The Effect of Sharing a Mother Tongue with Peers: Evidence from North Carolina Middle Schools

January 2015

Thomas Ahn
Department of Economics
University of Kentucky
335X Gatton B&E Building
Lexington, KY 40506-0034
thomas.ahn@uky.edu

Christopher Jepsen[*]
School of Economics and The Geary Institute
University College Dublin
Newman Building, Room G215
Belfield, Dublin 4, Ireland
christopher.jepsen@ucd.ie
+353 (0) 1 716 8320

Abstract:

This paper provides the first analysis of the relationship between the language mix of Limited English Proficient (LEP) peers and student achievement, using detailed panel data from 2006 to 2012. Percent LEP has a negative association with mathematics and reading test scores, more so for non-LEP students than for LEP students. The overall language mix of LEP students has little if any discernable relationship with achievement. For LEP students, having more LEP peers speak their mother tongue is positively associated with reading achievement and negatively associated with mathematics achievement.

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[*] Corresponding author.

Introduction

Immigration has increased sizably in the United States and worldwide over the last decade. In 2011, 13.0 percent of individuals in the United States were foreign-born, compared with 11.1 percent in 2000 and 7.9 percent in 1990 (Migration Policy Institute, 2013). In addition to moving to traditional immigrant destinations such as California and Texas, recent waves of immigrants are arriving in states that have had only modest immigration for the last 50 years if not more.

One potential consequence of this increased immigration is that sizable numbers of Limited English Proficient (LEP) children attend public schools. LEP students speak a language other than English at home[1] and have sufficiently low levels of English proficiency to make them eligible for additional services to improve their English skills. Once LEP students have sufficiently learned "academic" English to participate successfully in the classroom, as measured by a standardized test designed to measure the English proficiency of non-native English speakers, they are reclassified as Fully English Proficient (FEP) and are no longer considered LEP (WIDA Consortium, 2013).

Many states are seeing dramatic increases in the LEP population, often from a very low base. For example, the percentage of LEP students has increased by at least 200 percent in Indiana, Kentucky, and South Carolina between 1994-1995 and 2009-2010, although current percent LEP is still below five percent in these states (NCELA, 2011). In North Carolina and Virginia, the LEP population has more than doubled and is now above 10 percent of the school population. These states may not have sufficient resources to educate the rapidly increasing population of LEP students.

Although data limitations usually force researchers to treat students with a mix of languages, cultures, and geographic origins as a single LEP category, recent immigration

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[1] Students who speak only English but do not speak it proficiently and score poorly in reading exams are not defined as LEP students.

patterns show that LEP students are not a mono-linguistic group. In the United States, for example, the 2012 American Community Survey finds that approximately 21 percent of those surveyed speak a language other than English at home.[2] Of these non-English speakers, roughly 62 percent speak Spanish or Spanish Creole, 18 percent speak another Indo-European language, 16 percent speak an Asian or Pacific Island language, and 4 percent speak an "Other" language. In many European countries, recent immigrants from Eastern Europe, North and Sub-Saharan Africa, the Indian sub-continent, and Turkey have introduced more ethnic and linguistic diversity into schools, creating new learning opportunities and challenges.

This increased language diversity in the classroom has potential spillover effects, both positive and negative, on student achievement. For example, teachers may need to alter their teaching practices in response to an influx of LEP students, with the response dependent on the language mix of LEP students. Furthermore, the effect of language mix likely differs between LEP students and non-LEP students. In particular, an LEP student may have additional spillover effects – beyond the "baseline" effect of having LEP peers – due to the share of peers who speak the same non-English language.

In this paper, we study the effect of LEP peers on student achievement in North Carolina middle schools, which include grades 6 through 8. Our results are likely representative of many states which have seen dramatic growth in percent LEP but still have relatively small percentages of LEP students. Previous studies have focused on primary school and on areas like California or Texas with large immigrant populations from many countries. Work from outside the U.S. has focused on the effect of immigration rather than language proficiency. We identify the effect of idiosyncratic changes in peers through a detailed panel dataset of students between 2006 and 2012, along with the use of controls for

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[2] Authors' calculations.

student, school, and grade-by-year fixed effects to account for student-specific and school-specific differences in peers and in student achievement. This paper is the first to study the extent to which the distribution of languages spoken by LEP students affects the achievement of LEP and non-LEP students. In contrast to previous work, we are able to isolate the effects of having LEP peers from the effects of having low-achieving or low-income peers by including additional controls for these peer characteristics.

For non-LEP students, an increase of 10 percent in LEP peers, approximately two students per classroom, is associated with a 0.7 to 1.1 percent standard-deviation decrease in mathematics and reading test scores, respectively. The language concentration of LEP students has no discernable effect on the achievement of non-LEP students. For LEP students, percent LEP is unrelated with reading achievement, whereas a 10 percent increase in LEP peers corresponds with a 2.8 percent standard-deviation decrease in mathematics. Having more LEP students speaking the same language is beneficial for reading achievement and harmful for mathematics achievement among LEP students, but the overall language concentration of LEP students is weakly if at all related with LEP students' achievement in reading or mathematics.

Relation to Previous Research

Our work builds on previous work using North Carolina data. Diette and Oyelere (2012) estimate the effect of LEP peers on native students' achievement in grades four through eight. Their results are sensitive to model specification. In their preferred model with school-by-year fixed effects, percent LEP has a negative effect similar in magnitude to our results. However, in their student fixed effects model, percent LEP has a positive association with mathematics achievement. The negative effects in their preferred model are concentrated among students in the top 25 percent of the test score distribution. Diette and

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Oyelere (2014) further study heterogeneity by student race and gender, finding small negative effects for males and blacks.

Santillano (2009) studies the effect of percent LEP peers in fourth and fifth grade in North Carolina. His preferred method is a matching estimator. Again, the results are sensitive to model specification, although the effects are small in magnitude.

Using data from one large, urban school district in the Southwestern U.S., Bui (2014) studies the effects of percentage LEP peers on the fifth-grade test scores of LEP students in one large, urban district. She does not study the effects on non-LEP students. She finds that percent LEP is positively associated with mathematics achievement and mainstreaming and negatively associated with grade retention of LEP students.

Cho (2012) studies the effect of having LEP classmates on kindergarten and first-grade test scores in Early Childhood Longitudinal Study Kindergarten Cohort (ECLS-K) data. The author uses school fixed effects and student fixed effects to control for potential non-random sorting of LEP students. The data contain at most two observations per student (one for spring of kindergarten and one for spring of first grade). Having LEP classmates is associated with lower reading scores but has essentially no impact on mathematics test scores.

Friesen and Krauth (2011) study the impact of immigration on fourth- and seventh-grade student achievement in British Columbia. The authors use multiple cohorts of students and control for school-by-grade fixed effects. They generally find negative effects of Punjabi-speaking peers and positive effects of Chinese-speaker peers, although the results vary by grade level and test subject.

Several papers study the effect of immigrant peers in Europe.[3] The paper most similar to ours is Geay, McNally, and Telhaj (2013), who study the impact of immigrant peers on sixth-grade test scores in the UK. Using panel data from the National Pupil Database from 2003 to 2009, they look at the percentage of students in the same grade who do not speak English as the first language. In a model using school fixed effects and school-specific time trends, they find essentially no effect of immigrant peers on mathematics and reading tests.[4] Similarly, Ohinata and van Ours (2013a) find little effect of the percent immigrant on the achievement of Dutch fourth-grade students in their school-fixed effects models.

Other studies using European data have much weaker controls for the nonrandom sorting of students across schools. Brunello and Rocco (2013) use country as the unit of analysis to avoid concerns about the sorting of students into schools, using country fixed effects to study cross-country differences in the impacts of immigration. Jensen and Rasmussen (2011) use instrumental variables based on the immigrant concentration in the county to study the effect of immigration on secondary-school test scores in Denmark. Entorf and Lauk (2008) and Schnepf (2007) use ordinary least squares (OLS) regression models with no controls for non-random student sorting.

However, one concern with all of these papers on Europe is that they do not study the effect of language proficiency. Instead, they study the effects of immigration and / or first language spoken at home. Because LEP students usually become proficient in English after 5 to 7 years of schooling (Hakuta, Butler, and Witt, 2000), the vast majority of immigrants who

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[3] We refer to this literature as immigrant peers because the native language varies across countries. Some research, including ours, focuses on the role of language, which may be especially relevant for recent immigrants.

[4] Because they are concerned about potential nonrandom sorting of students across schools, they also estimate an instrumental variable (IV) model using the influx of Polish students into Catholic schools after 2005 as an instrument. Their IV results are imprecisely estimated but are similar to their fixed effects results. The concern about nonrandom sorting may be over stated in their data. Although they find significant effects of percent non-English on student characteristics, the magnitudes are small. Furthermore, such significance is to be expected in their data set of approximately 2.4 million observations.

arrive before starting school should no longer be LEP by middle school, the age range we study in this paper. Consequently, in our context, immigration, or even a measure of the first language spoken, is a weak proxy for language proficiency, and these studies likely introduce measurement error as a measure of peer language by using measures of immigration rather than language proficiency.[5] Because these papers focus on the relationship between immigrant peers and achievement, they provide limited insight on the research topic of the current paper, the relationship between peer language mix and achievement. In particular, our focus is most relevant to study the impact of recent immigrant students on their peers. Recent immigrant students who are not proficient in the language and unaccustomed to their new homeland may have a much larger impact on native and non-native peers than those who are fully acclimated. In the methods section, we show how peer language skills in the country's language affect student achievement. The theoretical argument is much weaker, if not nonexistent, for peers speaking another language at home or for immigrant peers.

The literature on immigrant and/or LEP peers also looks at long-run outcomes as well as test scores. Gould, Lavy, and Paserman (2009) exploit the sizable increase in immigration from the former Soviet Union to Israel to study the effects of immigrant peers on completing the high-school matriculation exam and attending college. Similarly, Conger (2012) studies the relationship between percent foreign born and high school achievement in Florida. Hunt (2012) looks at high-school completion, and Neymotin (2009) looks at college-level outcomes.

This literature on immigrant peers builds on a large peer effects literature, particularly on the effect of peers as measured by past test scores. Our methods are most similar to Lavy, Silva, and Weinhardt (2012), who use student and school fixed effects to study peer effects in

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[5] Appendix Figure A1 shows the distribution of standardized reading scores for all NC middle school students in our sample years, divided by LEP status. LEP students clearly score lower compared to their non-LEP peers.

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UK secondary schools. Prominent work on peer effects in U.S. schools includes Hanushek et al. (2003), Imberman, Kugler, and Sacerdote (2012), and Burke and Sass (2013).[6]

Our work differs from previous work in North Carolina in many ways. First and foremost, we study the effect of the language mix of LEP students. Second, we focus exclusively on middle school, whereas Diette and Oleyere (2012, 2014) assume that the percent LEP has a constant effect for grades four through eight and Santillano (2009) studies grades four and five. Third, we use data from 2006 to 2012 compared to previous work using data from 2006 and before. Fourth, we include additional peer controls for mobility and, more importantly, lagged peer test scores. Fifth, we look at achievement for all students, whereas Diette and Oyelere (2012, 2014) look only at native students.

More generally, we provide multiple contributions to this literature. Unlike studies from Europe, we focus on the effect of English proficiency rather than the effect of immigration or of speaking a foreign language at home. We are the first paper in this literature to focus exclusively on middle school, whereas most research focuses on primary school. Our detailed panel data from three consecutive grades (six through eight) allow us to identify effects of peers based on year-to-year changes in students' peers as they progress through middle school rather than relying on sparse differences such as that between fourth and seventh grade or on transitions between primary school and middle school. Furthermore, our results from the entire middle school population North Carolina are applicable to many areas in the U.S. – particularly in the South, Midwest, and Mountain regions – with recent increases in immigration. In contrast, studies from specific districts in Texas and British Columbia are of areas with a large base of immigrants from a diverse set of countries, and Cho (2012) looked at survey data from the U.S. as a whole, where areas have vastly different LEP populations. Finally, we are the first study to explicitly disaggregate LEP students (from

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[6] Bifulco, Fletcher, and Ross (2011) look at the effects of peer effects on post-secondary outcomes rather than in-school effects.

a single group of "non-English speakers") and analyze the potential academic impact of differing mixes of students within this group.

Data

We use an administrative data set for the North Carolina public school system from 2006-2007 to 2011-2012. The focus is on recent years in order to study the recent increase in non-English speaking students in North Carolina.[7] The data set contains information on all public schools, teachers, and students in North Carolina. Student data are collected annually and can be matched across years, yielding a relatively complete panel data set of *all* public school students in North Carolina.[8] In other words, we have a population data set of North Carolina middle school students aside from a few atypical schools with very small samples, in contrast to most migration studies that rely on surveys or on small geographic areas.

We restrict attention to students in grades 6, 7, and 8 in order to use two-year lags of student achievement and to include course membership data available in middle school. Because we have the capacity to follow the same student through middle school, we observe the majority of students three times. Thus, we have data on four cohorts of students – those who start in grade 6 in 2006, 2007, 2008, or 2009. We collect student demographic information such as gender, race, free/reduced-price lunch status, as well as LEP status. We also collect information on their peers, at the level of class (English and mathematics) as well as grade. Teacher demographic information such as gender, race, and whether the teacher is new to the profession is also collected. Schools who have fewer than 10 students in their grade and students who attend schools with fewer than 30 total students are deleted from the data set.[9]

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[7] Additional reasons for using more recent data are that the definition of Limited English Proficient is different before this period and that we cannot match middle school students to specific teachers before this period.
[8] For further details, see North Carolina Education Research Data Center (NCERDC: www.pubpol.duke.edu/centers/child/nceddatacenter.html).
[9] The majority of these students are in alternative schools/programs (schools of last-resort). Including these students does not qualitatively change results.

Relevant student outcome measures are standardized exam scores. All students in grades 3 to 8 in North Carolina must take an end-of-grade (EOG) exam in reading and mathematics. The exam scores are used to generated school-level report cards and enter into the final grade calculations for the students. Therefore, the exams are high-stakes not only for the school, but for the students as well.

Descriptive Statistics

Table 1 summarizes student and teacher observations. North Carolina has a relatively small LEP population in middle school. Approximately five percent of the student population is identified as LEP, and four percent were previously LEP. Most North Carolina public schools do not provide specialized language programs such as bilingual education, as less than 1/5 of LEP students take a designated English-as-a–Second-Language course. Instead, most LEP students are in "regular" classrooms with non-LEP students.

[INSERT TABLE 1]

Approximately half the students are eligible for free or reduced-price lunch. Forty percent of students are nonwhite: 28 percent Black, 10 percent Hispanic, and two percent Asian / Pacific Islander. The rate at which students switch schools is around 32 percentage points, driven by the fact that most North Carolina middle schools contain grades six to eight.

The bottom two panels of the table contain teacher characteristics. Because the characteristics of reading and mathematics teachers are quite similar, the table only contains the statistics for reading teachers. Nearly 90 percent of students have female reading teachers and over 15 have black reading teachers. [10] Around six percent of students have teachers in their first year of teaching.

Methods

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[10] Less than one percent of students have either Hispanic or Asian / Pacific Islander teachers.

Before presenting the full model, we first consider the reduced-form relationship between LEP peers and student achievement. The impact of LEP peers on non-LEP students may be negative or positive. If a teacher's time and energy are assumed to be private and excludable goods, a student's education production is negatively impacted if LEP peers demand more resources from the teacher because they are not sufficiently fluent in the language of instruction. Similarly if lessons must be targeted for a single group of students, and if LEP students yield the largest "bang-for-buck," non-LEP students may be adversely impacted by an increase in the percentage of LEP peers.

On the other hand, LEP peers may positively impact non-LEP student test scores as well. For instance, if teachers were systematically over-estimating non-LEP students' abilities, being forced to re-calibrate to LEP students may in fact increase average achievement. Alternatively, if LEP students, who are typically first generation immigrants, are more motivated to learn, this attitude may have positive spillovers for the rest of the class, due to, for example, less disruptive behaviors in class.

To fully capture the effect of LEP peers, the language mix of LEP students should be considered, although the effects likely vary between LEP and non-LEP students. Non-LEP students may be distracted if the LEP students speak the same non-English language constantly in class. However, they may benefit from exposure to a diverse mix of other languages and cultures. LEP students may benefit from having many peers who speak the same language, as they can communicate in their native tongue. Conversely, LEP students may have reduced incentives to learn English if they have many peers who speak their non-English language. Thus, the effects of LEP peers likely differ for LEP students and non-LEP students, and we estimate separate regressions for LEP students and non-LEP students.

Teachers may be impacted by the language mix as well, which could affect the delivery of instruction. A diverse mix of languages and cultures may mean that a teacher will

have to devote more time and effort for any given lesson. Instead of the traditional lecture format, teachers may have to use more visual aids, clearer and more diverse examples, and more structured lesson plans. The impact of such a change in teacher behavior may be positive or negative, depending on what fraction of his or her students benefit from the revised lesson. Having many students who speak the same language (and who assist each other) may allow the teacher to focus efforts on other students, or the teacher may have to expend effort to prevent these students from becoming disruptive in class.

Thus, the predicted effect of language mix on student achievement is not clear. However, the theoretical mechanisms through which language mix affects achievement are focused on language and are not as pronounced when considering immigration or students who speak another language at home. Much of the teacher or student behavior that could result from immigrant students would also result from having students with diverse backgrounds generally, such as teachers avoiding culture-specific references to certain television shows. In other words, immigrant-specific changes are also changes that are likely to occur in heterogeneous classrooms generally, whereas LEP peers likely introduce changes that are specific to having limited language skills. It is the effect of these language-specific changes in teacher and student behavior that we attempt to model in this paper.

We start with a conventional model of student achievement, modeling student achievement for student i in grade g and school s at time t as follows:

$$A_{igst} = X_{igst}\beta + T_{gst}\gamma + \bar{P}_{igst}\delta + \sum_{j=1}^{g-1}\left[X_{ijst}\eta + T_{jst}\lambda + \bar{P}_{ijst}\mu\right] + \omega_i + \rho_s + \tau_{gt} + \varepsilon_{ijst}. \quad (1)$$

The dependent variable is a standardized test score in either reading or mathematics, X contains student characteristics, T contains teacher characteristics, and $\bar{P}$ contains peer characteristics (excluding student i, of course). The primary peer characteristic of interest is the percentage of peers who are LEP. The model includes student fixed effects (ω), school

fixed effects (ρ), and grade-specific time fixed effects (τ), discussed in more detail below. In all specifications, standard errors are clustered at the school by grade by year level.

The specification in equation (1) assumes that education inputs are cumulative. For example, a student's achievement in sixth grade is a function of current as well as past student, teacher, and peer characteristics (as illustrated by the lagged terms in brackets). In practice, the data requirements to estimate equation (1) are substantial. Rather than attempting to collect complete information on past teachers and peers, researchers often use prior test scores as an imperfect proxy for these characteristics. Equation (2) illustrates this simplified specification:

$$A_{ijst} = X_{ijst}\beta + T_{jst}\gamma + \bar{P}_{ijst}\delta + A_{ijst-1}\varphi + \omega_i + \rho_s + \tau_{gt} + \varepsilon_{ijst}. \tag{2}$$

Although the inclusion of prior achievement captures many of the impacts of past teacher and peer characteristics, the introduction of past achievement potentially introduces endogeneity, as unobserved components of prior achievement are likely correlated with current achievement, including the unobserved component ε_{ijst} (Todd and Wolpin, 2003).

A special case of the value-added model in equation (2) is the gains model, where the dependent variable is measured as test score growth. For example, Hanushek et al (2003) use a gains model to estimate peer effects. The gains model is equivalent to a value-added model where φ equals one, implying that students have no decay in test scores or learning from one year to the next. In practice, value-added models routinely reject the hypothesis that the coefficient on previous achievement (φ) equals one. Therefore, the value-added model is much more common than the gains model, and we follow the traditional approach by estimating a value-added model as in equation (2).

The inclusion of multiple fixed effects, a standard approach when using detailed panel data, mitigates endogeneity concerns in the value-added model. The inclusion of student fixed effects controls for any between-student variation that is constant over time, such as

innate ability, gender, etc. School fixed effects control for time-invariant differences across the schools. Because students often switch schools, the student fixed effect will not subsume the school fixed effect. Lavy, Silva, and Weinhardt (2012) include student fixed effects to address concerns about high correlation between pupils' and their peers' ability and characteristics even after the inclusion of school fixed effects. Finally, we control for broad differences across school years through the inclusion of grade-specific time fixed effects. The time dummy variables are grade specific to allow for additional flexibility. For example, the impacts of a given year such as 2010 may be different in sixth grade versus eighth grade due to factors such as changes in curriculum for specific grades. Overall, the detailed panel of student-level data in North Carolina allows us to identify changes in the percent of non-English-speaking classmates based on idiosyncratic changes on students' peers from one year to the next. However, as in all nonexperimental methods, our model is potentially subject to bias due to unobserved variables, but such variation would have to vary across time, students, and schools so as not to be captured by the student, school, and grade-by-year fixed effects.

Another concern in the literature on immigrant peers – and in the education literature more generally – is the possible nonrandom assignment of students to classrooms and schools. Using panel data from North Carolina primary schools, Rothstein (2010) argues that the nonrandom assignment of students to classrooms leads to biased estimates of teacher – and presumably classroom-based peer – effects on achievement. However, Kinsler (2012) demonstrates that Rothstein's (2010) falsification tests are problematic when sample sizes are small. Kinsler (2012) cannot reject the hypothesis of random assignment of students to classrooms when using a test that addresses potential small sample size concerns. Furthermore, Koedel and Betts (2011) show that using a complex value-added model with multiple years of data – such as the model we estimate – greatly reduces the potential bias.

Peer Characteristics

As mentioned previously, the primary independent variables of interest are measures of LEP peers, with a particular focus on the distribution of non-English languages spoken. The typical variable for LEP peers is the percentage of peers (excluding the student) who are not proficient in English (i.e. LEP) and do not speak English at home. In addition, we include a measure of the distribution of "mother tongues," LEP students' primary language spoken at home.

We consider three possible measures of peers. In the first measure, peers are measured as current classmates in either mathematics or reading. Using the current LEP status is appealing because it identifies students who may potentially create distractions in the classroom due to their limited grasp of English.

The second possible measure of peers is the set of students in the same school and grade, but not necessarily the same classroom. Because previous literature has estimated this variable at the grade level to mitigate concerns about the sorting of students across classrooms within a given grade, our preferred measure defines peers at the grade level to minimize concerns about sorting across classrooms within a grade as well as for consistency with previous studies.

The third potential definition of peers is based on Geay, McNally, and Telhaj (2013), who use the school attended at age 7, rather than at age 11, the age at which the outcome variable is measured, to reduce concerns about endogeneity. They use the current LEP status of the age 7 peers. We create an analogous measure based on the classroom attended two years ago because outcomes are measured at different ages rather than in a single grade as in Geay, McNally, and Telhaj (2013). Because the results from this measure are not substantively different than those of current peers (as Geay, McNally, and Telhaj (2013) find), we only report results for current peers, i.e. students in the same grade and school.

Because the language mix of LEP peers has not been studied before, we consider different definitions of languages spoken. One measure is the Herfindahl index of language concentration. The index ranges from 1/N (N students each speaking a different language) to 1 (each student speaks the same language). Another measure is the number of languages spoken in the grade and school. For LEP students, we measure the percentage of peers who speak the same non-English language (i.e. mother tongue).[11]

These three statistics are designed to measure the "variance" in language exposure in the classroom. The usual percent of peers that are LEP captures the "scale" effect. For example, assume there are four different classes, identical across all other dimensions except the number of LEP students. Classes 1 and 2 have 10 percent and 20 percent of their students as LEP respectively, and they all speak Spanish.[12] Classes 3 and 4 have 10 percent and 20 percent of their students as LEP respectively, but the LEP students are evenly split between Spanish and Portuguese speakers. Previous studies would treat classes 1 and 3 as identical, and classes 2 and 4 as identical. However, doing so assumes that all LEP peers impact each other, non-LEP peers, and the teacher in the exact same way, even if the LEP peers do not share the same language. If at least some portion of the peer effect is generated by interaction amongst peers, then the ease (or difficulty) with which students can communicate with each other may matter for education production.[13] In a school with a large number of LEP students from various cultures, it may be important to know about the impact of not just the mix between LEP and non-LEP students, but the mix *among* LEP students.

In order to isolate the effects of non-English speaking peers, the set of peer characteristics, $\bar{P}$, also includes the percentage of peers who are eligible for free- or reduced-

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[11] For non-LEP students, the percentage of students speaking the same language – English – is equal to 100 minus the percentage of LEP students. Thus, it is perfectly collinear with percentage of LEP students.
[12] In the regressions, the LEP percentages are lagged, in keeping with other peer variables. However, for explanatory purposes, this example uses current LEP percentages.
[13] An alternative explanation, mentioned before, is that a teacher may struggle to deliver quality instruction to a classroom where many students speak many different languages, compared to a classroom with one or two languages.

price lunch, are black, are Hispanic, are female, and have switched schools since the previous school year. We also include two controls for peer test scores, the mean and standard deviation excluding the student himself or herself. All the peer effect variables (including percent LEP) are lagged two years to minimize concerns about endogeneity. Such practice is common in the peer effects literature (Hanushek et al., 2003; Vigdor and Nechyba, 2004).

Teacher Characteristics

Teacher characteristics are included in the model to isolate the effects of peers on student achievement from the effects of teachers. Therefore, the model includes controls for experience, gender, and race. Because not all students can be linked with the teachers, robustness checks are run to see if the results are sensitive to the inclusion or exclusion of teacher characteristics.[14]

Student Characteristics

Because the model includes student fixed effects, all time invariant characteristics such as race/ethnicity and sex will be captured in the student fixed effects. The model does include time-varying student characteristics concerning mobility and free lunch eligibility. Transfer behavior is captured by a dummy variable equal to one for students who have moved since the previous school year, including moves from primary to middle school. The free lunch variable is simply a dummy variable for receipt of free- or reduced-price lunch during the current school year.

Results

Non-LEP Students

Tables 2 and 3 contain student fixed effects results for standardized reading (Table 2) and mathematics (Table 3) test scores, where the sample is restricted to non-LEP students. In order to isolate the effect of non-English speaking peers from other peer effects, all

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[14] Another justification for the sensitivity tests is that students are matched to teachers based on the teacher administrating the end of year tests. In rare instances, the teacher administering the exam is not the regular classroom teacher.

specifications contain controls for other peer effects. In particular, we control for percent free

and reduced price lunch – a proxy for low parental income – because LEP students are

disproportionately eligible for this program. We also control for the test score mean and

standard deviation of the student's peers (excluding the student), lagged two-years. LEP

students also have lower average test scores than English proficient students. We also control

for percent female, percent Black, and percent Hispanic. Therefore, the coefficient on

percent LEP reflects the effect of language and the not the effect of having low-income peers,

low-achieving peers, or Black or Hispanic peers.

In specification NL1 (short for "Non-LEP") of each test, LEP peers are defined as the

percentage of LEP students in the same grade and school. This specification contains basic

time-varying student demographic characteristics, grade-level peer demographic

characteristics, grade-level peer mean achievement, and teacher-level characteristics. The

regression specification also contains student, school, and grade-by-year dummies. In this

specification, a one-percent increase in percent LEP in the grade, all else equal, corresponds

with a 0.106 percent of a standard deviation decrease in reading test score, a result that is

statistically significant at the one-percent level (all significance tests are two-sided tests). For

mathematics, the coefficient is -0.0725 and is not statistically different from zero. An out-of-

sample change of going from a no LEP grade to an all-LEP grade would correspond to

decline in test scores of seven to 10 percent of a standard deviation. In comparison, a ten-

percent increase in percent free or reduced-price lunch (about half a standard deviation)

would correspond to a drop in test scores of 0.7 to 0.8 percent of a standard deviation.

Although the marginal effect of percent LEP may seem modest, the actual impact of

additional LEP students in practical terms is nontrivial. The "average" grade in middle

schools in North Carolina has approximately 11 LEP students and 110 students who receive

free or reduced price lunch. Thus, increasing the number of LEP students in a grade, even by

one student, corresponds to roughly a 0.1 percent of a standard deviation decline in reading test scores.

[TABLE 2 HERE]

[TABLE 3 HERE]

These results are larger than the effects on natives' test scores found in Diette, and Oyelere (2012). For comparison, Cho (2012) finds that having an EL classmate is associated with a decline in reading test scores of roughly three percent of a standard deviation for kindergarten and first-grade students, but the effect is practically zero for mathematics test scores. In Europe, the effects of immigrant peers are statistically insignificant in Geay, McNally, and Telhaj (2013) and Asako and van Ours (2013a).

The results in Specification NL1, similar to specifications elsewhere in the literature, contain no controls for the language mix of LEP students. Therefore, specification NL2 includes an additional measure of LEP peers, the LEP Herfindahl index of non-English languages spoken. As mentioned previously, the index measures the concentration of mother tongues spoken. Lower values of the index correspond with greater language diversity. Grades with no LEP students have an LEP Herfindahl index of zero. Because the index measures the concentration or diversity of languages spoken rather the number or concentration of LEP students, NL2 includes the LEP Herfindahl index in addition to the percent LEP.

The coefficient on percent LEP in specification NL2 is nearly identical to its coefficient in S1. The LEP Herfindahl index has economically and statistically insignificant effects on reading and mathematics test scores, with coefficients of 0.00145 and -0.00479, respectively. Even though the coefficient for mathematics is statistically significant at the ten-percent level, the magnitude is trivial in practical terms. A ten percent increase in the language concentration of LEP students (i.e. change of 0.1) is associated with a trivial

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decrease in mathematics achievement of 0.0005 standard deviations. The concentration of non-English languages spoken has no measurable effect on the test scores of non-LEP students.

In Appendix Table A1, we measure LEP peers as the number of foreign languages spoken. Regardless of whether percent LEP is also included, the number of foreign languages spoken is essentially unrelated to the test scores of non-LEP students. In the last column, where the language count coefficient is largest, an additional foreign language corresponds with an increase in achievement of 0.001 percent of standard deviation.

As mentioned above, our preferred model includes lagged peer test scores, where the test scores are lagged by two years rather than one for consistency with previous work on peer effects. We find that lagged peer test scores have a negative effect on student achievement, consistent with recent findings in Antecol, Eren, and Ozbeklik (2013). In contrast, previous work found essentially no effects (Lavy et al., 2012, Ohinata and van Ours 2013b) or positive effects (Hanushek et al., 2003; some specifications in Vigdor and Nechyba, 2004).

One potential explanation of the negative effect is a version of regression to the mean. Because test scores are standardized with mean zero, a perfectly random peer distribution with no peer-level shocks should yield zero average score in expectation, and the parameter on peer score should also be zero. If there was a positive shock, the peer lagged score should be greater than zero, and a negative shock would yield a negative score. If a shock occurs in either direction, the current year student score, with individual fixed effect netted out, should be negatively correlated with peer lagged score.

The student-level parameters are consistent across tests. The parameter on test score from last year is approximately -0.25 across all specifications.[15] Again, this pattern of results may be indicative of mean reversion. Being low income has essentially no effect on test scores in mathematics or reading.[16]

Alternate Specifications for non-LEP Students

Tables 2 and 3 also contain alternate specifications of language mix, although these specifications include the preferred language mix variables: percent LEP and the LEP Herfindahl index. In specification NL3, for each subject, we include additional variables for the LEP peers at the school level: school percent LEP and school LEP Herfindahl index. Percent LEP at the school level is included in Geay, McNally, and Telhaj (2013) and Gould, Lavy, and Paserman (2009) to control for school-level variation in percent LEP. The inclusion of these school-level variables substantially increases the magnitudes of the percent LEP coefficient. In mathematics, the effect is nearly twice as big, with a 10 percent increase in percent LEP corresponding with a 1.4 percent decline in test scores. Note that although the increase in magnitude may seem troubling, it is offset by the positive school percent LEP coefficient.[17] Thus, the negative results for percent LEP in our preferred model (NL2) are not an artifact of excluding school-level controls for LEP peers. The effect of the LEP Herfindahl index remains small and statistically insignificant. However, the standard errors approximately double with the inclusion of school-level LEP Herfindahl index, suggesting substantial correlation between the grade-level and school-level measures.

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[15] We ran two types of robustness checks to make certain that the negative results was not due to data problems or coding mistakes. First, we re-estimated the models without last year scores. All coefficients remained qualitatively similar. The mean difference across the coefficients was about 15%. Second, we re-estimated the models *without* individual fixed effects. Doing so returned the last year test score coefficient to between 0.7 and 0.8, which are widely seen in the literature. See online appendix, available at sites.google.com/site/tomsyahn.

[16] Another potential explanation may be a mechanical relationship between current and lagged scores. See Goldberger (1989) for an example of a mechanical relationship with a lagged dependent variable.

[17] As a rough calculation, a 10 percent increase in grade percent LEP (holding other grade percent LEP constant), would be associated with a 1.4 percent of a standard deviation decrease *plus* a 0.5 percent of a standard deviation increase from the school percent LEP (0.15 x 1/3 x 0.1 – one in three grades).

As mentioned previously, North Carolina has a relatively low LEP population in middle school. Thus, many grades do not have any LEP students in a given school year. Specification NL4 for each subject excludes observations (i.e. combinations of students and school years, such as Joe Smith in 2008) where there are no LEP students in the student's grade during that particular school year. The idea here is to attempt to isolate the effect of going from no LEP students to at least one LEP student from the effect of an increase in LEP students in grades that already had LEP students. The results in specification NL4 show that the focus on grades with LEP students has a slight decrease in the magnitude of the coefficient for reading to -0.075 (only significant at the ten percent level), whereas the magnitude of the effect for mathematics increases to -0.14 (now significant at the one-percent level). The size of the percent LEP effect varies between the samples, but the negative effect persists.

LEP Students

Now we turn to the effect of percent LEP on the achievement of LEP students. Table 4 contains three specifications, each labeled with "L" to denote LEP students. Specification L1 contains percent LEP as the only measure of LEP peers. Specification L2 contains the LEP Herfindahl index in addition to percent LEP; specification L3 contains the percent of LEP students who share the same common tongue, as well as a control for percent LEP. We do not estimate a specification with all three terms because an increase in the percent mother tongue will necessitate an increase in the Herfindahl index, holding all else constant. For this reason, trying to interpret a change in mother tongue holding the Herfindahl index constant does not make sense.

Percent LEP is negatively associated with mathematics achievement for LEP students, but the effect for reading is positive, small, and statistically insignificant. This pattern is quite consistent across all three specifications. In mathematics, a ten-percent increase in

percent LEP (about 2 students in our sample) is associated with a decrease in mathematics test scores of approximately three percent of a standard deviation. In contrast, a ten-percent increase in percent LEP is associated with an increase in reading test scores of 0.4 to 0.5 percent of standard deviation, although results are statistically insignificant.

The results for mathematics contrast with the positive effects found in Bui (2014) for one grade (fifth grade) and one school district in the Southwest U.S. Bui (2014) also finds a modest and statistically insignificant positive effect on reading test scores. There are many possible explanations for the difference, including different models, grades, locations, and time periods.

The Herfindahl index, which captures the language concentration generally without taking into consideration whether that language concentration is in the student's mother tongue, has little discernable effect with the test scores of LEP students. A ten-percent increase in the Herfindahl index corresponds with an increase of 0.3 percent of a standard deviation for reading (statistically significant at the ten percent level) and a decrease of 0.08 percent of a standard deviation for reading (statistically insignificant at the ten percent level). Thus, we find little evidence that the general language diversity (or concentration) of LEP students has any effect on the achievement of LEP students.

In contrast, we find that an increase in the share of LEP students speaking the LEP student's mother tongue is positively related to reading achievement and negatively related to mathematics achievement. The effect sizes of a ten-percent increase in the percent common tongue are 0.8 and -0.7 percent of a standard deviation for reading and mathematics, respectively. Again, the practical impact of this term is non-negligible. If a student is in a peer group with 4 other LEP students, and he or she shares a language with 1 other student, the percent common language is 0.25. If a new student that shares his or her common language enters the grade, percent common language for this student increases to 0.4, which

would be associated with a 1.2 and -1.1 percent of a standard deviation change in achievement for reading and mathematics, respectively.

Discussion

Our preferred estimates show that having peers – defined at the grade level – who are not proficient in English is associated with modestly lower achievement in both reading and mathematics for non-LEP students. An increase of 10 percent in LEP peers, approximately one student per grade, is associated with a 1.1 percent standard-deviation decrease in reading test scores and a 0.7 percent standard-deviation decrease in mathematics test scores.

For LEP students, an increase of 10 percent in LEP peers corresponds with a positive but statistically insignificant increase in reading test scores and a three-percent standard-deviation decrease in mathematics test scores. Having more LEP students speaking the same mother tongue corresponds with increased reading achievement and decreased mathematics achievement, with coefficients of 0.09 and -0.07, respectively.

Taken together, these results are consistent with providing LEP students with language classes in a separate setting from non-LEP students. Such a strategy would reduce the negative effects we find of percent LEP on non-LEP reading scores, along with the positive effects of percent common tongue for LEP students (as well as the positive – although statistically insignificant – effect of percent LEP on reading test scores). However, the policy prescription for mathematics achievement is less clear. Percent LEP is associated with negative mathematics test scores for both LEP and non-LEP students. However, separate mathematics classes are most likely not the answer. While the gains for non-LEP student would be about 0.4 percent of a standard deviation (marginal impact x Δ percent LEP = -0.073 x -0.053), the loss for LEP students would be devastating, at about 26 percent of a standard deviation (marginal impact x Δ percent LEP = -0.275 x 0.947).

These results provide numerous contributions to the small but growing literature on the language ability of peers. The paper is the first to study the effects of the language distribution of LEP students on the achievement of LEP and non-LEP students, and it is the first to focus on LEP peers in middle school. The study is on the language proficiency of students, whereas many previous studies – especially in Europe – focus on the effect of immigrant peers. The focus on language mix isolates the potential concern that students with limited language proficiency divert classroom resources that would otherwise be devoted to instruction. The paper provides more extensive controls for non-language peer effects in order to isolate the effects of language (i.e. percent LEP, LEP Herfindahl index, etc.) from other peer effects. This isolation is particularly important given that LEP students often have low income and low achievement. The paper looks at the effects in a state – North Carolina – that has had dramatic growth in LEP population. Finally, our analysis uses more recent data than other studies. In sum, the paper provides a more extensive look at LEP peers – with a particular focus on the language distribution of LEP students – than previous research.

Despite our detailed analysis on LEP peers, much work remains to be done on this topic. Much research is devoted to effective strategies for assisting LEP students in improving English proficiency and academic achievement, but little is known about how to help other students in their classes and grades. In other words, what can teachers and schools do to mitigate if not eliminate the negative LEP peer effects that we have documented? Another promising path for future research is to study how, if at all, the effect of LEP peers varies with the composition of the LEP population, such as the country / region of the LEP peers.

Acknowledgements

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Table 1: Descriptive Statistics

Variable	All Students Mean	All Students Std.Dev.	LEP Students Mean	LEP Students Std.Dev.	Non-LEP Students Mean	Non-LEP Students Std.Dev.
Individual Characteristics						
Reading Std. Score	0.165	0.910	-0.634	0.801	0.208	0.896
Last year Reading Std. Score	0.126	0.927	-0.720	0.800	0.170	0.912
Math Std. Score	0.306	0.918	-0.223	0.789	0.335	0.916
Last year Math Std. Score	0.187	0.949	-0.407	0.809	0.219	0.945
Female	0.493	0.500	0.454	0.498	0.496	0.500
Low Income	0.487	0.500	0.861	0.346	0.466	0.499
Black	0.279	0.448	0.026	0.158	0.293	0.455
Hispanic	0.097	0.295	0.833	0.373	0.055	0.228
Asian/Pacific Islander	0.022	0.146	0.102	0.302	0.017	0.130
LEP	0.053	0.225				
Transferred schools	0.316	0.465	0.357	0.479	0.314	0.464
Grade-Level Peer Characteristics						
% Female	0.493	0.047	0.492	0.046	0.493	0.047
% LEP	0.053	0.057	0.109	0.089	0.050	0.053
% Black	0.279	0.227	0.320	0.213	0.276	0.228
% Hispanic	0.099	0.084	0.172	0.122	0.095	0.079
% Asian/Pacific Islander	0.022	0.031	0.026	0.033	0.022	0.030
% Low Income	0.487	0.206	0.575	0.203	0.482	0.205
% Common Tongue (LEP only)	0.039	0.172	0.422	0.403	0.017	0.116
LEP Herfindahl Index	0.887	0.122	0.799	0.155	0.892	0.118
Reading Teacher Characteristics						
Reading: Female Teacher	0.891	0.312	0.881	0.324	0.891	0.311
Reading: Black Teacher	0.174	0.379	0.213	0.410	0.171	0.377
Reading: Hispanic Teacher	0.005	0.071	0.010	0.101	0.005	0.069
Reading: Asian Teacher	0.004	0.059	0.005	0.073	0.003	0.058
Reading: First-year Teacher	0.062	0.240	0.072	0.259	0.061	0.239
Number of Students	597,036		26,889		570,147	
Number of Student-Year Observ	1,340,833		71,465		1,269,368	

Notes: The statistics reported in the Table are measured at the student+year, or observation, level. Each student has at most 3 observations. All grade-level peer characteristics and teacher characteristics correspond to the means at the student+year observation level. For example, 0.493 for % Female in the first column shows that observations in our data, students in given school years, have on average 49.3% female peers. Analogously, 89.1% of student observations in our data have a female teacher.

Table 2: Effect of LEP Peers on Reading Test Scores, Non-LEP Students

	NL1	NL2	NL3	NL4
Peer Characteristics				
% LEP	-0.106 ***	-0.106 ***	-0.130 ***	-0.075 *
	(0.042)	(0.042)	(0.050)	(0.044)
School % LEP			0.049	
			(0.054)	
LEP Herfindahl Index		0.002	0.004	-0.0005
		(0.003)	(0.006)	(0.003)
School LEP Herfindahl			-0.003	
			(0.007)	
% Female	-0.003	-0.003	-0.003	0.010
	(0.024)	(0.024)	(0.024)	(0.028)
% Black	0.002	0.002	0.002	0.042
	(0.025)	(0.025)	(0.025)	(0.029)
% Hispanic	0.027	0.025	0.025	0.059
	(0.043)	(0.043)	(0.043)	(0.046)
% FRL Student	-0.072 ***	-0.072 ***	-0.072 ***	-0.103 ***
	(0.014)	(0.014)	(0.014)	(0.015)
% Transfer	0.006 *	0.006 *	0.006 *	0.001
	(0.003)	(0.003)	(0.003)	(0.004)
Mean Std. Score	-0.082 ***	-0.082 ***	-0.082 ***	-0.083 ***
	(0.007)	(0.007)	(0.007)	(0.008)
SD Std. Score	-0.045 ***	-0.045 ***	-0.046 ***	-0.060 ***
	(0.010)	(0.010)	(0.010)	(0.012)
Student Characteristics				
Last Yr. Std. Score	-0.276 ***	-0.276 ***	-0.276 ***	-0.277 ***
	(0.002)	(0.002)	(0.002)	(0.002)
FRL Student	0.002	0.002	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.002)
Transferred Schools	0.013 ***	0.013 ***	0.013 ***	0.014 ***
	(0.002)	(0.002)	(0.002)	(0.002)
Number of Students	597,036	597,036	597,036	447,983
Exclude Grades w/o LEPs?	No	No	No	Yes
Student Fixed Effects?	Yes	Yes	Yes	Yes
School Fixed Effects?	Yes	Yes	Yes	Yes
Grade-by-year Fixed Effects?	Yes	Yes	Yes	Yes

Notes: In addition to the variables shown, each regression also includes control variables for grade size and for the teacher characteristics listed in Table 1. Standard errors clustered at the school + grade + year level (such as Washington Elementary, 3rd Grade, 2008) are in parentheses. *, **, and *** denote statistical significance of a two-sided test at the ten, five, and one-percent levels, respectively.

Table 3: Effect of LEP Peers on Mathematics Test Scores, Non-LEP Students

	NL1	NL2	NL3	NL4
Peer Characteristics				
% LEP	-0.073	-0.071	-0.142 **	-0.140 ***
	(0.056)	(0.056)	(0.067)	(0.060)
School % LEP			0.150 **	
			(0.073)	
LEP Herfindahl Index		-0.005	0.008	-0.012 ***
		(0.004)	(0.009)	(0.005)
School LEP Herfindahl			-0.015 *	
			(0.009)	
% Female	0.102 ***	0.102 ***	0.102 ***	0.126 ***
	(0.030)	(0.030)	(0.030)	(0.036)
% Black	-0.135 ***	-0.136 ***	-0.138 ***	-0.147 ***
	(0.032)	(0.032)	(0.032)	(0.036)
% Hispanic	0.151 ***	0.155 ***	0.158 ***	0.170 ***
	(0.058)	(0.058)	(0.058)	(0.063)
% FRL Student	-0.090 ***	-0.089 ***	-0.090 ***	-0.078 ***
	(0.019)	(0.019)	(0.019)	(0.022)
% Transfer	0.046 ***	0.046 ***	0.046 ***	0.045 ***
	(0.004)	(0.004)	(0.004)	(0.005)
Mean Std. Score	-0.099 ***	-0.099 ***	-0.098 ***	-0.110 ***
	(0.007)	(0.007)	(0.007)	(0.008)
SD Std. Score	-0.028 **	-0.028 **	-0.028 *	-0.028 *
	(0.014)	(0.014)	(0.014)	(0.017)
Student Characteristics				
Last Yr. Std. Score	-0.231 ***	-0.231 ***	-0.231 ***	-0.234 ***
	(0.002)	(0.002)	(0.002)	(0.002)
FRL Student	-0.001	-0.001	-0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)
Transferred Schools	-0.006 ***	-0.006 ***	-0.006 ***	-0.008 ***
	(0.002)	(0.002)	(0.002)	(0.002)
Number of Students	597,036	597,036	597,036	447,983
Exclude Grades w/o LEPs?	No	No	No	Yes
Student Fixed Effects?	Yes	Yes	Yes	Yes
School Fixed Effects?	Yes	Yes	Yes	Yes
Grade-by-year Fixed Effects?	Yes	Yes	Yes	Yes

Notes: In addition to the variables shown, each regression also includes control variables for grade size and for the teacher characteristics listed in Table 1. Standard errors clustered at the school + grade + year level (such as Washington Elementary, 3rd Grade, 2008) are in parentheses. *, **, and *** denote statistical significance of a two-sided test at the ten, five, and one-percent levels, respectively.

Table 4: Effect of LEP Peers on Reading and Mathematics Test Scores, LEP Students

	Reading			Mathematics		
	L1	L2	L3	L1	L2	L3
Peer Characteristics						
% LEP	0.055	0.053	0.039	-0.275 **	-0.276 **	-0.265 **
	(0.121)	(0.121)	(0.121)	(0.134)	(0.134)	(0.134)
LEP Herfindahl Index		0.027 *			-0.008	
		(0.014)			(0.016)	
% Common Tongue			0.086 ***			-0.071 **
			(0.037)			(0.036)
% Female	0.085	0.086	0.080	0.079	0.078	0.080
	(0.100)	(0.100)	(0.100)	(0.101)	(0.101)	(0.101)
% Black	0.131	0.128	0.132	-0.078	-0.078	-0.082
	(0.106)	(0.106)	(0.106)	(0.104)	(0.104)	(0.104)
% Hispanic	0.303 **	0.282 *	0.267 *	0.182	0.189	0.209
	(0.144)	(0.144)	(0.145)	(0.155)	(0.156)	(0.156)
% FRL Student	-0.073 *	-0.076 *	-0.077 *	0.013	0.014	0.017
	(0.041)	(0.041)	(0.042)	(0.050)	(0.050)	(0.050)
% Transfer	0.007	0.007	0.007	0.035 **	0.035 **	0.035 **
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Mean Std. Score	-0.061 ***	-0.063 ***	-0.063 ***	-0.164 ***	-0.164 ***	-0.163 ***
	(0.025)	(0.025)	(0.025)	(0.020)	(0.020)	(0.020)
SD Std. Score	0.044	0.045	0.041	0.099 **	0.099 **	0.101 **
	(0.043)	(0.043)	(0.043)	(0.046)	(0.046)	(0.046)
Student Characteristics						
Last Yr. Std. Score	-0.276 ***	-0.276 ***	-0.276 ***	-0.233 ***	-0.233 ***	-0.233 ***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
FRL Student	0.012	0.012	0.012	-0.008	-0.008	-0.008
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Transferred Schools	0.003	0.002	0.003	-0.021 **	-0.021 **	-0.021 ***
	(0.010)	(0.010)	(0.010)	(0.009)	(0.009)	(0.009)
Number of Students	26,889	26,889	26,889	26,889	26,889	26,889
Student Fixed Effects?	Yes	Yes	Yes	Yes	Yes	Yes
School Fixed Effects?	Yes	Yes	Yes	Yes	Yes	Yes
Grade-by-year FE?	Yes	Yes	Yes	Yes	Yes	Yes

Notes: In addition to the variables shown, each regression also includes control variables for grade size and for the teacher characteristics listed in Table 1. Standard errors clustered at the school + grade + year level are in parentheses. *, **, and *** denote statistical significance of a two-sided test at the ten, five, and one-percent levels, respectively.

Appendix

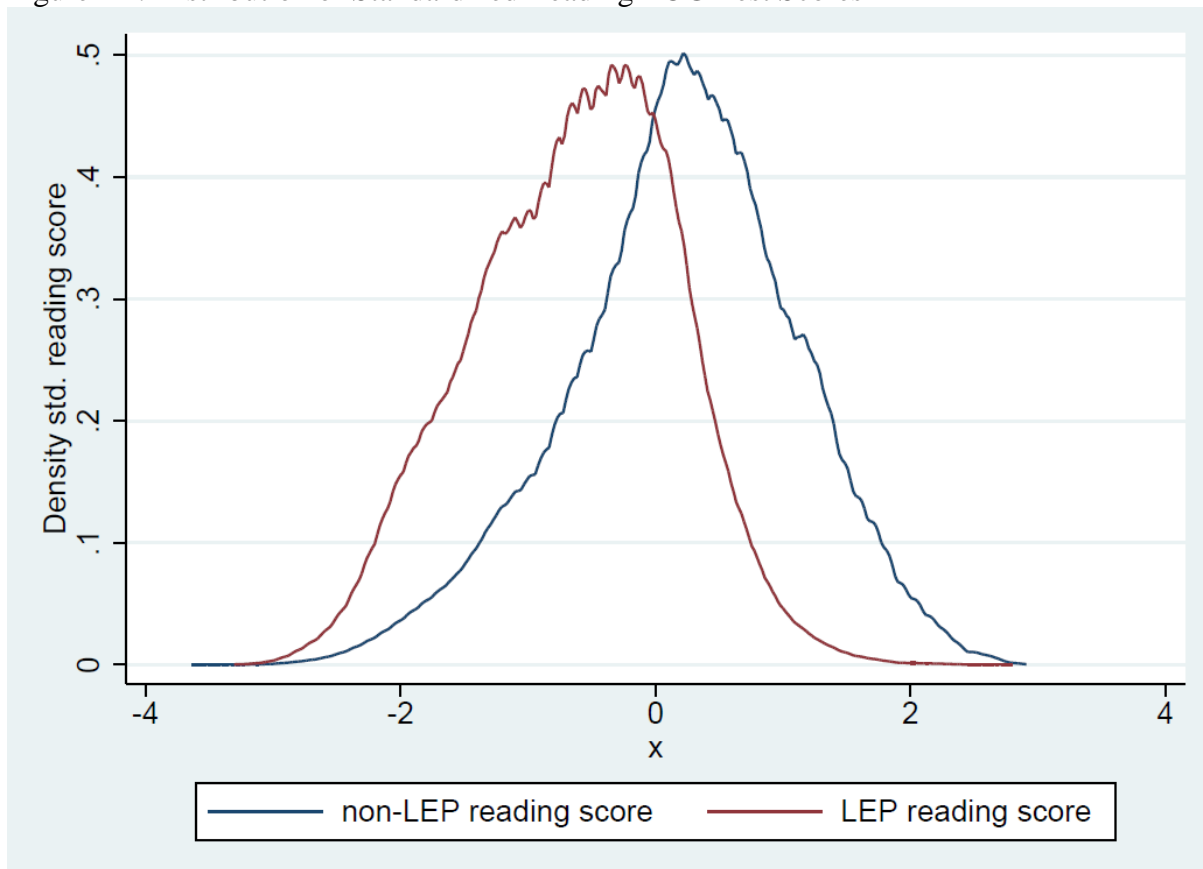Figure A1: Distribution of Standardized Reading EOG Test Scores

Table A1: Measuring LEP Peers as Number of Foreign Languages, Non-LEP Students

	Reading		Mathematics	
	NL1A	NL2A	NL1A	NL2A
Peer Characteristics				
% LEP		-0.108 ***		-0.081
		(0.042)		(0.056)
No. of Foreign Languages	-0.00005	0.00022	0.0009	0.0011
	(0.0008)	(0.0008)	(0.0011)	(0.0011)
% Female	-0.002	-0.003	0.103 ***	0.102 ***
	(0.024)	(0.024)	(0.030)	(0.030)
% Black	0.010	0.002	-0.129 ***	-0.134 ***
	(0.025)	(0.025)	(0.032)	(0.032)
% Hispanic	-0.008	0.027	0.125 **	0.153 ***
	(0.040)	(0.043)	(0.055)	(0.058)
% FRL Student	-0.075 ***	-0.072 ***	-0.092 ***	-0.090 ***
	(0.013)	(0.014)	(0.019)	(0.019)
% Transfer	0.006 *	0.006 *	0.045 ***	0.046 ***
	(0.003)	(0.003)	(0.004)	(0.004)
Mean Std. Score	-0.079 ***	-0.082 ***	-0.098 ***	-0.099 ***
	(0.007)	(0.007)	(0.007)	(0.007)
SD Std. Score	-0.045 ***	-0.045 ***	-0.028 **	-0.029 **
	(0.010)	(0.010)	(0.014)	(0.014)
Student Characteristics				
Last Yr. Std. Score	-0.276 ***	-0.276 ***	-0.231 ***	-0.231 ***
	(0.002)	(0.002)	(0.002)	(0.002)
FRL Student	0.002	0.002	-0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)
Transferred Schools	0.013 ***	0.013 ***	-0.006 ***	-0.006 ***
	(0.002)	(0.002)	(0.002)	(0.002)
Number of Students	597,036	597,036	597,036	597,036
Exclude Grades w/o LEPs?	No	No	No	Yes
Student Fixed Effects?	Yes	Yes	Yes	Yes
School Fixed Effects?	Yes	Yes	Yes	Yes
Grade-by-year Fixed Effects?	Yes	Yes	Yes	Yes

Notes: In addition to the variables shown, each regression also includes control variables for grade size and for the teacher characteristics listed in Table 1. Standard errors clustered at the school + grade + year level are in parentheses. *, **, and *** denote statistical significance of a two-sided test at the ten, five, and one-percent levels, respectively.