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Modeling a Multilevel Perspective on Latino Students' College Participation: Student, School, and State-level Effects

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ABSTRACT

This study provides the first quantitative test of a conceptual framework that addresses multiple levels of contextual influence on college enrollment (Perna & Thomas, 2008). Using three-level Hierarchical Generalized Linear Modeling (HGLM), we analyzed the Education Longitudinal Study (ELS: 2002) data to examine student, high school, and state-level effects on Latino students' college participation. ELS: 2002 offers the most current national data about high school students' postsecondary trajectories; therefore, this data source is particularly suitable for exploring educational experiences of the growing Latino population. Our findings suggest that parental involvement in college planning, financial aid support, and academic preparation continue to be central policy issues for Latino students and families in promoting college enrollment. Factors related to a high school's academic and social climate also appear to affect Latinos' college participation.

KEYWORDS: multilevel, Latino, Hispanic, Hierarchical Linear Modeling, college enrollment, college access, college participation, school effects

INTRODUCTION

Latinos are the largest non-White, youngest, and fastest growing population in the US, but Latino students attend college at lower rates than their non-Latino counterparts (Swail, Cabrera, & Lee, 2004). Latinos are expected to compose over half of the growth in the population of college-age students before 2020 (Martinez, 2002). Observers argue that US postsecondary attainment must increase for the U.S. to maintain its economic advantage (College Board, 2008). Thus, raising Latinos' college participation rates will be critical not only to equalize their educational attainment, but to sustain this country's economic health.

In recent decades, more American students have enrolled in college directly after high school, but the college participation rates of Latinos have remained flat, or even declined (St. John, 2003; Swail, et al., 2004). According to Bozick & Lauff (2007), 42% of Latino high school sophomores in 2002, compared with 18% of Asian American, 25% of White, and 38% of African American students, were not enrolled in *any* postsecondary education two years after their expected high school graduation.

Limited research exists about influences on college access for students who do not go to college or do not attend highly selective four-year institutions, although the majority of high school students follow these postsecondary trajectories. The National Center for Education Statistics Educational Longitudinal Study 2002/06 (ELS: 2002) follows the trajectories of high school sophomores who do *not* go to college as well as those who do. This study draws on ELS: 2002 to test a multicontextual model which addresses the role of student-, school-, and state-level characteristics in affecting Latinos' college enrollment.

CONCEPTUAL MODEL

College access research initially employed an econometric perspective, emphasizing the impact of financial factors on college participation (Perna & Thomas, 2008). More recent research has incorporated sociological perspectives emphasizing the role of social, cultural, and structural factors in college participation. These factors include social and cultural capital, as well as school, community, higher education, and social, political, and historical contextual factors (McDonough, 1997; Perna & Thomas, 2008). Including these variables has added significant predictive power to models of college participation (Perna, 2000).

This study tests a holistic and comprehensive model of college participation integrating classic and contemporary college access literature from multiple social science disciplines (Perna & Thomas, 2008). In this study's context, participation means whether or not a student enrolls in college (Martinez, 2002). The model stresses the layered and complex nature of college participation and acknowledges that students determine their own college-going behavior to some degree, but that their level of individual agency is also embedded in micro-, meso-, and macro-level structural contexts. The model identifies three main levels of college access: (a) individual, (b) high school level, and (c) social, historical and political context (Perna & Thomas, 2008).

Perna and Thomas (2008) emphasize that the "three most important units of analysis are students, the K-12 and higher education institutions they attend, and the public policies and programs that shape student and institutional behaviors" (p. 32). However, most studies examine the effects of only two of these units of analysis. This study provides a more comprehensive look at the influences on Latino students' college access by addressing all three of these units of analysis. In this first quantitative test of the Perna and Thomas (2008) framework, we use three-

level Hierarchical Linear Modeling (HLM) to simultaneously examine the effects of these three key units of analysis on college enrollment: (a) student-level characteristics, including internal and family context factors, (b) high school characteristics, and (c) state-level factors.

Level 1: Student-level characteristics

Student characteristics include students' demographic factors, internal qualities (including educational expectations and academic preparation), and family context influences (Perna & Thomas, 2008). Male Latinos are less likely to enroll than females (Santiago, 2008). The familial financial situation also influences Latino students' college participation; Latino families tend to be misinformed about the costs and benefits of college, and more resistant to taking out loans (Dowd, 2008; Author, 2007). Ethnicity may also affect Latinos' college participation tendencies; Mexican American students tend to enroll in less selective institutions than Puerto Ricans (Author, 2008). Immigration generational status also can affect K-12 Latinos' academic achievement (Portes & Rumbaut, 2001).

Taking a rigorous academic curriculum in high school, particularly higher level mathematics, substantially affects college participation and completion (Adelman, 2006). Math academic performance, measured by standardized math test scores, significantly predicts college participation (Perna, 2000; Perna & Titus, 2004, 2005). Yet, Latino students tend to take lower level academic courses than other students, and are too often classified into lower academic tracks in their K-12 educations (Oakes, et al., 2006b).

The family context includes parental level of education and access to cultural and social capital (Perna, 2000; Perna & Titus, 2005). Cultural capital includes access to information about the college application process (McDonough, 1997). In fact, access to college information appears to influence Latino students' college choices more strongly than for other students

(Oakes, et al., 2006a; O'Connor, 2009). Parental education level can serve as a proxy for a students' access to cultural capital, as it indicates the level of college information a student may have access to within the family (Perna, 2000, 2006; Walpole, 2007). Parental education level, parental involvement (as a measure of social capital), and expectations for the child's postsecondary trajectories can profoundly affect college enrollment (Walpole, 2007).

Level 2: School-level characteristics

Oakes and her colleagues (2006a) identify several schooling conditions that promote college enrollment, including: (1) safe and adequate school facilities, (2) a college-going school culture, (3) a rigorous academic curriculum, (4) qualified teachers, (5) intensive academic and social supports, and (6) family-neighborhood-school connections around college going. According to Oakes and her colleagues, safe and adequate school facilities are clean, provide a pleasant environment and enough space for all students, and are violence-free. A college-going school culture involves key stakeholders (e.g., teachers, administrators, parents, students) who expect students to go to college and provide the experiences and caring relationships to support that goal. A rigorous academic curriculum involves having adequate access to college preparatory courses such as advanced math and AP classes. Qualified teachers have been certified in their subject material and teach effectively; higher teacher salaries can draw more qualified teachers who can better prepare students to attend college (College Board, 2008).

Other indicators of a school's college-going culture include its attendance rates and the proportion of graduates who attend college (Konstantopoulos, 2006; Perna & Titus, 2005). Family-neighborhood-school connections around college-going include communication and engagement between families and schools, and linkages with community resources (Conchas, 2006). Generally, schools enrolling larger proportions of Latino students provide fewer academic

resources to support college-going than do schools with larger White enrollments (Gandara & Contreras, 2009).

Level 3: State-level characteristics

The factors composing state-level characteristics can be categorized into two groups: state context (e.g., a state's political, economic, historical, and social background) and state policy (e.g., a state's organization and legislation regarding higher education) (Martinez, 2002). Indicators of state context include elements of state history, culture, political makeup, demographic characteristics (percentage of state population with a bachelor's degree, racial/ethnic composition), and economic conditions (state poverty rate, unemployment rate) (Martinez, 2002; McLendon & Hearn, 2007; Perna & Titus, 2004). Such measures include the level of funding for state postsecondary institutions, amount and type of financial aid that students receive from the state, and capability of preparing K-12 students for college (Perna & Titus, 2004).

Few quantitative studies address state-level influences on college access (Oakes, et al., 2006a). While some studies examine the school or state level influences on college participation (e.g., Perna & Titus, 2004, 2005), few have *simultaneously* examined the effects of school and state-level influences. By using three-level Hierarchical Generalized Linear Modeling (HGLM) to address effects of student-, school-, *and* state-level factors on college participation, this study concurrently addresses multiple layers of organizational influence on college access.

METHODS

Data Sources

This study employed multiple datasets to address whether Latino students' college access is influenced not only by individual characteristics, but also by students' schools and states. This

emphasis on multiple contexts required us to draw on multiple sources of data to represent each statistical level – student, school, and state. *Student-level* data were drawn from the Education Longitudinal Study: 2002 (ELS: 2002). This data set afforded us the opportunity to utilize the most current information available to examine factors that affect Latino high school students' college participation. ELS: 2002 drew a nationally representative sample of students and followed their trajectories from high school to college at three time points: when they were sophomores (2002 base year), seniors (2004 first follow-up), and two years after their expected high school graduation date (2006 second follow-up). The base year and first follow-up data addressed students' social, economic, cultural, and academic backgrounds and school experiences; their school characteristics and environment; and their college aspirations. Second follow-up data addressed students' transitions from high school to college, work, and/or other opportunities. ELS data were collected from students and their parents, teachers, and school administrators. Supplementary data came from students' high school transcripts and linked files of the NCES Common Core of Data (CCD). Students' and parents' surveys and high school transcript data were the main sources of student-level data.

School-level data were derived from the ELS: 2002 high school administrators and teachers' survey components. In the base year (2002), NCES conducted separate surveys for school administrators and teachers, in addition to students. These data afforded us the opportunity to clarify school effects on college participation, including effects of the school's physical facilities, the academic/social environment, and teachers' quality.

The *state-level* data were intended to represent a given state's social, economic, and educational environment (Perna & Titus, 2004; McLendon & Hearn, 2007). These data were drawn mainly from the Digest of Education Statistics published by NCES, the Integrated Public

Use Microdata Samples (IPUMS) published by the University of Minnesota Population Center, the National Association of State Scholarships & Grant Programs (NASSGAP, 2004), and the NCES Integrated Postsecondary Education Data System (IPEDS).

Latino students comprised about fourteen percent of the total ELS sample of high school students, representing 2,430 cases. To have the adequate amount of variability at the high school and state level analyses, high schools were included only when they had three or more individual cases, and states were selected only when they had three or more high schools with at least three high school student responses (Raudenbush & Bryk, 2002). This procedure resulted in a final sample for the multivariate analysis of 1,570 students at 200 high schools, located in 15 states.

Student-level variables

The dependent variable of this study was whether the student had ever attended college within two years of high school graduation. Student-level variables included demographic background, family context, and academic preparation variables (Perna & Thomas, 2008). The demographics that were taken into account were *gender* (with males as the reference group) and *ethnicity* (Cuban, Puerto Rican, Central and South American as compared to Mexican as a reference category). Immigrant generational status has also been shown to affect the academic achievement among students from different racial/ethnic groups (Portes & Rumbaut, 2001). The variable *immigrant generational status* included the standard categories used in immigration research (Louie, 2007; Portes & Rumbaut, 2001): (a) first-generation (foreign-born), (b) second-generation students born in US with two foreign-born parents, (c) second-generation students born in US with one foreign-born parent, and (d) third-generation, with both parents born in the US. We distinguished between second-generation students with one and two foreign-born

parents, because students with just one foreign-born parent might have an increased exposure to US educational system through their US-born parent.

For family context characteristics, we examined *family income, parental education, parental expectations* for the students' educational attainment, and *parental involvement* in students' educational activities. Family income and parental education were examined separately, as distinct indicators of economic and cultural capital (Walpole, 2007). Family income was categorized into four levels based on the frequency distribution; low, middle, and upper middle categories were compared to the highest income category. Measures of cultural capital have also been shown to add predictive power to models of college participation for Latinos and African American students (Perna, 2000). Many researchers have used parental education level as a proxy for cultural capital, indicating the kind of information about college the parent may be able to pass on to their child (Walpole, 2007). In this study, we distinguished between the effect of being a *first-generation* college-goer (not having either parent with a bachelor's degree) and being *continuing-generation*, defined as having one or both parents with a bachelor's degree. *Parents' educational expectations* while the student was in 10th grade represented how far parents expected student to get in their educations; these expectations can independently affect college participation (Walpole, 2007). Following Perna & Titus, (2005), *parental involvement* in students' educational activities represented a form of social capital, and it was defined as a composite measure of six variables on students' reported frequency of discussing college-related matters with parents in 10th grade. (See Appendix A).

Internal characteristics included a *student's educational expectations* (reported in the 10th grade) and *academic preparation*. A student's educational expectations reflect his/her internal sense of his/her postsecondary possibilities, and these expectations can condition a student's

level of college enrollment (McDonough, 1997). Students' academic preparation level was represented by their maximum *level of math course taking* (Adelman, 2006). We adapted Burkam and Lee's (2003) scheme and categorized math course taking as: no math, low level academic, middle level academic, and advanced math (including pre-calculus and calculus). (See Appendix B for more details on student-level variables.)

School-level variables

School-level variables were categorized into three groups: structural characteristics, indicators about the school culture with respect to college-going, and teaching staff characteristics (Oakes, et al., 2006a). Structural characteristics included *urbanicity*, *percentage of students on free lunch*, *student to teacher ratio*, and *school size*, each of which has been shown to affect college enrollment (Konstantopoulos, 2006). The condition of facilities was represented by administrators' reports on the extent to which limited space in the school hindered learning, termed *learning hindrance*.

School culture characteristics reflecting a school's academic and social climate significantly affect student dropout or college-going rates, even after controlling for students' background characteristics (Bryk & Thum, 1989; Oakes, et al., 2006a; Rumberger, 1995). Academic and social climate measures included the school's *frequency of absenteeism*, *proportion of 2003 graduates who went to 4-year colleges*, and the *mean value of math and English teachers' educational expectations* for the students who were sampled in the school (Conchas, 2006; Konstantopoulos, 2006). The mean score on a standardized math test for all the students in the school served as a proxy to measure the general level of students' math preparation in the school. In various ways, these measures have been found to be related to

students' educational outcomes; they reflect the extent to which a school fosters attitudes and behaviors conducive to college-going (Oakes, et al., 2006a).

The school-level measures involving mean values were developed by aggregating individual values of students within the same high school. Given that the school-level data in the study were unbalanced, in that the number of survey respondents varied at each school, concerns might be raised about using aggregate student composition variables as school characteristics because they do not represent the responses of the total population of a high school's students. However, our analytic method considered the number of cases within schools when weights were applied at the high school-level analysis and is, therefore, an appropriate technique for unbalanced data analysis (Author, 2007; Raudenbush & Bryk, 2002).

Teaching staff characteristics included the *percentage of certified full-time teachers* and the *lowest salary paid to full-time teachers* at the school. Oakes and colleagues (2006) have found these to be key indicators of the quality of teaching at the school. (See Appendix C for more details on school-level variables.)

State-level variables

State-level data representing the state's social, economic, and educational environment were collected from various sources, including the *Digest of Education Statistics 2007* (National Center for Education Statistics, 2007), and *NASSGAP 35th Annual Survey Report 2003–2004 Academic Year* (NASSGAP, 2004). Following Perna and Titus (2004), the *proportion of direct appropriations to higher education* by each state government was included, as was the *proportion of non-need based grant aid allocated per college student*. Certain teacher conditions were also measured, including *average annual teacher salary* in the state's public K-12 schools and the *proportion of public school teachers who had a master's, education specialist, or*

doctoral degree. Other economic and demographic variables included the state's *unemployment rate*, the *proportion of children (age 5 through 17) living below the poverty level*, and *the percentage of the state population that held at least a bachelor's degree.* The analysis also took into account whether an *exit exam* was a state requirement for graduation. (See Appendix D for more information about the state-level variables).

To maximize the number of cases for the analysis, this study employed missing imputation using several methods. For demographic variables, the hot deck imputation method was used. Given that most of missing values in demographic variables were regarded as missing at random (MAR), random imputation algorithms that replaced the missing values by using the values from the matching respondents in the sample are considered appropriate (Altmayer, 2002; Shieh, 2003). This technique generates less biased measures and thus a better way to impute, if the imputed data are the basis for additional analysis (Statistical Solutions, nd). Multiple imputations using a predictive model- based method were also used for other independent variables. Using an ordinary least-squares regression method of imputation, this technique generates an estimated model from the observed data and a new linear regression; parameters are randomly drawn from their Bayesian posterior distribution (Rubin, 1976; Shieh, 2003). By comparing the incomplete and imputation data set analysis using general linear mixed models of longitudinal studies, Sheif (2003) found that multiple imputation is an effective technique that allows researchers to use complete data statistics on the data with missing values.

Analysis

Schools are nested within states, and there is significant variation among states with respect to legislative policies, the availability of different types of higher education, and social, political, and economic contexts relating to higher education access (Martinez, 2002; McLendon

& Hearn, 2007; Perna & Titus, 2004). Therefore, this study used three-level HLM to address the effect of state-level, school-level and individual-level characteristics on whether or not a student attended college. Because the dependent variable was binary, this study used hierarchical generalized linear modeling (HGLM), which is an extension of the generalized linear model (GLM) and generates estimates of how various factors predict the probability of outcomes.

The first step in any HGLM analysis is to construct a null model (a one-way ANOVA model with random effects) in which no predictors enter into the model. This null model provides an estimated grand mean of the outcome measure and information about the outcome's variance due to between-school and between-state differences (Raudenbush & Bryk, 2002).

$$Y_{ijk} \mid \varphi_{ijk} = B(m_{ijk} = 1, \varphi_{ijk}) \quad \text{(i=individual student, j=school, k=state)} \tag{1}$$

$$\eta_{ijk} = \log(\varphi_{ijk} / (1-\varphi_{ijk})) \tag{2}$$

In equation 1, Y_{ijk} is the outcome variable, indicating whether students attended college and φ_{ijk} is an individual's probability of attending college. Equation 1 denotes that Y_{ijk} has a Bernoulli distribution with a single trial (m_{ijk}=1), a special case of binomial distribution, $B(m_{ijk,} \varphi_{ijk})$ with m_{ijk} trials. In equation 2, η_{ijk} is the log-odds of attending college. We use η_{ijk} as an outcome variable based on the common logistic regression assumption that the relationship of a binary outcome to the predictor variables is linear in the log-odds (Raudenbush & Bryk, 2002). Equation 2 can be rewritten for probability φ_{ijk} as in equation 3.

$$\varphi_{ijk} = \frac{1}{1 + \exp[-\eta_{ijk}]} \tag{3}$$

The next step is constructing a model which specifies a series of student-level (level 1) variables, but which is unconditional at the high school-level (level 2). Equation 4 estimates differences in the outcome variable attributable to differences in student-level characteristics.

$$\eta_{ijk} = \beta_{0jk} + \beta_{1\sim11jk}(\text{individual background characteristics})_{ijk} + \beta_{12\sim15jk}(\text{academic preparation})_{ijk} + \beta_{16\sim18jk}(\text{individual's cultural and social capital})_{ijk} \quad (4)$$

The parameter β_{0jk} is the intercept for the level 1 model predicting log-odds of college enrollment associated with the reference student. In equation 4, $\beta_{1\sim18jk}$ are the slopes/effects of individual-level variables, respectively, associated with school j in state k. In this study, only the intercept is specified at a high school-level conditional model (as shown in equation 5). This model uses high-school level variables to explain the variance in college participation that is attributable to differences among high schools:

$$\beta_{0jk} = \gamma_{00jk} + \gamma_{01\sim5k}(\text{structural characteristics})_{jk} + \gamma_{06\sim11k}(\text{school environment characteristics})_{jk} + \gamma_{12\sim13k}(\text{teaching staff characteristics})_{jk} + \mu_{0jk} \quad (5)$$

In Equation 5, γ_{00jk} is the level 2 intercept and $\gamma_{01\sim13k}$ are the slopes/effects associated with the reference high school. Further, μ_{0jk} is the random effect term associated with high school j and state k. A Level 3 (i.e., between state-level) conditional model is shown in equation 6. This model includes state-level variables to explain the remaining variance in college participation that is attributable to differences among states:

$$\gamma_{00k} = \pi_{000} + \pi_{001\sim0012}(\text{state characteristics})_{k} + \mu_{00k} \quad (6)$$

In Equation 6, π_{000} is intercept and $\pi_{001\sim0012}$ are the slopes/effects associated with reference state, and μ_{00k} is the random effect term associated with state k, where the term is assumed to be randomly distributed.

All the continuous variables at Level 1, Level 2, and Level 3, were centered around their grand mean; this technique controls for the differences in student and school characteristics across states. No additional centering technique was used for binary variables; binary variables were assumed to be the value of zero when interpreting the intercept terms in the model. The

HGLM method provides more accurate estimates of the distinct effects of school- and state-level variables on the student-level outcomes being measured (Raudenbush & Bryk, 2002).[1]

FINDINGS

Table 1 indicates the estimated coefficients, standard errors, and corresponding odds ratios meeting at least the $p < .1$ level for the final model.

[INSERT TABLE 1 HERE]

Student-level

At the student level, gender held a significant effect on Latino students' college enrollment behavior; the odds of going to college were about 1.45 times (or 45 percent) higher for female students than for male students, even after controlling for all student, school, and state variables. First-generation (foreign-born) immigrant students, net of all other factors, were less likely than third-generation immigrant students (students with two US-born parents) to enroll in college. Third-generation immigrant students had odds of going to college that were about 1.5 times greater than those for first-generation immigrant students.

Family income, certain family context variables, and internal characteristics also were significantly related to college enrollment. Students whose family incomes were below $50,000 were significantly less likely to go to college than those with incomes over $75,000. Those from families making $50,000 or less per year had a 60% chance of going to college, compared with those from families making $75,000. Students from the top two income categories ($50,001 - $75,000, and $75,000 or more) evidenced no differences in college-going. In addition, students whose parents expected their children to earn at least a four-year degree had higher (12%) odds of going to college than their counterparts whose parents expected their children to earn less than

a bachelors' degree. Increased levels of parental involvement in students' academic matters were also associated with higher odds of going to college.

Student expectations were also a significant predictor of college enrollment. Students with expectations for at least a bachelor's degree had higher (23%) odds of going to college than those without such expectations. More advanced math course taking was also associated with increased college enrollment. The effect of different course taking patterns was particularly striking for students who took lower level math courses. Students who took advanced math had odds of enrolling in college that were about 3.5 times greater than those who took mid-level math, about 7.5 times greater than those who took low-level math, and about 23 times greater than those who took no or very basic math courses.

School-level

At the school level, three variables emerged as significant predictors of college enrollment: absenteeism, percent of graduates enrolled in college, and mean standardized math score for the school's students. Students enrolled in schools with higher absenteeism rates were less likely than their counterparts at schools with lower absenteeism to attend college. Students enrolled in schools with higher rates of college-going among graduates had odds of going to college that were about 1.2 times (20%) higher than those from schools with lower rates of college-going. At the school-level, a higher mean standardized math test score was associated with increased college-going as well; the odds of students at schools with higher scores were about 1.05 times (5%) greater than students at schools with lower scores. Beyond the school-level, none of the state-level variables had significant effects on college enrollment.

DISCUSSION

This study employed three-level Hierarchical General Linear Modeling to test a conceptual model of college access that stipulates that multiple contextual layers, including school and state-level factors, affect college enrollment (Perna & Thomas, 2008). Our analysis revealed that most of the significant predictors of college enrollment for Latino high school students were at the student-, rather than the school- or state-, level. We will address these unexpected findings in more detail later in this article.

Among student-level variables, being a female Latina had a positive influence on college enrollment, net of all other factors in the model. This finding reflects the national disparity in females' and males' college enrollment rates, which is greater among Latinos than for the general college-age population (Santiago, 2008). This study's comprehensive multivariate analysis highlights the distinct effect of being Latina, yet it remains unclear why being Latina has a positive effect on college enrollment. It is possible that other psychosocial, cultural, economic, and structural factors not included in this model may promote Latinas' college enrollment in comparison to that of male Latinos. For example, more stringent gender norms for Latinas to maintain family values and reputation may influence them to perform better in school (Suarez-Orozco & Suarez-Orozco, 2001). Macro-level structural trends such as increasing incarceration levels and availability of community colleges as an educational option may also contribute to the positive effect of being Latina (Long, 2007).

First-generation (foreign-born) immigrant students were less likely than their third-generation counterparts to attend college, net of other factors. This finding extends research indicating that K-12 first-generation immigrant students tend to achieve academically at lower rates than US-born students (Louie, 2007) to the outcome of college-going. First-generation

Latino immigrants are also less likely to attend college. Language barriers and limited understanding of the U.S. educational system may contribute to this condition (Gandara & Contreras, 2009). This study did not measure whether first-generation immigrant students were undocumented, but the category of first-generation immigrant students would have included any and all undocumented students. Current policies tend to exclude undocumented immigrants from postsecondary admission and financial support, thus disadvantaging their prospects for attending college (Gandara & Contreras, 2009).

Having a family income below $50,000, compared with one over $75,000, negatively predicted Latino students' likelihood to enroll in college, controlling for the model's array of factors. This finding underscores the critical influence of financial capital in determining whether or not Latinos attend college (Gandara & Contreras, 2009; St. John, 2003). It points out the importance of providing adequate aid to Latino students and of offering information about finance to families early in the college planning process, so that families can be aware of the available financing options and the benefits of a college degree (Dowd, 2008).

Family context variables, including increased parental educational expectations and parental involvement in the student's college planning, were found to have a positive influence on college enrollment. These findings support other research highlighting the role families play in encouraging students to plan for and attend college (Walpole, 2007). Building on comparable analyses of 1990 high school sophomores (O'Connor, 2009; Perna & Titus, 2005), these results suggest that family involvement in the college planning process continues to be a focal research and policy area for 21st century Latino high school students.

The student variables classified as internal (Perna & Thomas, 2008), including student's educational expectations and math preparation, were each found to have a significant effect on

college enrollment. These findings support other research suggesting the importance of higher student expectations in college enrollment, particularly for Latino students (McDonough, 1997; Perna, 2000; Walpole, 2007). Our study supports these conclusions with more recent national data and points to the importance of targeting student expectations in research and practice.

An increased level of math coursetaking was found to have a strong influence on college enrollment for Latino students, consistent with other research (e.g., Adelman, 2006; Perna, 2000). Yet, Latino high school students, regardless of their abilities, are less likely than others to enroll in advanced math (Oakes, et al., 2006b). Promoting advanced math coursetaking appears critical to promoting Latino students' college enrollment. In addition to providing adequate advanced math courses and preparing students for these classes, involving families in curricular planning for college as early as middle school can help ensure that more Latino students are taking the math necessary to enroll and succeed in college. More broadly, higher math coursetaking reflects an academic curriculum indicative of a college-going culture, where students have access to skilled teachers and college preparatory courses (Oakes, et al., 2006a).

At the school-level, absenteeism, the percentage of students going to college, and mean standardized math scores had significant effects on college enrollment, net of all the other factors in the model, including school structural characteristics such as demographics and school size. These variables reflect academic attitudes, commitments, and behaviors among students and teachers in a school, and thus can serve as indicators of a college culture (Oakes, et al, 2006a). These results extend research on the significance of school-level absenteeism in affecting high school academic achievement (Konstantopoulos, 2006) to its influence on the outcome of enrolling in college. The percentage of a school's graduates going to college is positively associated with Latino students' college enrollment. This suggests that a peer culture where

students are oriented toward going to college contributes positively to college enrollment (Conchas, 2006; Oakes, et al., 2006a). The school's level of math preparation is also positively associated with college enrollment, indicating that having highly academically-achieving peers supports Latino students' college-going. Policies focusing on math preparation at the student and school-level have the potential to contribute to increasing Latino students' college-going rates. The level of math preparation also reflects the school's college-going culture with respect to access to a rigorous curriculum and qualified teachers (Oakes, et al., 2006a).

The state-level factors in this study did not appear to have an influence on college enrollment, net of student- and school-level factors. This finding is unexpected, but it is possible that other variables are masking the effect of state-level policy-related variables. Recent qualitative research indicates that state policies have an indirect effect on college enrollment, for these policies can significantly influence the dissemination and clarity of information to students and families about the college planning process (Perna, et al., 2008; Rowan-Kenyon, Bell, & Perna, 2008). State-level variables can influence schools', families' and students' college planning experiences that, in turn, affect college enrollment decisions.

Limitations

This study proposes an innovative and comprehensive statistical approach to explore the influence of multiple contexts on Latino students' college enrollment, but there are important limitations. NCES data sets have limited proxies that may not fully reflect the meaning of theoretical constructs such as cultural and social capital, or elements of a college-going culture (Perna, 2007). Also, quantifying state-level influences on educational outcomes is difficult, because of limited comparable state data elements and proxies for state policy and political considerations (McLendon & Hearn, 2007). In addition, our quantitative approach only

addressed direct effects of the variables on college enrollment. Thus, we could not uncover key indirect effects of factors in the model or relationships among independent variables.

CONCLUSION AND IMPLICATIONS

This study used three-level Hierarchical General Linear Modeling to analyze the most recent national study tracking high school students' postsecondary trajectories. It provided the first quantitative test of a conceptual model addressing how two key contextual levels (high school and state) affect Latino students' college participation (Perna & Thomas, 2008). Few contextual variables at the school-level, and none at the state-level, had significant effects on this outcome. Considering previous research insights and our study's methodological approach, we conclude that some effects of these variables may be obscured in our analysis.

This study suggests that, net of a host of factors, being female positively conditions Latino students' college enrollment. There appears to be something unique about gender that affects whether or not Latino students go to college. Further research comparing Latinas' and Latinos' psychosocial characteristics and K-12 schooling experiences can provide insights about how to address policy concerns about the limited number of Latino males in college.

This research highlights the importance of family involvement and college information in facilitating Latinos' college enrollment. Information about college-going appears to play a more important role for Latino students than others in affecting their likelihood of enrolling in college (Oakes, et al., 2006a; O'Connor, 2009). Because Latino families have limited information about college costs and are more resistant to taking out loans (Dowd, 2008), providing Latino families with financial information about college early on in students' K-12 careers is critical in promoting their college enrollment. Working with Latino families to ensure that their children take college preparatory courses can positively influence Latino students' college participation.

Building school norms and behaviors that reflect a commitment to education also appears to be important in affecting Latino students' likelihood to enroll in college. This study indicates that measures related to the academic and social climate (or college culture) of a school are significantly associated with college-going. Incentives to promote high school attendance may encourage increased college-going. The peer group also appears to be important, as evidenced by the significance of college enrollment rate of a school's graduates. Given the importance of family involvement, perhaps outreach programs could involve graduates from the high school to return to discuss their college experiences with students and families. The significance of the school's mean standardized math scores indicates that encouraging students to meet high academic expectations, particularly in mathematics, can promote Latinos' college-going as well. Promoting a college-going school culture where highly qualified teachers offer a rigorous academic curriculum can enhance Latino students' likelihood of going to college.

Policy and programmatic implications from the state-level are more difficult to draw. Qualitative case studies can provide insight about how the complex dimensions of states' policies toward higher education condition college access. Future quantitative studies, such as multilevel models employing Structural Equation Modeling, should address indirect effects of school and state-level variables on college participation, and extend the analysis to enable comparisons between racial/ethnic groups.

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TABLE AND APPENDICES

Table 1. Estimated Coefficients from the final three-level model (population-average model) – fixed effects

Individual-level variables	**Coefficient**	**SE**	**Odds ratio**
Gender (reference: male)	.373**	.140	1.453
Ethnicity (reference: Mexican American)			
Cuban American	-.158	.359	
Puerto Rican	-.175	.284	
Central/South American	.161	.266	
Immigrant Generational Status (reference: 3rd Generation)			
1st Generation	-.394*	.184	.675
2nd Generation with neither parent born in US.	.175	.208	
2nd Generation with one parent born in U.S.	-.046	.229	
Income (reference: high income with more than $75,000)			
Less than $25,000	-.553*	.259	.575
$25,001~$50,000	-.481+	.257	.618
$50,001~$75,000	-.438	.301	
Parental Education (reference: first-generation college-going)	.012	.185	
Parental expectations	.110*	.050	1.12
Parental involvement	.308***	.076	1.36
Student expectations	.207***	.047	1.23
Math coursetaking (reference: advanced math)			
No math	-3.14***	-.441	.043
Low level math	-2.02***	.302	.134
Middle level math	-1.26***	.177	.284
School-level variables			
Urbanicity (reference: Urban)			
Suburban	-.179	.169	
Rural	-.062	.321	
Percentage free lunch	-.001	.003	
Student: teacher ratio	-.002	.023	
School size	.000	.000	
Learning Hindrance	.074	.106	
Absenteeism	-.305*	.153	.736
Percentage of graduates enrolled in college	.189*	.094	1.20
Mean Math Score	.053*	.022	1.05
Mean Level of Teachers' Educational Expectations	.202	.146	
Percentage of Certified Teachers	-.001	.005	
Lowest salary paid to full-time teachers	-.010	.021	
State-level variables			
Proportion of direct appropriations to higher education	-19.24	11.80	
Proportion non-need based aid per student (reference: none)			
Low	.323	.450	
Middle	.685	.556	
High	-.220	.469	
Average Teacher's Salary	.077	.041	
Exit Exam Graduation Requirement	-1.31	.824	
Proportion of teachers who have graduate degrees	-.014	.014	
Unemployment Rate	-.463	.393	
Proportion of Children below Poverty Level	.227	.169	
Proportion of BA degree holders	-.013	.060	

***p < .001, **p < .01, *p < .05, +p < .1

Appendix A. Factor loadings and reliability tests for factors used in the model

Parental involvement (original coding: 1-never to 3-often)	Factor Loadings [a]
Discussing school courses with parents	.982
Discussing school activities with parents	.985
Discussing materials studied in class with parents	.987
Discussing grades with parents	.983
Discussing preparation for ACT/SAT with parents	.970
Parents' reported frequency of providing advice about college	.982
Cronbach Alpha	**.994**

[a] Factor analysis was conducted via Maximum Likelihood Estimation. Only one factor was extracted and no rotation was conducted.

Appendix B. Operational definitions of the student-level variables in the analysis

VARIABLE	DISTRIBUTION	SOURCE
College enrollment (Dependent Variable)	Enrolled = 62.9% Did not enroll = 37.1%	F2EVRATT
Gender	Female = 48.3% Male (reference) group = 51.7%	BYS14
Ethnicity	Cuban = 8.4% Puerto Rican = 10.8% Central and South American = 11.3% Mexican American (reference group) = 69.5%	BYHISPAN
Immigrant Generational Status	First-generation (foreign-born) = 38.7% Second-generation (no US-born parents) = 23.4% Second-generation (one US-born parent) = 12.9% Third-generation (both US-born parents) = 23.9%	BYP17, BYP20, BYP23
Family income	$25,000 or less = 40.9% $25,001 - $50,000 = 34.3% $50,001 - $75,000 = 11.3% More than $75,000 = 13.6%	BYP85
Parental education	Continuing generation (BA or above) = 22.2% First-generation (less than BA) = 77.8%	BYPARED
Parental expectations	Coding scheme: 1-less than high school graduation to 8-obtain Ph.D., MD, or other advanced degree Mean = 5.43 SD = 1.37 Range = 1-8	BYPARASP
Parental involvement	Mean = -.02 SD = 1.37 Range = -3.09 to -2.34	F1S64A, F1S64B, F1S64C, F1S64E, F1S64G, F1S64H
Student expectations	Coding scheme: 1-less than high school graduation to 8-obtain Ph.D., MD, or other advanced degree Mean = 4.95 SD = 1.50 Range = 1-8	BYSTEXP
Math course taking (maximum level of coursework)	No math = 3.8% (low or no math courses) Low level math = 6.3% (algebra I and geometry) Middle level math = 60.3% (algebra 2, advanced trigonometry , probability or statistics, or algebra 3) Advanced math = 29.7% (precalculus or calculus)	F1RMAPIP

Appendix C. Operational definitions of the school-level variables in the analysis

VARIABLE	DISTRIBUTION	SOURCE
Urbanicity	Rural = 8.6% Suburban = 43.9% Urban (reference) = 47.5%	BYURBAN
% Free lunch	Mean = 33.15 SD = 19.80 Range = 0-90.49	CPO4FLUN
Student: teacher ratio	Mean = 19.08 SD = 4.55 Range = 7.30 – 28	CPO3STRO
School size	Mean = 1958 SD = 968 Range = 72 - 4653	CPO3STEN
Learning hindrance (1-not at all to 4 – a lot	Mean = 1.88 SD = .81 Range = 1-4	BYA50A
Absenteeism (1-never happens to 5- happens daily)	Mean = 4.80 SD = .6 Range = 1-5	BYA49B
Percentage of 2003 graduates who went to college	Coding scheme: 1: none, 2:1-10%, 3: 11-24%, 4: 25-49%, 5:50-74%, 6:75-100% Mean = 4.33 SD = 1.01 Range = 2-6	F1A19A
Mean value of math standardized test scores	Mean = 48.56 SD = 4.89 Range = 36.99 – 60.76	From student-level variable (F1TXMSTD)
Mean value of teacher's expectations for students	Coding scheme: 1-less than high school graduation to 8-obtain Ph.D., MD, or other advanced degree Mean = 4.13 SD = .72 Range = 2-6.25	BYTE20 (English teacher) BYTM20 (Math teacher)
Percentage of certified full-time teachers	Mean = 90.05 SD = 18.25 Range = 0-100	BYA24A
Lowest salary paid to school's teachers	Mean = $30,630 SD = $4, 620 Range = $13,510 - $45,000	BYA26A

Appendix D. Operational definitions of the state-level variables in the analysis

VARIABLE	DISTRIBUTION	SOURCE
Proportion of direct appropriations to Higher Education	Mean = 9% SD = 2% Range = 5% - 14%	*Digest of Education Statistics 2007*, Table 28
Proportion of non-need based state grant per college student	No non-need based grant (reference) = 33% Low (less than 30% of total state grant aid) = 20% Middle (less than 90% of total state grant aid) = 20% High (less than 100% of total state grant aid) = 27%	*NASSGAP 35th Annual Survey Report*, Table 12
Average annual teacher salary	Mean = 40,110 SD = 6,000 Range = 32,290 - 51,210	*Digest of Education Statistics 2007*, Table 73
Proportion of public school teachers who have graduate degrees	Mean = 49.62 SD = 12.97 Range = 27.20 - 78	*Digest of Education Statistics 2007*, Table 66
Unemployment rate	Mean = 5.44 SD = .57 Range = 4.60 - 6.30	*US Census Bureau State and Metropolitan Area Data Book*, 2006 – state data table A-29
Proportion of children ages 5-17 below poverty level	Mean = 12.37 SD = 2.89 Range = 8.10 - 18.60	*Digest of Education Statistics 2007*, Table 20
Percentage of state population holding at least a bachelor's degree	Mean = 27.42 SD = 3.96 Range = 23.00 - 34.70	*US Census Bureau State and Metropolitan Area Data Book*, 2006 – state data table A-22
State administers exit exam for graduation	Yes = 60% No = 40%	BYA34A

[1] ELS:2002 data are based on a complex survey design which uses intricate sampling techniques such as stratification and oversampling of certain populations. To overcome the artifacts caused by the complex design, this study followed the recommendation by Thomas & Heck (2001). For descriptive analyses, this study used relative weights, in which NCES sampling weight variable (F2F1WT) was divided by its average in the sample. Relative weights preserve the sample size for statistical testing but adjust for oversampling. The weighted sample was then used in the HGLM analysis. Because multilevel analysis directly accounts for the clustered sample design, it was not necessary to consider the design effect in further analyses.