both student achievement and whether the student has a teacher with the same native language, simple test score comparisons between students with teachers who have the same native language and students with teachers who don't, will not provide the causal effect of interest.

In order to reliably identify the causal effect of having a teacher with the same native language, both groups of students – those who have teachers with the same native language, and those who do not – have to be as similar as possible, with the only difference between them being whether or not they were assigned to a teacher who spoke the same native language. This way, any difference in test scores can be attributed solely to the effect of teacher language. A potential way to approximate such a comparison is to exploit a student fixed effects strategy, comparing test scores across subjects within-student, in subjects where a student shares the same native language as the teacher and in subjects where that same student does not. This is the approach used in this paper (the empirical framework is explained in Section 4).

Although the NELS 1988 is rather dated, it is perhaps the most appropriate dataset for the research question at hand because it is the only nationally representative dataset I am aware of, which asks students and their teachers in more than one academic subject about their language use, allowing one to know whether the student shares the same native language as his or her teachers in 2 different subjects. Because of the availability of each student's native language, achievement, and teachers' native language in 2 different subjects, I am able to implement the student fixed effects strategy mentioned above.

4 Empirical Framework

The econometric specification takes the following form:

$$y_{itj} = \boldsymbol{X}_i'\beta + \delta L_{tj} + \boldsymbol{Z}_{tj}'\gamma + \boldsymbol{D}_j'\eta + \left(\mu_i + \mu_{ij} + \varepsilon_{itj}\right) \qquad (1)$$

where y_{itj} denotes the academic achievement of student i with teacher t in subject j; $\boldsymbol{X}_i$ denotes a vector of observed student and family characteristics; $\boldsymbol{Z}_{tj}$ denotes a vector of observed teacher and class characteristics pertaining to teacher t in subject j; and $\boldsymbol{D}_j$ denotes a set of subject dummy variables, representing all but one subject (i.e subject fixed effects). β and γ represent respectively the return to student and family characteristics and the return to teacher and class characteristics. η are the coefficients on the subject dummy variables. The variable of interest is L_{tj}, a dummy variable which takes on a value of 1 if the student and the teacher share the same native language and a value of 0 if they do not. The error in equation (1) consists of three terms, μ_i, μ_{ij}, and ε_{itj}, which represent respectively, unobserved determinants of student achievement which vary across students but not across subjects for each student, unobserved determinants of student achievement which vary across both students and subjects, and a mean zero error term.

The coefficient of interest is δ, which represents the causal effect on student achievement of having a teacher who shares the same native language as the student.

If teachers were assigned to students either randomly or solely on the basis of observed student characteristics, then an OLS regression of y_{itj} on L_{tj}, with controls for $\boldsymbol{X}_i$, $\boldsymbol{Z}_{tj}$, and $\boldsymbol{D}_j$ (equation (1)) would suffice to yield an unbiased estimator of δ. In reality, however, teachers are unlikely to be either randomly assigned or assigned to students solely on the basis of their observed characteristics. Instead, assignment could be based partly on students' unobserved traits, such as their innate ability or motivation. Non-random matching of students with teachers occurs because of a tendency for teachers and students to sort themselves at two levels (Clotfelter et al., 2006). The first is at the school level: teachers and students are not simply assigned to schools, but rather, make a choice on which schools to go to. If, for instance, non-native English-speaking teachers have a greater tendency to sort themselves into schools where students have a lower unobserved propensity for achievement (lower innate ability or motivation), then this non-random sorting behaviour *across* schools would mean that non-

native English-speaking teachers have a greater tendency to be matched with lower-achieving students. Non-random sorting can take place across classrooms *within* schools as well. This could happen if, for instance, non-native English-speaking teachers have a tendency to be assigned to classes that are lower-achieving. The latter should not be too surprising once one considers that many schools typically employ Spanish-speaking teachers to cater to the needs of Spanish-speaking immigrant students, many of whom read English as a second language (Mitchell, 2016). Since immigrant students tend to do worse on achievement tests than native students, this assignment pattern could again result in a tendency for native Spanish-speaking teachers to be matched with students with a lower unobserved propensity for achievement, within schools.

The patterns of sorting described above – both across schools and across classrooms within schools – imply that the error term in equation (1) would be correlated with L_{tj}. This is because teacher native language (L_{tj}) would be correlated with unobserved student traits that influence achievement such as ability and motivation ($\mu_i + \mu_{ij}$). As such, even after controlling for $\boldsymbol{X}_i$, $\boldsymbol{Z}_{tj}$, and $\boldsymbol{D}_j$, OLS estimation of equation (1) will not yield unbiased estimates of the true δ.

To address the bias in the estimator of δ that arises due to the non-random sorting of teachers and students across schools and across classrooms within schools, I exploit the matched-pairs nature of the NELS 1988 dataset, essentially comparing student performance across the two subjects within-student, one in which a student shares the same native language as the teacher and another in which that same student does not. In other words, I exploit variation in test scores and native language of teachers across subjects *within-student* to identify the effect of having a teacher with the same native language. As discussed in Section 3, NELS 1988 contains test scores for 8th graders in two subjects as well as data on their teachers for those subjects. This therefore makes it possible to study how differences in student achievement across subjects for each student are related to differences in whether the student shares the same native language as the teacher across those subjects, and in so doing, control for any unobserved (and hence, omitted) determinants of student achievement which do not vary across subjects.

Operationally, this is achieved by including a set of student dummy variables for all but one student (i.e. student fixed effects) in equation (1). Doing so effectively moves μ_i (unobserved student and family background characteristics which vary across students but not

across subjects) out of the error term in equation (1). More precisely, the student dummy variables will absorb the influences of all subject-invariant determinants of student achievement – whether or not they are observed – and hence controls for the effects of all variables in $\boldsymbol{X}_i$ and μ_i. This therefore mitigates the bias which results from the omission of any student determinants of achievement which are subject-invariant.

$$y_{itj} = \boldsymbol{X}_i'\beta + \delta L_{tj} + \boldsymbol{Z}_{tj}'\gamma + \boldsymbol{D}_j'\eta + \mu_i + (\mu_{ij} + \varepsilon_{itj}) \qquad (2)$$

This method, which is termed the *within-student* approach, will produce an unbiased estimator of δ as long as one of two conditions hold: either (i) all unobserved student traits which influence achievement are non-varying over the two subjects for each student (for instance, if all unobserved student traits such as ability and motivation do not vary across the subjects for each student), or (ii) if some unobserved traits vary across subjects but there is no systematic tendency for students to be assigned to teachers who share the same native language in subjects in which they are weaker (or stronger). If either of these conditions hold, the conditional expectation of μ_{ij} (and hence the error term) will be independent of L_{tj}. Hence, OLS estimation of equation (2) will allow us to reliably identify δ. Because the validity of the within-student approach hinges importantly on these assumptions, the end of this section tests whether assignment to a teacher with the same native language can reasonably be thought of as being unrelated to a student's past performance in the subject.

This identification strategy is similar to that used by Dee (2005, 2007), Dee and Cohodes (2008), Dee and West (2011), Clotfelter et al. (2010), and Seah (2018), which evaluate the effects of various teacher attributes and classroom characteristics on student achievement.

The specification in equation (2) assumes that the effect of having a teacher with the same native language does not depend on the subject being taught. However, this assumption may not be realistic since oral and written communication skills might be more important in teaching some subjects than in others. Equation (3) therefore relaxes this assumption and allows the effect of having a teacher with the same native language to differ by subject. Specifically, each of the subject dummy variables is interacted with the binary variable indicating whether the student and the teacher share the same native language. These interaction terms are then included as additional regressors in equation (2).

$$y_{itj} = \boldsymbol{X}_i'\beta + \delta_1 L_{tj} + \delta_2(L_{tj} \times D2_j) + \delta_3(L_{tj} \times D3_j) + \delta_4(L_{tj} \times D4_j) + \boldsymbol{Z}_{tj}'\gamma + \eta_2 D2_j + \eta_3 D3_j + \eta_4 D4_j + \mu_i + (\mu_{ij} + \varepsilon_{itj}) \qquad (3)$$

where $D2_j$ is a dummy variable that equals 1 if $j = 2$ and equals 0 otherwise, and so forth. Subject fixed effects are represented using 3 (= 4 - 1) binary indicators since there are 4 possible subjects (though each student is actually observed in only 2 of the 4 subjects). Here, the effect of L_{tj} on y_{itj} is allowed to depend on the subject of instruction. If $j = 1$ (i.e. subject 1), the effect is simply δ_1. If $j = 2$ (i.e. subject 2), then the effect is $\delta_1 + \delta_2$, and so forth.

Note that all inferences in this paper are based on standard errors which allow for arbitrary correlation of regression errors within schools.

<Insert Table 2 here>

As noted above, the within-student identification strategy can be relied on to produce unbiased estimates of δ only if assumptions (i) or (ii) hold. Assumption (ii), however, might be violated if, for instance, students are systematically more likely to be assigned to teachers of the same native language in subjects in which they are weaker in. This would be the case if schools have a deliberate policy of assigning teachers of the same native language to non-native English-speaking students in their weaker subjects because of a belief that this would help to improve their performance in those subjects. To check whether, for any given student, assignment to a teacher with the same native language in a subject is plausibly independent of the student's past performance in the subject, I perform a regression of a binary variable indicating whether the student and the teacher share the same native language on a binary variable indicating whether the student received mostly A's in the subject previously, conditional on student fixed effects. The results of this test are shown in Table 2. They indicate that, within student, there is no statistically significant association between how well the student performed in a subject previously and whether the student shares the same native language as the teacher in that subject. Hence, this lessens concerns regarding the validity of estimates from the within-student approach.

5 Results

5.1 Baseline Results

<Insert Table 3 here>

Table 3 reports the means and standard deviations for all the variables included in the regressions. These variables – most of which represent teacher and classroom characteristics – are those for which variation might still exist after conditioning on student fixed effects. Because the research design exploits variation across academic subjects within-student to identify the effect of having a linguistically-similar teacher, all student traits which are subject-invariant drop out from the analysis and are therefore ignored[14].

The outcome variables of interest are the subject test scores of students. The main independent variable of interest is the dummy variable indicating whether the student and the subject teacher share the same native language.

The remaining variables are controls for various teacher and classroom characteristics, which include the gender, type of teaching certification[15], educational attainment[16], years of teaching experience[17], employment status[18], undergraduate major[19], and ethnicity of the teacher[20], as well as the number of students in the teacher's class, and the percentage of students in the teacher's class who are limited English proficient. Variables controlling for each student's past achievements in the subject are also included[21].

[14] These subject-invariant student characteristics include things such as the gender, ethnicity, family size, family income, and parental educational attainment of students.
[15] Teachers can possess 1 of 4 types of teaching certification: "Standard", "Probationary", "Temporary", or "No certification".
[16] Teachers can possess 1 of 5 education levels: "less than a bachelor's degree", "bachelor's degree", "master's degree", "education specialist degree", or "PhD".
[17] Teaching experience is measured by 9 categorical dummy variables: "less than 4 years", "4-6 years", "7-9 years", "10-12 years", "13-15 years", "16-18 years", "19-21 years", "22-24 years", and "25 or more years". Using a series of teaching experience dummies is less restrictive than using a specification where teaching experience is expressed using polynomials or logarithms. Allowing for this non-linearity is important in light of evidence which shows that the effect of teaching experience on student achievement is non-linear (Clotfelter et al., 2010).
[18] This is a dummy variable indicating whether or not the teacher is employed full-time by the school.
[19] This is a dummy variable indicating whether or not the teacher has an undergraduate major in the subject of instruction.
[20] Teachers can belong to 1 of 4 ethnicities: "Hispanic", "Black", "White", or "Other".
[21] Past achievement in the subject is measured by 5 categorical dummy variables: Student received "Mostly A's", "Mostly B's", "Mostly C's", "Mostly D's", "Mostly below D's" in subject from grade 6 up till survey

Table 3 indicates that 90% of students share the same native language as their teacher. However, it should be noted that this value varied sharply across student language groups. Specifically, while 97.9% of native English-speaking students shared the same native language as their teacher, only 10.9% of native Spanish-speaking students did so.

<Insert Table 4 here>

Table 4 reports results from 5 different regression specifications showing the estimated coefficient on the variable indicating whether the student and the teacher share the same native language, separately for English and Spanish native-speaking students. The dependent variable in all regressions is the student test score.

To examine whether there is any relationship between test scores and having a teacher with the same native language when subjects are stacked to begin with, I first run a simple OLS regression that includes only subject fixed effects. These results are reported in columns (1) and (6). While having a teacher with the same native language has no association with the test scores of native English-speaking students, it is found to be associated with lower test scores for native Spanish-speaking students. Columns (2) and (7) add student fixed effects. By including student fixed effects, variation in whether the student and the teacher share the same native language and student test scores across the 2 academic subjects within-student is exploited to identify the effect of having the same native language. For both groups of students, the coefficient on the same-language variable becomes somewhat closer to zero: for native English-speaking students, the coefficient falls to essentially zero, while for native Spanish-speaking students, the coefficient falls by about 30%, from -0.147 to -0.106, though it remains statistically significant at the 5% level. The sizeable change in the magnitude of the coefficient indicates that native Spanish-speaking students with unobserved propensities for low achievement are more likely to be assigned to native Spanish-speaking teachers. Columns (3) and (8) include controls for the student's past performance in each of the 2 subjects. Controlling for students' prior subject performance may be important given that students might be assigned to same or different native language teachers in subjects based on their past performance in the subject. This would be the case if, for instance, within schools, school administrators have a deliberate policy of assigning non-native English-speaking students to teachers with the same native language for subjects in which these students are weaker in. For native English-speaking

date. Past achievement is included in the regression to reflect the cumulative nature of the education process and to pick up the effects of prior knowledge in the subject (Clotfelter et al., 2006).

students, there is essentially no change in the coefficient on the same-language variable, while for native Spanish-speaking students, the coefficient does become slightly more negative. That only small to no changes in these coefficients are found should not be too surprising given the results of our test in Table 2, which showed that there was no evidence that whether a student shares the same native language as the teacher in a subject was associated with how well the student performed in the subject previously, within-student. Columns (4) and (9) introduce controls for various teacher and classroom characteristics, but excludes controlling for teacher ethnicity. This accounts for the possibility that teachers who share the same native language as their students and teachers who do not, may differ in other characteristics such as education, type of certification, years of teaching experience, undergraduate major, size of classes they teach, and the percentage of LEP students in their classes. Even after adjusting for these differences in teacher and classroom characteristics, the coefficients on the same-language variable do not change much. The stability in the coefficient estimates to the inclusion of the different control variables is reassuring. The estimates in columns (4) and (9) suggest that while sharing the same native language as the teacher has no effect on the achievement of native English-speaking students, it does have a somewhat sizeable and statistically significant (at the 10% level) negative effect on the achievement of native Spanish-speaking students. More specifically, assignment to a teacher with the same native language is estimated to reduce the achievement of native Spanish-speaking students by 0.105 standard deviations. Considering that the difference in achievements between a student at the 50th percentile of the test score distribution and a student at the 75th percentile is about 0.813 standard deviations, this effect – which is about one-tenth of this difference – is arguably sizeable[22].

It may seem counterintuitive that the assignment to a teacher with the same native language actually hurts the achievement of native Spanish-speaking students. However, the estimates in column (5) make it clear that this result is really driven by teacher ethnicity. In particular, because Spanish-speaking teachers tend to be Hispanics, the student-teacher language variable, in regressions which do not control for teacher ethnicity, is largely capturing the effect of teacher ethnicity[23]. Once controls for teacher ethnicity are included, the coefficient on the student-teacher language variable undergoes a dramatic change for native Spanish-speaking students, flipping from negative to positive (-0.105 to 0.026 standard deviations). The

[22] The difference in test scores between the student at the 50th percentile and the student at the 75th percentile is 0.795, 0.872, 0.885, and 0.699 standard deviations respectively for Science, Math, English, and Social Studies.
[23] This is evidenced by the large and statistically significant (at the 10% level) coefficient on the Hispanic teacher dummy reported in column (5) of Table A1 (appendix).

estimate in column (5) suggests that, conditional on teacher ethnicity and observable teacher and classroom characteristics, assignment to a teacher with the same native language has a small and statistically insignificant effect on the achievement of native Spanish-speaking students[24]. Overall, these results indicate 2 things: (1) although assignment to a Hispanic teacher reduces the achievement of native Spanish-speaking students (who are, themselves, overwhelmingly Hispanic[25]), nevertheless, (2) a native Spanish-speaking student is estimated to do no worse or better when assigned to a native Spanish-speaking Hispanic teacher than when assigned to a non-native Spanish-speaking Hispanic teacher.

It seems surprising that, compared to White teachers, Hispanic teachers are found to have a negative impact on the achievements of native Spanish-speaking students (who themselves tend to be Hispanic). After all, studies which assess the impact of assignment to demographically-similar teachers have tended to find that assignment to teachers of the same ethnicity increases student achievement. However, as noted by Egalite et al. (2015), the Hispanic population is an especially diverse one, comprising individuals who identify themselves as belonging to different sub-groups and origins – including the Caribbean, Central America, South America, and Mexico, among others. Because of considerable heterogeneity among members of this ethnic group, it is unclear whether students and teachers who identify themselves as Hispanic are indeed culturally similar[26]. Indeed, Egalite et al. (2015) find, as well, using a large administrative dataset comprising students from Florida public schools (a state comprising one of the largest community of Hispanics in the U.S.), that the achievements of Hispanic students are significantly negatively affected when they are assigned Hispanic teachers than when they are assigned non-Hispanic teachers.

<Insert Table 5 here>

Table 5 repeats the analyses presented in Table 4, but allows the effect of having a teacher with the same native language to vary by the subject being taught. The results in Table 5 are based on equation (3) of Section 4, and they show directly, the estimated effect of having a teacher with the same native language in each of the 4 subjects – Science, Math, English, and

[24] Inclusion of teacher ethnicity controls appear to matter little for the native English-speaking student regressions. Both columns (9) and (10) of Table 4 suggest that assignment to a teacher with the same native language has essentially no effect on the achievement of native English-speaking students.
[25] 89.8% of native Spanish-speaking students are Hispanic.
[26] If they are not culturally similar, then there is no reason to believe that the "role model" and "teacher bias" effects – discussed in the Introduction – will apply.

Social Studies.[27] The OLS estimates (i.e. simple regressions of the type presented in Columns (1) and (6) of Table 4) are not presented for brevity.

The results in Table 5 indicate that those in Table 4 did mask some interesting heterogeneity by subject, particularly for native Spanish-speaking students. In particular, column (3) of Table 5 (the specification with the full set of teacher, classroom, and prior grade controls) indicates that, unconditional on teacher ethnicity, assignment to a teacher with the same native language significantly lowers the Science and English achievement of native Spanish-speaking students, but has only smaller and statistically insignificant effects on their Math and Social Studies achievements. Consistent with the results from Table 4, there is evidence that student-teacher native language matters for student achievement (the hypothesis that the coefficients on all variables involving the "same language" variable are jointly equal to zero is rejected at the 1% level in column (3). The p-value of the F-statistic is 0.003). More importantly, the F-test in column (3), which tests the hypothesis that the effects are the same across all 4 subjects, indicates that this hypothesis can be rejected at the 5% level (p-value of the F-statistic is 0.014).

Column (4) of Table 5 shows what happens when we control for teacher ethnicity. For all subjects, the estimated effect of assignment to a teacher of the same native language undergoes a drastic change. More specifically, the effect of assignment to a teacher with the same native language no longer remains statistically significant for Science and English achievement. Further, assignment to a teacher with the same native language in Social Studies is now positive and significant for native Spanish-speaking students. The latter result implies that relative to being assigned to a non Spanish-speaking Hispanic teacher, being assigned to a Spanish-speaking Hispanic teacher is estimated to significantly increase Spanish-speaking students' Social Studies achievement by 0.314 standard deviations. The F-test in column (4), testing the hypothesis that assignment to a teacher of the same native language is the same across all 4 subjects, indicates that this hypothesis can be rejected at the 5% level (p-value of the F-statistic is 0.016). Hence, whether we condition on teacher ethnicity, the effect of sharing the same native language as the teacher appears to depend on the subject of instruction.

[27] English is the omitted subject category in this regression. In other words, the specification in equation (3) includes the set of subject dummies (with the English subject dummy omitted) and three interaction terms, each comprising a subject dummy interacted with the "same language" variable (with the "same language"- English dummy interaction term omitted). If we take $D2_j$, $D3_j$, and $D4_j$ to represent the dummy variables for Science, Math, and Social Studies respectively, then the estimated effect of having a teacher with the same native language is $\hat{\delta}_1 + \hat{\delta}_2$ for Science, $\hat{\delta}_1 + \hat{\delta}_3$ for Math, $\hat{\delta}_1 + \hat{\delta}_4$ for Social Studies, and $\hat{\delta}_1$ for English.

The results for native English-speaking students are less remarkable. Columns (7) and (8) of Table 5 indicate that whether or not we condition on teacher ethnicity, there is no evidence that assignment to a teacher with the same native language matters for the achievements of native English-speaking students, regardless of the subject taught.

5.2 Effect of Assignment to a Linguistically-Similar Teacher on the Test Scores of Native Spanish-Speaking Students who are Non-LEP

The results in Tables 4 and 5 suggest that, unconditional on teacher ethnicity, assignment to a teacher with the same native language reduces the achievement of native Spanish-speaking students. However, these estimates in Tables 4 and 5 could be biased if, within schools, native Spanish-speaking students were non-randomly assigned to same and different language teachers in subjects based on their unobserved propensity for achievement in the subject. Although the test reported in Table 2 indicated that whether a student shares the same native language as his/her teacher in a subject was not statistically significantly associated with how well the student previously performed in the subject, it remains impossible to address fully the concern that students may be non-randomly assigned to same and different language teachers across subjects based on their performance in those subjects. Because it is more likely for such non-random sorting to occur if a student is limited English proficient (LEP), since under some LEP programmes, such as "Pull-Out ESL", a non-native English-speaking student may be pulled out of his/her regular classroom for special instruction in English or another subject by a teacher who shares the student's native language, I repeat the analyses in Tables 4 and 5, but restrict my sample to only native Spanish-speaking students who are non-LEP[28]. This makes it

[28] A description of the various types of English Learner Programs offered by schools can be found in Barrow and Markman-Pithers (2016). NELS 1988 provides an LEP composite variable which allows one to identify if a student is LEP. This composite variable was constructed from the student self-evaluation and the teacher evaluations of the student's proficiency in the English language. Specifically, a student is classified as LEP if the student responded with "Not very well" (as opposed to Very well, Pretty well, and Well) to any of the 4 following questions: How well do you understand spoken English?, How well do you speak English?, How well do you read English?, and How well do you write English? or if either teacher indicated "Yes" to the question which asks if the student is a limited English proficiency student. Among the 19,319 students in the sample, 409 (2.1%) are identified as LEP, 18,730 (96.9%) as non-LEP, and 180 (1.0%) had a missing response to the LEP question. Among the 1,690 students who had a non-English first language, 197 (11.7 %) are identified as LEP, 1,487 (88.0%) as non-LEP, and 6 (0.3%) had a missing response to the LEP question. 17,629 students had English as a first language.

less likely that the estimates will be biased by non-random teacher assignment resulting from students' participation in LEP programmes.

<Insert Table 6 here>

The results are reported in Table 6. Columns (1) and (2) are from specifications that do not control for teacher ethnicity while Columns (3) and (4) are from specifications that do. Columns (2) and (4) allow the effect of having a linguistically-similar teacher to vary by subject taught while Columns (1) and (3) do not allow for this. All models include subject and student fixed effects as well as controls for teacher and classroom characteristics and students' past subject performance. As can be seen, the estimates do not change substantively when the analysis is restricted to native Spanish-speaking students who are non-LEP programme participants.

<Insert Table 7 here>

Another way of addressing the concern is to restrict the sample to only native Spanish-speaking students who are from classes with no LEP students. Specifically, the NELS 1988 teacher questionnaire asks each teacher, "How many limited English proficiency (LEP) students are assigned to this class?". I restrict the sample to only native Spanish-speaking students who are themselves non-LEP and are from classes where both subject teachers report having zero LEP students. Table 7 reports the results for this restricted sample (the way the columns in Table 7 are organized is the same as that in Table 6). Again, the estimates do not change substantively when the analysis is restricted to this alternative sample.

The robustness checks provided by Tables 6 and 7 further lessen concerns that the results found earlier were driven by non-random sorting of students to teachers across subjects arising from native Spanish-speaking students' participation in LEP programmes.

6 Conclusion

This study is the first to examine whether assignment to a linguistically-similar teacher matters for students' academic achievement in the United States. It considers, separately, the effects on the academic achievement of native English-speaking students and native Spanish-speaking students.

Comparisons of test scores across subjects within-student indicate that, unconditional on teacher ethnicity, assignment to a native Spanish-speaking teacher reduces the achievement of native Spanish-speaking students. However, once teacher ethnicity is controlled for, assignment to a teacher who speaks the same native language largely neither hurts nor benefits the achievement of these students.

Because teacher native language is highly correlated with teacher ethnicity, the results from regressions that do not condition on teacher ethnicity largely capture the effect of teacher ethnicity. In other words, the results suggest, for instance, that assignment to a Spanish-speaking Hispanic teacher will result in a Spanish-speaking student achieving no worse or better than if he/she were assigned to a non Spanish-speaking Hispanic teacher. However, unconditional on teacher ethnicity, assignment to a Spanish-speaking teacher (relative to a non-Spanish-speaking teacher) does hurt a Spanish-speaking student's achievement.

In other words, while sharing the same native language as the teacher per se neither benefits nor harms student achievement, unconditional on teacher ethnicity, assigning native Spanish-speaking students to native Spanish-speaking teachers does harm their achievement.

It may seem surprising to find that native Spanish-speaking teachers hurt the achievement of native Spanish-speaking students, since studies assessing the impact of assignment to demographically-similar teachers have tended to find that assignment to demographically-similar teachers increases student achievement. However, it is important to realize that native Spanish-speakers are a diverse group, comprising individuals who may identify themselves as belonging to different sub-groups and ethnic origins. The heterogeneity among native Spanish-speakers implies that it is unclear whether students and teachers who report speaking Spanish as their native language are indeed culturally similar. If they are not, then there is no reason for the "role model" and "teacher bias" effects – discussed in the Introduction of this paper – to apply. Consequently, there is less reason for matches in the native language of the student and the teacher to benefit the student. In fact, to the extent that native Spanish-speaking teachers

are less proficient in English or have accents which impede student understanding, having a native Spanish-speaking teacher might instead make the course content less accessible to native Spanish-speaking students.

For native English-speaking students, being assigned to a linguistically-similar teacher (relative to a non-native English-speaking teacher) has little effect on their achievement. This finding applies regardless of whether we control for teacher ethnicity.

Specifications which allow for the effect of having a native Spanish-speaking teacher to vary by the subject taught indicate that the negative effects of Spanish-speaking teachers on Spanish-speaking students is concentrated in Science and English. There is no evidence that having a linguistically-similar (or dissimilar) teacher affects the achievement of native English-speaking students in any subject.

The fact that this study finds that assignment to a native Spanish-speaking teacher may be counterproductive for native Spanish-speaking students and that a match in the native language between the student and the teacher per se neither harms nor benefits student achievement (at least for most subjects), suggests that schools' concerns about the need to recruit Spanish-speaking teachers to cater to the needs of Spanish-speaking students may be misplaced. Rather than ensuring that Spanish-speaking students have access to Spanish-speaking teachers, schools may be better off working to increase the quality of instruction provided to these students instead.

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Figure 1: Share and Number of Native English-Speaking Students to Non-Native English-Speaking Students in the NELS 1988 Sample

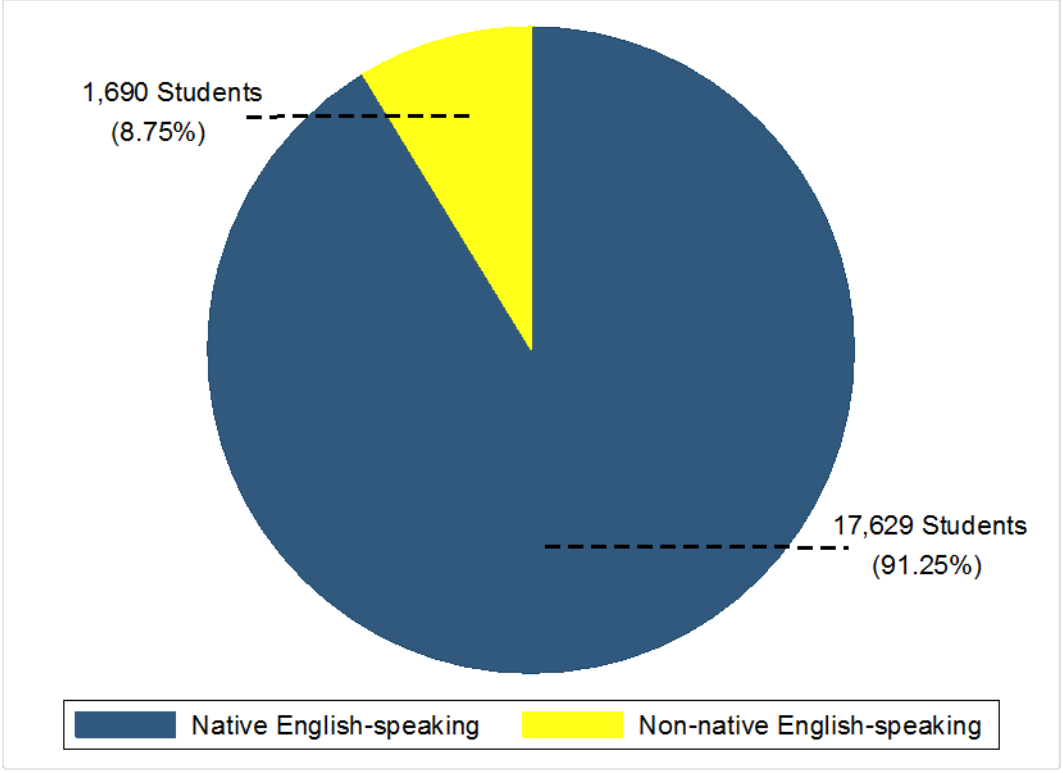
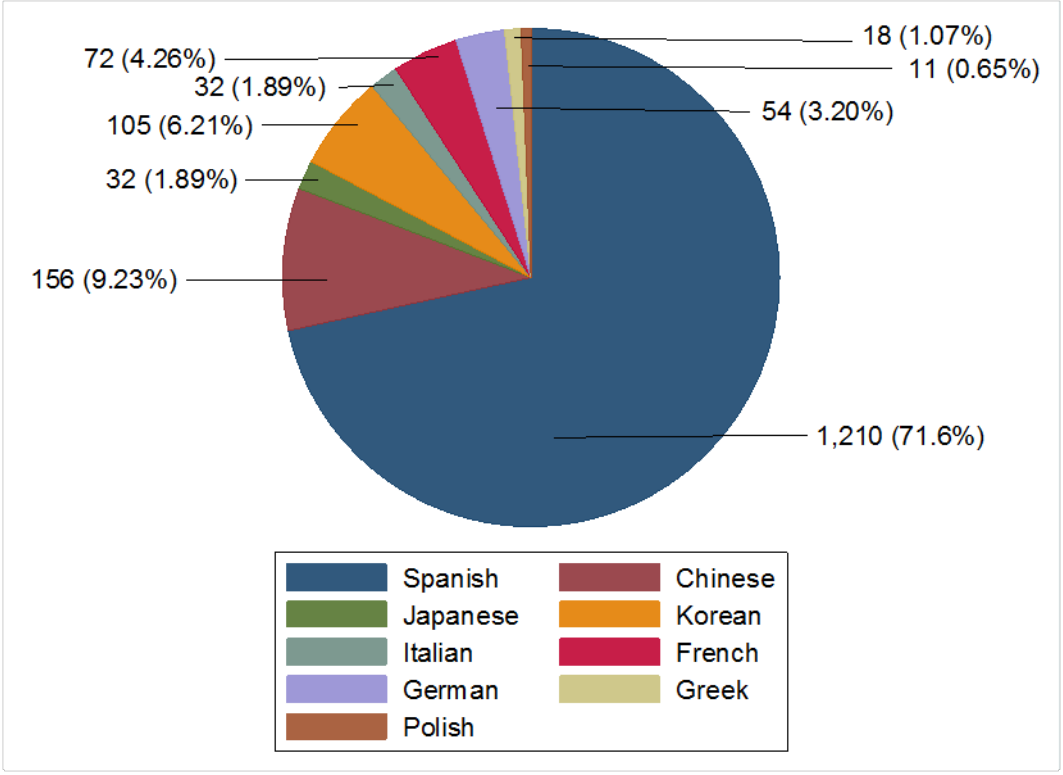


Figure 2: Share and Number of Students Speaking Each Language, Among Students who Speak a Non-English Native Language in the NELS 1988 Sample



Notes: The sample of non-English native speakers does not include students who report their first languages as either Portuguese, Filipino, or "Other Language". Footnotes 10 and 11 explain their omission.

Table 1A: Characteristics of Native Spanish-Speaking Students with Same and with Different Native Language Teachers, by Academic Subject

	Science			Math			English			Social Studies		
	Same Native-Language Teacher	Different Native-Language Teacher	Difference	Same Native-Language Teacher	Different Native-Language Teacher	Difference	Same Native-Language Teacher	Different Native-Language Teacher	Difference	Same Native-Language Teacher	Different Native-Language Teacher	Difference
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A												
Standardized test score	-0.594	-0.515	-0.079	-0.645	-0.483	-0.162**	-0.683	-0.502	-0.181**	-0.716	-0.586	-0.130
			(0.102)			(0.063)			(0.077)			(0.130)
Panel B												
Student had mostly As in subject from grade 6 till survey	0.292	0.201	0.090	0.267	0.345	-0.078	0.253	0.216	0.037	0.237	0.234	0.003
			(0.068)			(0.052)			(0.051)			(0.072)
Student is female	0.480	0.537	-0.057	0.602	0.520	0.082	0.512	0.542	-0.030	0.476	0.527	-0.051
			(0.074)			(0.056)			(0.058)			(0.080)
Student's mother is a college graduate	0.049	0.131	-0.082**	0.083	0.113	-0.029	0.065	0.106	-0.042	0.067	0.138	-0.071
			(0.038)			(0.036)			(0.034)			(0.049)
Student's father is a college graduate	0.054	0.154	-0.100**	0.103	0.157	-0.054	0.018	0.135	-0.117***	0.037	0.188	-0.151***
			(0.042)			(0.041)			(0.024)			(0.042)
Student's family income is $35,000 and above	0.059	0.211	-0.152***	0.120	0.203	-0.083**	0.096	0.198	-0.102***	0.080	0.217	-0.137**
			(0.045)			(0.042)			(0.039)			(0.058)
Student's family size	6.300	5.333	0.967***	5.466	5.329	0.137	6.024	5.339	0.685***	5.537	5.309	0.227
			(0.272)			(0.222)			(0.215)			(0.310)
Number of students	50	516		88	556		84	583		42	501	

Notes: This table reports average characteristics of native Spanish-speaking students who share and do not share the same native language as their teacher, by subject. Columns (1), (2), (4), (5), (7), (8), (10) and (11) show average characteristics of students specified by the column heading. Columns (3), (6), (9), and (12) report the difference between the average characteristic for students who share and do not share the same native language as their teacher. Standard errors are reported in parentheses. ***Difference is statistically significant at the 1% level. **Difference is statistically significant at the 5% level. *Difference is statistically significant at the 10% level.

Table 1B: Characteristics of Native English-Speaking Students with Same and with Different Native Language Teachers, by Academic Subject

	Science			Math			English			Social Studies		
	Same Native-Language Teacher	Different Native-Language Teacher	Difference	Same Native-Language Teacher	Different Native-Language Teacher	Difference	Same Native-Language Teacher	Different Native-Language Teacher	Difference	Same Native-Language Teacher	Different Native-Language Teacher	Difference
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A												
Standardized test score	0.078	-0.136	0.213***	0.029	-0.236	0.265***	0.033	0.058	-0.026	0.081	0.195	-0.113
			(0.069)			(0.063)			(0.069)			(0.089)
Panel B												
Student had mostly As in subject from grade 6 till survey	0.317	0.260	0.057*	0.335	0.316	0.019	0.325	0.406	-0.081**	0.325	0.368	-0.043
			(0.034)			(0.033)			(0.035)			(0.041)
Student is female	0.502	0.553	-0.051	0.499	0.500	-0.001	0.496	0.544	-0.048	0.504	0.564	-0.059
			(0.039)			(0.035)			(0.035)			(0.041)
Student's mother is a college graduate	0.277	0.159	0.118***	0.262	0.198	0.064**	0.253	0.266	-0.012	0.280	0.426	-0.146***
			(0.031)			(0.029)			(0.034)			(0.044)
Student's father is a college graduate	0.344	0.248	0.096**	0.326	0.256	0.070**	0.315	0.396	-0.081**	0.349	0.419	-0.070
			(0.037)			(0.033)			(0.038)			(0.045)
Student's family income is $35,000 and above	0.477	0.422	0.055	0.459	0.359	0.100***	0.456	0.411	0.045	0.478	0.527	-0.048
			(0.040)			(0.035)			(0.036)			(0.044)
Student's family size	4.528	4.688	-0.160*	4.542	4.732	-0.190*	4.541	4.663	-0.122	4.531	4.678	-0.147
			(0.097)			(0.106)			(0.102)			(0.121)
Number of students	8,493	170		8,754	212		8,934	206		8,340	149	

Notes: This table reports average characteristics of native English-speaking students who share and do not share the same native language as their teacher, by subject. Columns (1), (2), (4), (5), (7), (8), (10) and (11) show average characteristics of students specified by the column heading. Columns (3), (6), (9), and (12) report the difference between the average characteristic for students who share and do not share the same native language as their teacher. Standard errors are reported in parentheses. ***Difference is statistically significant at the 1% level. **Difference is statistically significant at the 5% level. *Difference is statistically significant at the 10% level.

Table 2: Relationship between Teacher's Native Language and Student's Past Academic Performance

	All Students	Native Spanish-Speaking Students	Native English-Speaking Students
Independent variable	(1)	(2)	(3)
Student received mostly As in subject from grade 6 till survey	0.000	0.004	-0.001
	(0.003)	(0.017)	(0.003)
Student fixed effects	X	X	X
Observations	37,456	2,289	34,243
R-Squared	0.001	0.022	0.000

Notes: This table presents results that test the hypothesis that assignment to same and different native language teachers across academic subjects within students is unrelated to students' past performance in a subject. Values are the estimated coefficients from a regression of a dummy variable indicating whether the student and the teacher share the same native language on a dummy variable indicating whether the student received mostly As in the subject previously, controlling for student fixed effects. Standard errors in parentheses are cluster-robust standard errors that allow for correlation in individual error terms within schools. All models include student and subject fixed effects. *** p-value<0.01, ** p-value<0.05, * p-value<0.1.

Table 3: Descriptive Statistics, Eight Grade Students in NELS 1988

Variable	Mean	Standard Deviation	Sample Size
Test score in subject	0	1	38,638
Student shares the same native language as teacher	0.900	0.300	38,638
Student had mostly As in subject from grade 6 till survey	0.324	0.468	37,456
Student had mostly Bs in subject from grade 6 till survey	0.361	0.480	37,456
Student had mostly Cs in subject from grade 6 till survey	0.224	0.417	37,456
Student had mostly Ds in subject from grade 6 till survey	0.065	0.247	37,456
Student had mostly below Ds in subject from grade 6 till survey	0.026	0.158	37,456
Student is LEP	0.021	0.145	38,278
Female teacher	0.564	0.496	38,638
Teacher has standard teaching certification	0.890	0.313	38,585
Teacher has probationary teaching certification	0.017	0.130	38,585
Teacher has temporary teaching certification	0.042	0.200	38,585
Teacher has no teaching certification	0.051	0.220	38,585
Teacher has less than a bachelor's degree	0.003	0.056	38,636
Teacher has a bachelor's degree	0.558	0.497	38,636
Teacher has a master's degree	0.373	0.483	38,636
Teacher has an education specialist degree	0.059	0.235	38,636
Teacher has a PhD	0.007	0.085	38,636
Less than 4 years of teacher experience	0.109	0.311	38,591
4-6 years of teacher experience	0.098	0.298	38,591
7-9 years of teacher experience	0.102	0.303	38,591
10-12 years of teacher experience	0.113	0.317	38,591
13-15 years of teacher experience	0.127	0.333	38,591
16-18 years of teacher experience	0.138	0.345	38,591
19-21 years of teacher experience	0.100	0.301	38,591
22-24 years of teacher experience	0.072	0.259	38,591
25 or more years of teacher experience	0.140	0.347	38,591
Teacher is employed full-time	0.970	0.170	38,545
Teacher has a bachelor's major in subject of instruction	0.525	0.499	38,259
Hispanic teacher	0.021	0.143	38,284
Black teacher	0.077	0.266	38,284
White teacher	0.891	0.312	38,284
Teacher of other race	0.011	0.105	38,284
Class size	23.61	6.38	38,069
Percentage of students in class with limited English proficiency	0.011	0.060	37,449

Table 4: Estimated Effect of a Teacher with the Same Native Language on Test Scores, by Student Native Language

	Native Spanish-Speaking Student					Native English-Speaking Student				
	OLS	Within-Student	Within-Student	Within-Student	Within-Student	OLS	Within-Student	Within-Student	Within-Student	Within-Student
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Teacher with Same Native Language	-0.147**	-0.106**	-0.123**	-0.105*	0.026	0.095	0.012	0.016	-0.009	0.001
	(0.069)	(0.053)	(0.057)	(0.062)	(0.099)	(0.082)	(0.044)	(0.044)	(0.044)	(0.051)
Subject fixed effects	X	X	X	X	X	X	X	X	X	X
Student fixed effects		X	X	X	X		X	X	X	X
Previous grades			X	X	X			X	X	X
Teacher & class controls, except teacher ethnicity				X	X				X	X
Teacher ethnicity					X					X
Observations	2,420	2,420	2,289	2,135	2,101	35,258	35,258	34,243	32,788	32,526
R-Squared	0.005	0.011	0.017	0.032	0.036	0.001	0.000	0.018	0.021	0.022

Notes: Standard errors in parentheses are cluster-robust standard errors that allow for correlation in individual error terms within schools. Class controls include class size and percentage of LEP students in the class. Teacher controls include gender, type of teaching certification, educational attainment, years of teacher experience, whether teacher is employed full-time, and whether teacher has a bachelor's major in the subject of instruction. *** p-value<0.01, ** p-value<0.05, * p-value<0.1.

Table 5: Estimated Effect of a Teacher with the Same Native Language on Test Scores, by Student Native Language and Academic Subject

	Native Spanish-Speaking Student				Native English-Speaking Student			
	Within-Student	Within-Student	Within-Student	Within-Student	Within-Student	Within-Student	Within-Student	Within-Student
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Teacher with Same Native Language in Science	-0.181*	-0.217**	-0.297**	-0.198	-0.009	-0.004	0.013	0.027
	(0.094)	(0.104)	(0.119)	(0.136)	(0.043)	(0.038)	(0.041)	(0.049)
Teacher with Same Native Language in Math	-0.115	-0.125	-0.076	0.093	0.063	0.057	0.024	0.036
	(0.084)	(0.086)	(0.088)	(0.108)	(0.073)	(0.079)	(0.066)	(0.076)
Teacher with Same Native Language in English	-0.139**	-0.152**	-0.152**	-0.004	0.021	0.047	-0.029	-0.020
	(0.061)	(0.066)	(0.066)	(0.100)	(0.091)	(0.095)	(0.100)	(0.102)
Teacher with Same Native Language in Social Studies	0.022	0.008	0.134	0.314**	-0.045	-0.051	-0.054	-0.039
	(0.097)	(0.111)	(0.122)	(0.144)	(0.073)	(0.075)	(0.070)	(0.070)
Subject fixed effects	X	X	X	X	X	X	X	X
Student fixed effects	X	X	X	X	X	X	X	X
Previous grades		X	X	X		X	X	X
Teacher and class controls, except teacher ethnicity			X	X			X	X
Teacher ethnicity				X				X
F-Statistic testing coefficients on all subject dummy-same language interaction terms = 0	1.370	1.270	3.610	4.150	0.430	0.450	0.380	0.380
(p-value of F-Statistic)	0.253	0.284	0.014	0.007	0.730	0.719	0.765	0.771
F-Statistic testing coefficients on all variables involving "same language" variable = 0	2.730	2.870	4.080	3.110	0.320	0.340	0.290	0.300
(p-value of F-Statistic)	0.029	0.023	0.003	0.016	0.862	0.852	0.884	0.877
Observations	2,420	2,289	2,135	2,101	35,258	34,243	32,788	32,526
R-Squared	0.013	0.019	0.038	0.044	0.000	0.018	0.021	0.022

Notes: Standard errors in parentheses are cluster-robust standard errors that allow for correlation in individual error terms within schools. Class controls include class size and percentage of LEP students in the class. Teacher controls include gender, type of teaching certification, educational attainment, years of teacher experience, whether teacher is employed full-time, and whether teacher has a bachelor's major in the subject of instruction. The first reported F-statistic (and p-value) is from an F-test which tests the null hypothesis that the effect of having a teacher with the same native language is the same across all academic subjects. The second reported F-statistic (and p-value) is from an F-test which tests the null hypothesis that sharing the same native language as the teacher has no effect on student test score. *** p-value<0.01, ** p-value<0.05, * p-value<0.1.

Table 6: Estimated Effect of a Teacher with the Same Native Language on Test Scores of Native Spanish-Speaking Students who are Non-LEP

	Native Spanish-Speaking Student			
	Within-Student	Within-Student	Within-Student	Within-Student
Independent variable	(1)	(2)	(3)	(4)
Teacher with Same Native Language	-0.127**		-0.019	
	(0.064)		(0.106)	
Teacher with Same Native Language in Science		-0.366***		-0.284**
		(0.116)		(0.126)
Teacher with Same Native Language in Math		-0.105		0.064
		(0.096)		(0.120)
Teacher with Same Native Language in English		-0.148**		-0.022
		(0.073)		(0.107)
Teacher with Same Native Language in Social Studies		0.164		0.342*
		(0.161)		(0.206)
Subject fixed effects	X	X	X	X
Student fixed effects	X	X	X	X
Previous grades	X	X	X	X
Teacher and class controls, except teacher ethnicity	X	X	X	X
Teacher ethnicity			X	X
F-Statistic testing coefficients on all subject dummy-same language interaction terms = 0	-	3.090	-	3.530
(p-value of F-Statistic)	-	0.027	-	0.015
F-Statistic testing coefficients on all variables involving "same language" variable = 0	-	3.490	-	2.760
(p-value of F-Statistic)	-	0.008	-	0.028
Observations	1,856	1,856	1,826	1,826
R-Squared	0.037	0.044	0.041	0.050

Notes: Standard errors in parentheses are cluster-robust standard errors that allow for correlation in individual error terms within schools. Class controls include class size and percentage of LEP students in the class. Teacher controls include gender, type of teaching certification, educational attainment, years of teacher experience, whether teacher is employed full-time, and whether teacher has a bachelor's major in the subject of instruction. The first reported F-statistic (and p-value) is from an F-test which tests the null hypothesis that the effect of having a teacher with the same native language is the same across all academic subjects. The second reported F-statistic (and p-value) is from an F-test which tests the null hypothesis that sharing the same native language as the teacher has no effect on student test score. *** p-value<0.01, ** p-value<0.05, * p-value<0.1.

Table 7: Estimated Effect of a Teacher with the Same Native Language on Test Scores of Native Spanish-Speaking Students who are Non-LEP and are from Classes with No LEP Students

	Native Spanish-Speaking Student			
	Within-Student	Within-Student	Within-Student	Within-Student
Independent variable	(1)	(2)	(3)	(4)
Teacher with Same Native Language	-0.239**		-0.118	
	(0.096)		(0.150)	
Teacher with Same Native Language in Science		-0.584***		-0.454***
		(0.123)		(0.161)
Teacher with Same Native Language in Math		-0.194		-0.008
		(0.159)		(0.168)
Teacher with Same Native Language in English		-0.207**		-0.028
		(0.105)		(0.141)
Teacher with Same Native Language in Social Studies		-0.114		0.098
		(0.198)		(0.259)
Subject fixed effects	X	X	X	X
Student fixed effects	X	X	X	X
Previous grades	X	X	X	X
Teacher and class controls, except teacher ethnicity	X	X	X	X
Teacher ethnicity			X	X
F-Statistic testing coefficients on all subject dummy-same language interaction terms = 0	-	4.120	-	4.940
(p-value of F-Statistic)	-	0.007	-	0.002
F-Statistic testing coefficients on all variables involving "same language" variable = 0	-	5.970	-	3.950
(p-value of F-Statistic)	-	0.000	-	0.004
Observations	1,173	1,173	1,166	1,166
R-Squared	0.074	0.084	0.079	0.092

Notes: Standard errors in parentheses are cluster-robust standard errors that allow for correlation in individual error terms within schools. Class controls include class size and percentage of LEP students in the class. Teacher controls include gender, type of teaching certification, educational attainment, years of teacher experience, whether teacher is employed full-time, and whether teacher has a bachelor's major in the subject of instruction. The first reported F-statistic (and p-value) is from an F-test which tests the null hypothesis that the effect of having a teacher with the same native language is the same across all academic subjects. The second reported F-statistic (and p-value) is from an F-test which tests the null hypothesis that sharing the same native language as the teacher has no effect on student test score. *** p-value<0.01, ** p-value<0.05, * p-value<0.1.

Appendix Table A1: Full Set of Coefficient Estimates for Table 4 Regressions

	Native Spanish-Speaking Student					Native English-Speaking Student				
	OLS	Within-Student	Within-Student	Within-Student	Within-Student	OLS	Within-Student	Within-Student	Within-Student	Within-Student
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Teacher with Same Native Language	-0.147**	-0.106**	-0.123**	-0.105*	0.026	0.095	0.012	0.016	-0.009	0.001
	(0.069)	(0.053)	(0.057)	(0.062)	(0.099)	(0.082)	(0.044)	(0.044)	(0.044)	(0.051)
Student had mostly Bs in subject from grade 6 till survey	-	-	-0.023	-0.040	-0.048	-	-	-0.120***	-0.123***	-0.123***
			(0.041)	(0.044)	(0.045)			(0.012)	(0.012)	(0.013)
Student had mostly Cs in subject from grade 6 till survey	-	-	-0.068	-0.077	-0.083	-	-	-0.219***	-0.221***	-0.225***
			(0.051)	(0.058)	(0.059)			(0.015)	(0.016)	(0.016)
Student had mostly Ds in subject from grade 6 till survey	-	-	-0.092	-0.091	-0.096	-	-	-0.274***	-0.268***	-0.269***
			(0.065)	(0.069)	(0.068)			(0.022)	(0.022)	(0.022)
Student had mostly below Ds in subject from grade 6 till survey	-	-	-0.227***	-0.251***	-0.253***	-	-	-0.304***	-0.310***	-0.310***
			(0.082)	(0.083)	(0.088)			(0.031)	(0.033)	(0.034)
Female teacher	-	-	-	-0.034	-0.029	-	-	-	-0.011	-0.011
				(0.042)	(0.042)				(0.013)	(0.013)
Teacher has standard teaching certification	-	-	-	0.127	0.118	-	-	-	0.085*	0.086**
				(0.110)	(0.116)				(0.043)	(0.043)
Teacher has probationary teaching certification	-	-	-	-0.061	-0.060	-	-	-	0.069	0.074
				(0.147)	(0.149)				(0.076)	(0.073)
Teacher has temporary teaching certification	-	-	-	0.036	0.036	-	-	-	0.063	0.065
				(0.128)	(0.132)				(0.054)	(0.054)
Teacher has a master's degree	-	-	-	0.021	0.021	-	-	-	0.001	0.002
				(0.045)	(0.044)				(0.014)	(0.014)
Teacher has an education specialist degree	-	-	-	-0.084	-0.107	-	-	-	0.014	0.014
				(0.083)	(0.080)				(0.024)	(0.024)

	Native Spanish-Speaking Student					Native English-Speaking Student				
	OLS	Within-Student	Within-Student	Within-Student	Within-Student	OLS	Within-Student	Within-Student	Within-Student	Within-Student
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Teacher has a PhD	-	-	-	0.130	0.142	-	-	-	-0.102	-0.097
				(0.163)	(0.163)				(0.080)	(0.081)
4-6 years of teacher experience	-	-	-	-0.142	-0.122	-	-	-	-0.003	0.001
				(0.088)	(0.090)				(0.033)	(0.033)
7-9 years of teacher experience	-	-	-	-0.100	-0.087	-	-	-	0.042	0.041
				(0.073)	(0.075)				(0.031)	(0.031)
10-12 years of teacher experience	-	-	-	-0.020	-0.021	-	-	-	0.014	0.015
				(0.094)	(0.098)				(0.030)	(0.030)
13-15 years of teacher experience	-	-	-	-0.131	-0.111	-	-	-	0.034	0.038
				(0.087)	(0.093)				(0.031)	(0.032)
16-18 years of teacher experience	-	-	-	-0.164*	-0.167*	-	-	-	0.036	0.038
				(0.086)	(0.087)				(0.030)	(0.030)
19-21 years of teacher experience	-	-	-	-0.098	-0.091	-	-	-	0.049	0.051
				(0.099)	(0.100)				(0.031)	(0.032)
22-24 years of teacher experience	-	-	-	-0.121	-0.082	-	-	-	0.029	0.031
				(0.104)	(0.107)				(0.035)	(0.035)
25 or more years of teacher experience	-	-	-	-0.125	-0.125	-	-	-	0.032	0.038
				(0.096)	(0.097)				(0.031)	(0.031)
Teacher is employed full-time	-	-	-	-0.023	-0.031	-	-	-	-0.027	-0.032
				(0.121)	(0.119)				(0.043)	(0.043)
Teacher has a bachelor's major in subject of instruction	-	-	-	0.002	-0.005	-	-	-	0.027**	0.028**
				(0.041)	(0.041)				(0.013)	(0.013)
Class size	-	-	-	-0.006	-0.006	-	-	-	0.001	0.001
				(0.004)	(0.004)				(0.001)	(0.001)

	Native Spanish-Speaking Student					Native English-Speaking Student				
	OLS	Within-Student	Within-Student	Within-Student	Within-Student	OLS	Within-Student	Within-Student	Within-Student	Within-Student
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Percentage of students in class with limited English proficiency	-	-	-	-0.128	-0.147	-	-	-	-0.226**	-0.220**
				(0.115)	(0.110)				(0.108)	(0.105)
Hispanic teacher	-	-	-	-	-0.154*	-	-	-	-	0.025
					(0.081)					(0.061)
Black teacher	-	-	-	-	0.007	-	-	-	-	-0.069***
					(0.080)					(0.026)
Teacher of other race	-	-	-	-	0.097	-	-	-	-	0.026
					(0.161)					(0.053)
Subject fixed effects	X	X	X	X	X	X	X	X	X	X
Student fixed effects	X	X	X	X	X	X	X	X	X	X
Observations	2,420	2,420	2,289	2,135	2,101	35,258	35,258	34,243	32,788	32,526
R-Squared	0.005	0.011	0.017	0.032	0.036	0.001	0.000	0.018	0.021	0.022

Notes: Standard errors in parentheses are cluster-robust standard errors that allow for correlation in individual error terms within schools. Teacher ethnicity may fall into 4 categories – Other race, Hispanic, Black, or White (with White as the base category). Teaching certification may fall into 4 categories – Standard, Probationary, Temporary, or None (with None as the base category). Teacher education may fall into 5 categories – Less than a bachelor's degree, Bachelor's degree, Master's degree, Education specialist degree, or PhD (with Bachelor's degree as the base category). Teacher experience may fall into 8 categories – Less than 4 years, 4-6 years, 7-9 years, 10-12 years, 13-15 years, 16-18 years, 19-21 years, 22-24 years, or 25 or more years (with less than 4 years as the base category). Whether the teacher and the student share the same native language, teacher gender, whether the teacher is employed full-time, and whether the teacher has a bachelor's major in the subject of instruction are represented by dichotomous variables. Class size and Percentage of LEP students in the class are continuous variables. The dummy indicating whether the teacher had less than a bachelor's degree was dropped in regressions (4), (5), (9), and (10) as a result of collinearity because these regressions also included another dummy variable indicating whether the teacher majored in the subject of instruction as an undergraduate. *** p-value<0.01, ** p-value<0.05, * p-value<0.1.