This study examines the mathematics achievement of Latino native English speakers compared to non-native English speakers in U.S. high schools. We specifically focus on how academic tracking can influence mathematics achievement and, at the same time, whether having access to a mathematics teaching with specialized training in teaching English as a Second Language (ESL) students can help mitigate the negative impact of tracking on their mathematics achievement outcomes. Using the Education Longitudinal Study of 2002 (ELS:2002) dataset, we analyze a nationally representative sub-sample of 2,234 immigrant and non-immigrant Latino 10th graders. We use Hierarchical Linear Models (HLM) regression analysis to fit multi-level models that describe each student’s mathematics achievement as a function of: 1) their English proficiency, 2) their placement in a general or academic track in school, 3) whether they are provided with native language support, and, 4) the teacher’s attributions regarding the role of language in mathematics achievement. By illuminating the effects of academic tracking of Latino English learners, this research will help us address the achievement gap in math test scores between Latinos and Whites and among English proficient and non-proficient Latino students.

INTRODUCTION

The mathematics achievement scores of all Latinos on the National Assessment for Educational Progress (NAEP) have been described as “pervasively, disproportionately, and persistently low” over time, relative to similar outcomes for whites (Valencia, 2002). The scores of Latinos that are not proficient English-speakers are significantly lower (Abedi & Lord, 2001). Yet, there is a long-standing myth in mathematics education that the level of English proficiency of students is not an issue in instruction because mathematics is a "universal language." As a result, many educators assume that a student’s English proficiency has a minimal effect on learning mathematics (Flores, 1997; Gutierrez, 2002). However, recent research suggests that the English proficiency of Latino English Learners (ELs) plays a critical role in their learning of mathematics, particularly for ensuring that they are able to comprehend, and then apply, complex mathematical concepts (Garrison & Mora, 1999; Moschekovich, 1999). About one in ten public school students in the U.S. were Spanish-speaking ELs (Kindler, 2002). Their poor achievement in mathematics suggests that meeting the linguistic and academic needs of Latino ELs is a critical issue in our schools and, consequently, for educational research, policy and practice (August & Hakuta, 1997).

In our study, we examine how: 1) the level of English proficiency of students, 2) academic tracking, 3) the mathematics teacher’s ability to support English learners,
can simultaneously influence the mathematics achievement of Latino native and non-native English speakers, and 4) the teacher’s attributions regarding the role of language in mathematics achievement. We also assess whether these relationships differ for Latino ELs as compared to their native English-speaking and English proficient Latino peers. We hypothesize that the low-track placement of Latinos with low-levels of English proficiency has a greater compounded (interactive) negative effect on their mathematics achievement than on their English-speaking peers. We also suspect that the negative effect of academic tracking on mathematics achievement can be moderated in cases where students have access to a mathematics teacher with specialized training in teaching English as a Second Language (ESL).

BACKGROUND THEORY

Latino students as whole, irrespective of their level of English proficiency, repeatedly underachieve in U.S. public schools. For example, in 1992, the average NAEP mathematics scores for Latino eighth graders fell between the average scores of White fourth and eighth graders, suggesting that the mathematics skills of Latinos were as much as two years behind White eighth-graders (Smith 1995). Moreover, between 1972 and 1992, a separate NAEP-score analysis revealed only small gains in the lower cognitive areas of knowledge, such as basic computational skills, for Latinos while their performance in applications and complex problem-solving remained stagnant (Secada, 1992; Tate, 1997).

English proficiency is an important factor given the considerable research arguing that mathematics is itself a language that is more complex than everyday English (Gutierrez, 2002). The language of mathematics is described as a “register” of words and meanings that differ from those of everyday language (Secada, 1996). For example, the language of mathematics has specialized meanings for words and phrases such as “horizontal,” “vertical,” “subtract,” etc., that differ from the conversational and academic meanings (Khisty, 1995). Furthermore, as ELs become proficient in everyday English (which is not sufficient for success in mathematics), they must also learn the complex language of mathematics. This suggests that ELs require considerable support in both their first and second language to cope with the linguistic demands of learning advanced mathematics in their non-dominant language.

Whereas teachers’ attributions of student success have been studied in a wide variety of settings (McAllister, 1996; Fennema, Peterson, Carpenter, & Lubinski, 1990; Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998), we found no studies in which teachers’ expectations of mathematics performance was linked to language proficiency. Our current study explores the relationship between student test score data and a survey item inviting teachers to rate whether a student’s performance is owing to limited English proficiency.

Educational researchers have examined the role that institutional factors, such as tracking, play in structuring the academic success and failure of Latino ELs (Gandara, 1999; Valenzuela, 1999). Recent research has found that English
proficiency factors significantly into their track placement (Harklau, 1994). Scholars have argued that having a low-level of English proficiency is considered a “deficit” (Gutierez, 2002) and, as a result, ELs have limited access to advanced mathematics courses (Flores, 1997).

The placement of Latino ELs in lower-track classes raises important questions about the rigor of the curriculum in their classes. Research has found the low-level track curriculum to be cognitively undemanding and focused on memorization and repetition (Oakes, 1995). In contrast, research has documented several educational advantages from placement in high-track classes. Research on tracking has shown that even acquiring English fluency was rarely a guarantee for promotion into the high-track, instead Latino ELs are typically moved from the low-track ESL classes to the English-only low-track (Valenzuela, 2001).

Recent findings show that Latino ELs experience higher levels of success in secondary school mathematics courses that provide native language support (Moschkovich, 1999). Dentler and Hafner (1997) found that districts that successfully educated Latino ELs were more likely to have well-established language programs that used “the student’s primary language to build comprehension” (p. 67).

The aforementioned literature found that low-track placements negatively impact students’ achievement in mathematics. While some studies analyze whether tracking impacts mathematics achievement, no studies have examined how track placement and English proficiency interact to impact mathematics achievement for this population, particularly at a national level. We address this limitation in our paper.

Our research is guided by the following research questions, each of which applies only to the population of tenth-grade Latino high school students:

1. Does the impact of academic tracking on mathematics achievement differ for Latinos with high and low levels of English proficiency?

2. Is the disproportionate disadvantage to Latinos with low English proficiency in the low academic tracks mediated by the presence of linguistic supports, specifically the presence of mathematics teachers with specialized training in teaching ELs? And does the teacher’s attribution of achievement to the level of English proficiency of students influence their mathematics achievement?

In study we use the first wave of the Educational Longitudinal Study of 2002 (ELS:2002). The first wave of the ELS:2002 dataset is ideal for this analysis since it contains policy-relevant trend data about critical transitions experienced by tenth-grade students as they proceed through high school. We analyze a sub-sample of 2,234 Latino immigrants and their U.S.-born Latino counterparts. We use two-level hierarchical linear models (HLM) analysis and fit multi-level models to investigate the effect of select school-context variables (Level-2) on the mathematics achievement of students (Level-1) in ELS:2002. Multi-level modeling is well suited for this analysis due to the clustering of students within classrooms.
We also include a series of control Predictors in order to account for individual background and classroom variation. We control for individual-level gender, parental education and income, and immigrant student’s prior level of education (in their native country) and their age of arrival to the U.S. At the classroom level, we control for the mathematics teacher’s educational background and years of teaching experience.

**FINDINGS**

To address our first research question, we used HLM to fit multi-level models to investigate how English proficiency, academic track placement and their statistical interaction impact the mathematics achievement of Latinos. We fit multilevel model 5 (in Table 1), and our analysis reveals statistically significant interactions among the English and tracking variables, suggesting that the impact of academic tracking on the mathematics test scores of Latinos does differ as a function of the level of English proficiency of non-native English speaking Latinos. Due to the complexity in the interpretation, we present these findings graphically in Figure 1, for students with credentialed teachers who also have a background in mathematics, and holding all other control predictors constant.

Given the nature of interaction terms, we cannot interpret these coefficients alone. Rather, they must be interpreted in conjunction with the main effects of the English proficiency and tracking predictors. The test scores of Latinos non-native speakers in college preparatory track are quite revealing. While Latino non-native speakers in the college preparatory track with high levels of English proficiency score as high as native English speakers in the same high track, the test scores of those with low levels of English proficiency are much lower than even the lowest scoring students in the general track, the Latino ELs.

More specifically, the results show that, on average, English proficiency is much more important for predicting mathematics achievement for non-native English speakers in the college preparatory track, than it is for non-native English speakers in the general track. Interestingly, the mathematics scores of non-native English speakers with low-levels of English proficiency in the college track are lower than the mathematics scores of non-native English speakers with equally low-levels of English proficiency in the general track. However, the mathematics achievement scores of non-native English speakers with higher-levels of English proficiency are, on average, equal to the test scores of native English speakers in the college track and.

It is important to note the stark difference between low-English proficiency students in the college track are slightly over one standard deviation below the mean achievement of native English speakers in the college preparatory track.

In response to research question 2, our results indicate that non-native English speakers with access to a mathematics teacher with at least eight hours of specialized LEP training in the last three years does not have a significant impact on their mathematics achievement when controlling for students’ background characteristics, their mathematics teacher’s preparation, and selected school context measures.
DISCUSSION AND CONCLUSION

Our analysis shows that the impact of tracking does vary as a function of the level of English proficiency of non-native English-speaking Latinos. Our findings show that the impact of academic track placement on mathematics test scores of Latinos indeed differs by the level of English proficiency all non-native English speakers. For instance, Latino English Proficient Students (EPSs) in the college preparatory track scored at levels equal to Latino Non-native English Speakers (NESs) also in the college preparatory track. In stark contrast, Latino ELs that were also in the college preparatory track were the lowest performers on the ELS:2002 assessment. These findings show that the English proficiency level of non-native English speakers is extremely important in predicting their achievement in mathematics. For Latino ELs in the college track in particular, English proficiency seems to be critically associated with their achievement.

Our initial hypothesis was that Latino ELs in the general track would face greater disadvantage, and thus have lower mathematics scores, due to their exposure to low-level basic mathematics content, as compared to Latino ELs in the college preparatory track. Latino ELs in the general track were indeed disadvantaged and had lower mathematics assessment scores than Latino EPSs in the same low-level track. However, as compared to Latino ELs in the college preparatory track, Latino ELs (with equally low levels of English proficiency) in the general track had higher mathematics test scores, which is different than what we had originally hypothesized.

While surprising, this finding is supported by the research reviewed earlier which argued that the sophisticated mathematics-specific discourse and the complexity of the rigorous mathematics content itself demands a high degree of English proficiency. According to prior research, ELs have done well in rigorous mathematics courses when native language support was provided for them during instruction.

Latino EPSs outperform other Latino EPSs in the general track with equally high levels of English proficiency. Additionally, it was found that Latino EPSs in the college preparatory track performed at equally high levels as Latino NESs in the same track-level. This finding shows that while having a low level of English proficiency can disadvantage students in the college preparatory track, when students acquire a high level of English proficiency, they benefit much more from their placement in rigorous college preparatory courses than from placement in the general track.

Because Latino ELs in the general track had slightly higher test scores than Latino ELs in the college preparatory track, these findings might imply that they are more “appropriately” placed in lower level classes. However, this study strongly suggests that such placement decisions are not optimal given that Latino EPSs in the college preparatory track reached the mathematics test scores of the highest performing Latino students in the sample—the Latino NESs in the college preparatory track. This was so in spite of the lower achievement scores of Latino ELs in the college preparatory track.
This also suggests that the placement of non-native English speakers in the general track disadvantages them once they acquire English proficiency since they will likely remain in low-level track courses that teach unchallenging basic mathematics skills. Our point here is that the English proficiency level of Latino ELs will invariably improve over time but if they are relegated to remedial mathematics instruction in the general tracks they will not fully reap the academic benefits of English proficiency nor will they reach their full potential in mathematics.

Finally, our original hypothesis was that the presence of a teacher with specialized LEP training would mediate higher Latino EL mathematics test scores. However, the presence of teachers with specialized LEP training did not have an impact on the assessment outcomes of Latino ELs. This finding, however, is not conclusive since the measure of the linguistic training of teachers was very crude. The survey asked whether “teachers had at least 8 hours of specialized training over the last 3 years” in working with ELs. If teachers reported that they had such training, this could mean that they attended only a one-day (eight-hour) workshop for training on teaching ELs over the last three-year period. However, this could also mean that a teacher earned a degree in teaching ELs. Given the clear imprecision of this measure, more work is needed to create a more reliable measure of specialized linguistic training for future data collection. A more valid measure would be very useful for future studies on this topic in light of the fact that the rapid growth of Latino ELs and the political debates contesting whether or not native language support should be provided for them.

References


New Directions for Equity in Mathematics Education. New York, NY: Cambridge University Press.


