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Student Characteristics, Pre-College, College, and Environmental Factors as Predictors of Majoring in and Earning a STEM Degree: An Analysis of Students Attending a Hispanic Serving Institution

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This study examined the demographic, pre-college, environmental, and college factors that impact students' interests in and decisions to earn a science, technology, engineering, or mathematics (STEM) degree among students attending a Hispanic Serving Institution (HSI). Results indicated that Hispanic students were well represented among STEM majors, and students' decisions to declare a STEM major and earn a STEM degree were uniquely influenced by students' gender, ethnicity, SAT math score, and high school percentile. Earning a STEM degree was related to students' first-semester GPA and enrollment in mathematics and science "gatekeeper" courses. Findings indicate that HSIs may be an important point of access for students in STEM fields and may also provide opportunity for more equitable outcomes for Hispanic students.

KEYWORDS: Hispanic education, postsecondary education, student behavior/attitude

A large percentage of baby boomers are nearing retirement in science, technology, engineering, and mathematics (hereafter referred to as STEM) occupations (Barton, 2003; Maple & Stage, 1991), and it has been predicted that by the end of the decade, STEM employment opportunities in this country will increase by nearly 50% (National Science Foundation, 2002).

Despite the increasing number of Hispanic students entering postsecondary education, Hispanic students are currently underrepresented in terms of the percentage of students both pursuing and attaining STEM degrees (Oakes, 1990; Young, 2005). Data from the Integrated Postsecondary Education Data System (IPEDS) Completion Survey for the 1999-2000

academic year point out that Hispanic students were less likely to earn undergraduate degrees in biological and life sciences, computer and information sciences, engineering, and the health professions and related sciences.

The importance of increasing the number of undergraduate Hispanic students completing degrees in science, mathematics, and engineering has been recognized by Congress in the Goals 2000 Educate America Act (*Goals 2000*, 1994, section 102, 5Biii). In response, the federal government has allocated billions of dollars to increase funding earmarked for postsecondary STEM programs (U.S. Government Accountability Office, 2005). Currently, there are more than 200 education programs across the country specifically designed to increase the number of students pursuing and graduating with STEM degrees and entering STEM-related occupations or to improve programs in the areas of science, mathematics, engineering and technology (U.S. Government Accountability Office, 2005). Many of these programs focus on moving Hispanic students through the K-12 pipeline by impacting student achievement, promotion and graduation (e.g., No Child Left Behind Act, The College Board's Equity 2000 program, Project GRAD, Gaining Early Awareness and Readiness for Undergraduate Programs).

In spite of the generous federal support being given to help support STEM education programs, of which nearly half are sponsored by the National Institutes of Health (NIH) and the National Science Foundation (NSF), little evaluation work has been conducted specific to the factors or variables associated with STEM outcomes. Moreover, the multiple goals

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targeted for diverse groups of students have yet to be properly evaluated, which include the recruitment and academic preparation of minority students in STEM-related coursework, research opportunities for STEM students, and the recruitment of graduate students into STEM careers (United States Government Accountability Office, 2005).

Furthermore, a major shortcoming regarding both the evaluation of federal- and state-sponsored STEM programs and research on Hispanic students in STEM fields has been a lack of theoretically sound empirical work. As such, theoretically based work is needed to better understand the factors influencing various STEM outcomes among both Hispanic students and other traditionally underrepresented groups. Additionally, findings by Young (2005) indicate that nearly half of all Hispanic students who declare majors in engineering or science change majors during college and do not earn a degree in either area. However, there has been little research conducted to understand the factors influencing Hispanic students' decisions to persist in a STEM major (Fenske, Porter, & DuBrock, 2000).

A Hispanic Serving Institution (HSI) is defined as an institution that has at least 25% Hispanic full-time enrollment, of which at least 50% are low income (Bordes & Arredondo, 2005). Although nearly half of all Hispanic students are currently enrolling at colleges and universities designated as HSIs (Santiago, Andrade, & Brown, 2004), we have little empirical research that tells us how or why these institutions might produce more equitable educational outcomes for Hispanic students (Laird, Bridges, Morelon-Quainoo, Williams, & Holmes, 2007). Rather, the majority of published work to date on students attending HSIs has focused on the proportion of degrees earned by Hispanic students and how institutions compare to other 2- and 4-year colleges and universities (e.g., Dayton, Gonzalez-Vasquez, Martinez, & Plum, 2004; Laden, 2001, 2004; Stearns & Watanabe, 2002). With the exception of recent work by Crisp (2008); Maestas, Vaquera, and Zehr (2007); and Laird et al. (2007), there has been little attempt to identify the salient characteristics and factors that contribute to equity (or inequity) in student outcomes at HSIs. Furthermore, with the exception of data currently being collected by Malcom, Dowd, and Bensimon, no study to date has examined the factors that promote STEM outcomes among students attending a Hispanic Serving Institution.

In turn, the purpose of this study was to examine the demographic, precollege, environmental, and college factors that impact students' interest in and decision to earn a degree in STEM among undergraduate students attending an HSI. The following research questions guided the study:

1. Are there significant differences/relationships between the characteristics of Hispanic and White students and STEM majors at a Hispanic Serving Institution?
2. What factors predict students' decisions to declare a major in STEM?

3. What factors predict students' decisions to change majors from non-STEM to STEM?
4. What factors predict STEM degree attainment?

The study findings advance previous efforts in several ways. First, findings from this study add to our understanding regarding the variables influencing students' decisions to major in and ultimately earn a STEM degree at an HSI. Second, the present study is framed using Nora's (2003) Student/Institution Engagement Model in order to add to our theoretical understanding of the factors influencing student outcomes specific to STEM. Third, and most important, the present study is one of the only studies to date that examines the factors associated with equity in student access and outcomes among Hispanic students attending an HSI.

Literature Review

Theoretical Framework

The following section provides context to the variables used in the logistic models that posit that students' interests in and decisions to ultimately earn a degree in STEM are related to demographic, pre-college, environmental, and college factors. The predictor variables in our model were developed from Nora's (2003) Student/Institution Engagement Model that emphasizes the unique interaction between the student and the institution, as well as prior research around students' interests in and decisions to persist in a STEM major. The model theorizes that students' interaction between themselves and their chosen major is influenced by several student characteristics, behaviors, and experiences, which in turn produces a connection, or engagement, between the student and his or her institution that leads to persistence and degree attainment.

More specifically, students are said to bring pre-college characteristics to college, such as high school experiences and prior academic achievement that influence their college experiences and subsequent connection to the institution and chosen degree. Students' behaviors and college experiences are also thought to be influenced by environmental pull factors that exert a "pulling away" or a "drawing in" of students into the academic and social campus environments. These pull factors are thought to be related to students' attitudes and ability to remain in college and center on variables outside of university life, such as having to work off-campus, attending to family responsibilities, dealing with financial concerns, or attending campus part-time. At the same time, institutional or college experiences (e.g., coursework and academic performance) are said to solidify students' commitments, degree goals, and ultimate persistence decisions.

Empirical Findings From STEM Literature

Demographic variables. Research findings indicate that gender serves as one of the most powerful and robust predictors of choice of college major for minority students, as female minority students are much more likely to pursue degrees outside of STEM fields (Simpson, 2001) and less likely to aspire to STEM careers than males (Catsambis, 1994). Reyes, Kobus, and Gillock (1999) found that Latina students aspiring toward highly male-dominated careers such as STEM fields preferred having "American" friends, preferred using English in conversation, and were likely to have a better understanding of the steps needed to achieve their career goals and objectives. Similarly, a study of 181 undergraduates at Northern Arizona University used the expectancy-value theory to predict students' choice of major. Findings indicated that for males, the extent to which students perceived biology to be both interesting and personally useful were the overriding influences in their choice of major. For females, however, performance and ability, subjective value, general utility, others' perceptions, effort, and stereotypes were all found to be factors significantly related to their choice of major (Sullins, Hernandez, Fuller, & Tashiro, 1995).

Pre-college factors. Several pre-college experiences that have been shown to influence Hispanic students' interest in STEM fields include pre-college preparation (Tyson, Lee, Borman, & Hansen, 2007), test scores (Barton, 2003; Rakow & Bermudez, 1993), academic experiences in mathematics and science prior to high school (Eamon, 2004; U.S. Government Accountability Office, 2005), and prior achievement in mathematics (Astin & Astin, 1992; Gross, 1993; Moreno & Muller, 1999; Simpson, 2001). Additionally, the decision to remain enrolled in a STEM major has been shown to be influenced by a student's entering mathematics training prior to enrolling in college, as well as his or her academic aptitude (Astin & Astin, 1992). More specifically, student achievement in the form of grade point average and mathematics SAT scores has been found to be associated with the persistence of undergraduates in STEM majors (Bonous-Hammarth, 2000; Sondgeroth & Stough, 1992).

Research indicates that minorities tend to view general coursework as separate from a college-prep curriculum (as cited in Simpson, 2001), differing from the views of their nonminority peers who often begin to make occupational decisions, such as taking college-prep courses and engaging in extracurricular activities early on (Stage & Hossler, 1989). For instance, Rakow and Walker (1985) found that there was a statistically significant difference in the number of traditional college preparatory courses taken by White and minority students, with White students averaging about a third of a semester more in college-prep courses and averaging higher in science achievement than Black or Hispanic students. Similar findings were more recently found by Hurtado et al. (2006).

Moreover, findings tell us that tracking policies in high school may negatively influence Hispanic students' academic experiences in mathematics and science. A quantitative study by Zuniga, Olson, and Winter (2005) that examined the tracking policy of a high school with an 11,600% increase in Hispanic student enrollment within 10 years found that successful Hispanic students (as demonstrated by standardized tests written in English and high GPA) were often placed in lower level science courses and were, therefore, unlikely to take subsequent courses required for college admission, notwithstanding their college aspirations. Low-achieving non-Hispanic/White students at the same school were disproportionately placed in upper level science classes, which thereby increased their success in science.

In turn, Hispanic students are unlikely to have had appropriate K-12 academic preparation, and less than half of those graduating from high school qualify to enroll at a 4-year institution immediately following graduation (President's Advisory Commission on Educational Excellence for Hispanic Americans, 2002). Therefore, Hispanic students (68%) are much more likely to attend a community college than White students (Pew Hispanic Center, 2005), which may have a negative influence on STEM participation, as findings by Grandy (1998) indicate that minority students are more likely to complete a STEM major when they are enrolled in 4-year colleges during their sophomore year as opposed to attending a community college. Additionally, students who attend a 4-year institution and arrive on campus with a strong research focus have been found to be more likely to major in engineering (Astin, 1993).

Environmental pull factors. An environmental pull factor that has been shown to influence STEM outcomes for both Hispanic and non-Hispanic students is enrollment status. For instance, research findings by Millett and Nettles (2006) reveal that Hispanic doctoral students who maintained full-time enrollment throughout their academic program were four times more likely than part-time students to complete a STEM degree. Because science, engineering, and mathematics degrees often take longer to complete than other college majors, financial aid also takes on added importance in retaining students in those programs (Barton, 2003; Fenske et al., 2000). The importance of financial aid in keeping Hispanic students interested in and enrolled in STEM majors/careers cannot be overstated (Rakow & Bermudez, 1993). The availability of adequate financial resources has been rated as one of the top five factors related to the persistence of minority engineering students by the National Action Council for Minorities in Engineering (Landis, 1985). Moreover, recent findings by Malcom and Dowd (2008) indicate that higher levels of relative debt may negatively impact Hispanic students' decisions to enroll in graduate and professional schools among bachelor's degree holders in STEM.

College variables. Research indicates that all ethnic groups have equally positive attitudes and similar aspirations for STEM careers. However, as minority students progress through their academic careers, their interests in science and mathematics weakens as their achievement in these classes declines (Peng, Wright, & Hill, 1995). A disproportionate number of Hispanic and African American students are often assigned or incorrectly placed in developmental or remedial courses based on faulty achievement test scores (Catsambis, 1994). Consequently, they are limited in the number of science and mathematics courses they take and, in the end, are unlikely to be prepared for high school and/or college-level STEM coursework (Oakes, 1990; S. Peng, Wright, and Hill, 1995; Simpson, 2001). Moreover, once in college, students (both minority and nonminority) may face additional challenges during introductory mathematics and science courses, often referred to as "gatekeeper" courses. Research on these courses tells us that some introductory mathematics and science courses (such as biology, chemistry, or calculus) may serve to discourage students from earning a STEM degree as a result of highly competitive classrooms or a lack of engaging pedagogy that promotes active participation (Gainen, 1995; Seymour & Hewitt, 1997).

Method

Participants

Participants were obtained from institutional data files at a large doctoral-granting HSI in the southern United States. The institution was chosen for its national reputation for successfully graduating Hispanic students. In the 2007-2008 academic year, the HSI ranked fourth in the nation for the number of Hispanic students earning bachelor's degrees and first in the nation for graduating Hispanic students with an undergraduate degree in biology/biological sciences (Hixson, 2009). Students who earned an undergraduate degree in the fall and spring semesters between 2006 and 2008 were included in the analysis. Students with an ethnicity coded as "international student" (n = 12) and American Indian (n = 3) were excluded. Complete data were available for 76% (n = 1,925) of the population of graduates (n = 2,515), which were retained for the subsequent analysis.

The final sample included 1,925 students who were shown to be representative of the population of graduating students on all major characteristics including gender, ethnicity, first-generation status, full-time status, and major type. For instance, 43.2% of the population was male, compared to 42.9% of the sample. Similarly, the ethnic distribution of the population and the sample was nearly identical, as 39.2% of the graduates were White (40.2% of the sample) and 48.4% were Hispanic (48.2% of the sample). Nearly half (46.5%) of the population were classified as first-generation college students, compared to 46.9% of the sample. In addition, an identical percentage of the

population and sample were full-time students (68.7%) and STEM majors (21.5%). Moreover, the sample was found to be representative of the population of graduating students in terms of undergraduate GPA (sample and population mean were both 3.01) and SAT math scores (sample and population mean were both 506).

Outcome Variables

The degree variable was coded into a dichotomous variable, STEM or non-STEM, based on the taxonomy of the Classification of Instructional Program (CIP) codes provided by Kienzl, George-Jackson, and Trent (2008). More specifically, STEM majors were defined as those with a two-digit CIP code of 11 (computer and information sciences and support services), 14 (engineering), 27 (mathematics and statistics), or 40 (physical sciences). Three dependent variables were examined: (a) declaring a STEM major (coded 1) versus declaring a non-STEM major (coded 0), (b) declaring a non-STEM major and changing majors to STEM (coded 1) versus persisting in a non-STEM major (coded as 0), and (c) earning a degree in STEM (coded 1) versus earning a non-STEM degree (coded 0).

Predictor Variables

Guided by our theoretical framework, we selected several independent variables that were hypothesized to predict each of the outcome variables from available institutional data. Three *demographic variables* were included in the first block of the model: students' gender, ethnicity, and whether one or more of the students' parents earned a college degree. Next, several *pre-college variables* were added to the model. Pre-college variables were assessed using a student's SAT math score, high school percentile, and whether the student transferred to the HSI from another institution. The third set of predictor variables centered on *environmental "pull" variables*, which included enrollment status during the first semester (as a measure of integration into college life) and whether students received a Pell grant to finance their education (as a measure of financial attitudes). Finally, students' *college variables* were measured using first-semester GPA and whether students enrolled in a developmental course, enrolled in Algebra I or higher, or enrolled in Biology I or higher in their first semester at the institution. Table 1 presents the model specifications.

Data Analysis

Chi-square and *t* tests were computed for relevant student characteristics (such as gender, ethnicity, GPA) to identify significant differences/relationships among Hispanic and White students and STEM majors. Next, using block sequential modeling, three logistic regression analyses were run to predict the dependent variables on the basis of the independent

Table 1
Logistic Model Specifications

Variables	Coding
Demographic variables	
Gender	Male[a] = 0 (43%), female = 1 (57%)
Ethnicity	White[a] = 0 (40%), Hispanic = 1 (48%), African American = 2 (7%), Asian = 3 (5%)
First-generation status	One or both of the students' parents earned a college degree or higher[a] = 0 (53%), neither of the students' parents earned a college degree = 1 (47%)
Pre-college variables	
SAT math score	SAT math total score (0–800) (M = 506, SD = 80)
High school percentile	High school percentile (1–100) (M = 71, SD = 21)
Transfer status	First institution attended[a] = 0 (75%), transferred from another institution = 1 (25%)
Environmental variables	
Enrollment status	Enrolled in 12 or more credit hours the first semester[a] = 0 (69%), enrolled in 11 or fewer credit hours the first semester = 1 (31%)
Pell grant support	Did not receive a federal Pell grant[a] = 0 (51%), received a federal Pell grant = 1 (49%)
College variables	
First-semester GPA	First semester cumulative grade point average (M = 2.93, SD = 0.71)
Developmental course	Student did not enroll in a developmental course the first semester = 0 (85%), student enrolled in one or more developmental courses the first semester[a] = 1 (15%)
Algebra I or higher	Student enrolled in Algebra I or a higher level mathematics course in the first semester[a] = 0 (35%), student did not enroll in Algebra I or higher = 1 (65%)
Biology I or higher	Student enrolled in Biology I or a higher level biology course in the first semester[a] = 0 (22%), student did not enroll in Biology I or higher = 1 (78%)

[a]Reference category.

variables (Garson, 2008). Dichotomous logistic regression (DLR) was chosen over an ordinary least squares (OLS) analysis because the data were not all normally distributed and the probability of the outcome variable was not linearly related to the predictor variables (Lottes, DeMaris, & Adler, 1996).

Categorical predictors were recoded into dummy variables before they were entered into the logistic regression models. The variance inflation factor (VIF) was examined for each of the predictor variables, as a test of multicollinearity within the model. Variables with a VIF greater than 2.5 were not included in the final models. As recommended by C. Peng, So, Stage, and St. John (2002), the adequacy of the logistic regression models was evaluated through an examination and interpretation of the overall fit of the regression models and diagnostic statistics. Specifically, the evaluation of the logistic regression models involved an examination of the chi square goodness of fit and predicted probabilities (PCP). Beta weights, standard errors, the Wald chi-square statistic, associated p values, and odds ratios were then examined and interpreted for the significant predictors in the models (Garson, 2008). All analyses were run using SPSS 16.0.

Results

Descriptive Findings

Of the 1,925 students who earned an undergraduate degree in the long semesters between 2006 and 2008, 928 (48%) were Hispanic and 774 (40%) were White. When comparing Hispanic and White students, a significant relationship was not found between gender and ethnicity or between transfer status and ethnicity. However, Hispanic and White students were found to significantly vary by financial support, $\chi^2(1, n = 1{,}702) = 1.019, p < .001$; first-generation college status, $\chi^2(1, n = 1{,}702) = 80.177, p < .001$; and enrollment status, $\chi^2(1, n = 1{,}702) = 14.484, p < .001$. Hispanic students received higher levels of Pell grant support and were overrepresented in terms of first-generation college status. Hispanic students were also more likely to attend college part-time when compared to White students. Furthermore, Hispanic students were found to have significantly lower SAT math scores, $t(1{,}700) = 10.842, p < .001$; and first semester grade point averages, $t(1{,}700) = 3.827, p < .001$. However, Hispanic students' high school percentiles were found to be significantly higher than that of White students, $t(1{,}700) = -3.249, p < .01$.

When comparing characteristics of Hispanic and White STEM majors, findings of chi-square and t tests revealed similar differences/relationships. Hispanic and White STEM majors were found to significantly vary by financial support, $\chi^2(1, n = 349) = 10.686, p < .01$; first-generation college status, $\chi^2(1, n = 349) = 7.528, p < .001$; and enrollment status, $\chi^2(1, n = 349) = 4.658, p < .05$. Similarly, significant differences were once again found between Hispanic and White STEM majors' mean SAT scores, $t(347) = 5.368, p < .001$. However, significant differences were not found between Hispanic and White STEM majors in terms of high school percentile or first semester GPA. Table 2 provides a detailed comparison of White and Hispanic students and between White and Hispanic STEM majors.

Table 2
Descriptive Statistics—Hispanic and White Students and Science, Technology, Engineering, or Mathematics (STEM) Majors

	Hispanic Students (n = 928)	White Students (n = 774)	Hispanic STEM Majors (n = 198)	White STEM Majors (n = 151)
Gender				
Male	43.8%	42.0%	54.0%	54.3%
Female	56.2%	58.0%	46.0%	45.7%
Transfer status				
Native student	74.4%	73.3%	78.3%	74.2%
Transfer student	25.6%	26.7%	21.7%	25.8%
Financial support				
Received Pell grant	58.5%	34.0%	56.1%	38.4%
Did not receive Pell grant	41.5%	66.0%	43.9%	61.6%
First-generation status				
First generation	56.9%	35.1%	52.5%	37.7%
Not first generation	43.1%	64.9%	47.5%	62.3%
Full or part-time status				
Full-time	64.7%	73.3%	70.7%	80.8%
Part-time	35.3%	26.7%	29.3%	19.2%
Mean SAT math score	489.2	529.1	519.5	563.8
Mean high school percentile	72.4%	69.1%	77.1%	74.6%
First-semester GPA	2.87	3.01	3.09	3.19

Logistic Regression Analyses

Predicting declaring a STEM major. The first regression analysis examined the influence of demographic, pre-college, and environmental variables on whether a student declared a major in STEM on his or her university application. Table 3 displays the parameter estimates, significance values, and fit statistics for all of the regression models. Results indicated that adding demographic and pre-college variables significantly improved the fit of the model. Moreover, the overall model was found to be significant, $\chi^2(10, n = 1{,}925) = 116.920$, $p < .001$, and yielded correct predictions for 71% of the sample. A review of the parameter estimates and associated probabilities identified that the likelihood of declaring a STEM major was uniquely influenced by students' gender, ethnicity, SAT math score, and high school percentile. An examination of the odds ratios showed that females were less likely than males to declare a STEM major. In addition, the odds of declaring a major in STEM were 1.37 times as large for Hispanic students and 1.93 times as large for Asian students when compared to White students.

Predicting changing from a non-STEM to a STEM major. Demographic, pre-college, environmental, and college variables were used in the next model

Table 3
Logistic Regression Models: Parameter Estimates and Model Evaluation

	Predicting Declaring a STEM Major (n = 1,925)	Predicting Changing to a STEM major (n = 1,354)	Predicting Earning a STEM degree (n = 1,925)
Demographic variables			
Gender	–.576***	–.650**	–.747***
Ethnicity			
Hispanic	.317**	.115	.232
African American	.232	.452	.297
Asian	.655**	1.347*	.907**
First-generation status	.006	–.047	–.056
Pre-college variables			
SAT math score	.004***	.004*	.005***
High school percentile	.012***	.000	.008*
Transfer status	–.152	–.186	–.001
Environmental variables			
Enrollment status	.121	.183	.281
Pell grant support	.147	.229	.244
College variables			
First-semester GPA	—	.370	.583***
Developmental course	—	–.424	–.269
Algebra I or higher	—	–.319	–.818***
Biology I or higher	—	–2.013***	–1.748***
Model evaluation			
Chi-square	116.920***	94.891***	368.031***
Percentage of correct classification (PCP)	71.3	93.1	81.2

*$p < .05$. **$p < .01$. ***$p < .001$.

to predict whether a student changed to a STEM major from a non-STEM major during college. Demographic, pre-college and college variables were found to significantly improve the fit of the model. The model was found to be significant, $\chi^2(14, n = 1{,}354) = 94.891$, $p < .001$, and yielded correct predictions for 93% of the sample. The likelihood of changing from a non-STEM to a STEM major was found to be related to students' gender, ethnicity, SAT math score, and enrollment in Biology I or higher. Females were less likely than males to change to a STEM major, while the odds of changing majors were 3.85 times larger for Asian American students when compared to White students. The odds of changing to a STEM major was negatively associated with enrolling in Biology I or higher in the first semester.

Predicting earning a STEM degree. In contrast to the first two regressions, all four blocks (i.e., demographic, pre-college, environmental, and college)

were found to significantly improve the fit of the model that predicted students' earning a STEM undergraduate degree. The model was significant, $\chi^2(14, n = 1{,}925) = 368.031$, $p < .001$, and yielded correct predictions for 81% of the sample. The likelihood of earning a STEM degree was uniquely associated with students' gender, ethnicity, SAT math score, high school percentile, first-semester GPA, enrollment in Biology I or higher, and enrollment in Algebra I or higher during the first semester of college.

Females were less likely than males to earn a STEM degree, while the odds of earning a STEM degree were 2.48 times larger for Asian American students when compared to White students. An increase in SAT math scores or high school percentile increased the odds of earning a degree in STEM as compared to earning a non-STEM degree. A one-unit increase in first-semester GPA was found to increase the odds of changing to a STEM major by a factor of 1.79. The odds of earning a STEM degree were found to be 2.27 times lower for students who enrolled in Algebra I or higher and 5.74 times lower for students who enrolled in Biology I or higher in the first semester.

Limitations

The results must be considered in light of several limitations regarding the data and generalizability of the findings. First and foremost, our data were limited to institutional data files. As such, our models excluded several key variables that have been found in the literature to impact STEM outcomes for both White and minority students. Namely, our models did not include a measure of students' self-efficacy (Lantz & Smith, 1981; Leslie, McClure, & Oaxaca, 1998; Meece, Parsons, Kaczala, Goff, & Futterman, 1982; Post-Kammer & Smith, 1986); the power of support or mentoring from family, friends, or peers (Astin & Astin, 1992; Catsambis, 1994; Rakow & Bermudez, 1993); or the influence of negative racial attitudes on campus (Chang, Eagan, Lin & Hurtado, 2009).

Due to data limitations (as well as the scope of the project), the present study did not examine the influence of STEM major (e.g., biology, computer science) on students' decisions to major in or earn a STEM degree. Third, data were not available to indicate the number of students who may have enrolled in, but not completed, a biology or algebra course during the first college semester, which may have influenced the results. Finally, it should be noted that the sample was limited to undergraduate students at a single HSI. It is not clear to what degree this institution, or its students, are representative of other doctoral-granting HSIs around the country. As such, the ability to generalize the findings beyond the institution are not known.

Discussion/Conclusions

Findings from this study add to our understanding regarding the variables influencing students' decisions to major in and ultimately earn

a STEM degree at an HSI. Consistent with the STEM literature, women were found to be less likely to declare a STEM degree, change to a STEM major, and earn a STEM degree. It is important to acknowledge that these differences may be partly a function of the specific STEM major within which they were "nested." In turn, although a multilevel analysis was not possible for this study, it is recommended that future research examine the influence of major on STEM outcomes in order to properly examine the role that gender has on influencing students' decisions to pursue or earn a STEM degree.

Similar to prior STEM research (e.g., Astin & Astin, 1992; Barton, 2003; Moreno & Muller, 1999; Rakow & Bermudez, 1993), our findings suggest that a student's high school achievement and aptitude for math are related to STEM outcomes at an HSI. Our models specified that parental education (i.e., first-generation college status) would be related to students' decisions to major in or persist in a STEM major. Consistent with existing research (e.g., Astin & Astin, 1992; Grandy, 1998; Hoachlander, Sikora, & Horn, 2003; Ornelas & Solórzano, 2004), we also expected that students transferring from another 2- or 4-year institution would be less likely to major in STEM than those students who initiated their higher education at a 4-year HSI. However, both of these factors played little, if any, role in swaying students to select or to persist in a STEM major. The role the institution, as an HSI, plays in access to STEM and the representativeness of these findings are not clear. Research is needed to confirm or to further explain these findings. However, it is hoped that these findings are reflective of access provided by the HSI in terms of providing students with the necessary cultural capital and support to persist through college into their chosen career.

In contrast to prior research (e.g., Barton, 2003; Fenske et al., 2000; Millett & Nettles, 2006), the two environmental pull factors in our models (i.e., enrollment status, Pell grant support) were also not found to influence students' decisions to major or to persist in STEM. We were limited in terms of the variables available to measure financial support, and so it is not clear whether other forms of financial support may have influenced students' decisions to major in STEM. As such, we recommend that future research measure other types of financial aid, such as the amount of grants and loans received. We also recommend that future research consider possible intangible components of financial support, including affective attitudes associated with meeting financial obligations, which have been found in the persistence literature to influence Hispanic students' persistence decisions (Nora, 1993).

Consistent with research on gatekeeper courses (Seymour & Hewitt, 1997), enrollment in Biology I or higher during the first college semester was found to negatively influence students' decisions to change majors, and enrollment in both biology and algebra was found to influence STEM degree completion. Prior research suggests that this finding might be explained by numerous factors, including a highly competitive classroom or a lack of engaging pedagogy that promotes active participation (Gainen,

1995; Seymour & Hewitt, 1997). However, it should be noted that our data reflected student enrollment on the 12th day of class, not course completion or success. As such, we recommend that future research examine enrollment withdrawal patterns, especially for gatekeeper courses. For example, expanding the work of Tyson et al. (2007) to the college level, future research is recommended to further examine the role of course taking patterns and "gatekeeper" courses on STEM outcomes at HSIs.

Enrollment in developmental courses has become the center of discussion as many of our students entering higher education are not prepared to engage in college-level work. Arguments for and against remediation all focus on whether developmental courses play a significant role in bringing students up to a level where they can successfully enroll in and pass college-level work. Arguments have tried to link student persistence, academic achievement, attainment of an undergraduate degree, and transfer from a 2-year to a 4-year institution with developmental education, mostly in a negative fashion. Surprisingly, findings from this study suggest that developmental courses did not have a negative influence on STEM persistence or degree attainment. It is hypothesized that this finding might be related to our population of interest, as the majority of developmental or "high-risk" students may have been excluded from our population that only included students who successfully earned a 4-year degree from the HSI. As such, we recommend that future research examine the impact of developmental coursework on students who fail to earn a degree.

As previously mentioned, our study was framed around the STEM literature and Nora's (2003) Student/Institution Engagement Model in order to add to our theoretical understanding of the factors influencing student outcomes specific to STEM. The misspecification of theoretical and quantitative models of student success is an important issue, particularly as it applies to studies in STEM and at HSIs. It is recommended that future research continue to investigate how the current persistence models might be adapted or expanded to be specific to students attending HSIs. More sophisticated models are also necessary to unravel the complex influences of factors impacting the desire to major in STEM, those that play a role in retaining minority and women students, and those that encourage and secure a student's commitment to completion of a degree in those very vital areas. This includes nonacademic behaviors and attitudes influencing students' decisions to pursue and attain STEM degrees, including students' self-efficacy; mentoring support from family, friends, or peers; and the negative influence of racial prejudices on campus. Furthermore, because it is difficult with a single institution sample to situate the present findings within the context of HSIs, we recommend that future research be conducted using a large number of institutions (e.g., National Center for Education Statistics [NCES] data sets such as BPS or ELS) to allow for the examination

of the influence of student and institutional level variables on STEM outcomes.

Finally, the present study is one of the only studies to date that has examined the factors associated with equity in student outcomes among students attending an HSI. Results indicate that Hispanic students were well represented among STEM majors. This finding is consistent with prior work by Dayton et al. (2004) and Stearns and Watanabe (2002), which found HSIs to be an important point of access for Hispanic students in STEM fields. Despite pre-college differences among Hispanic and White students in terms of financial support, parental education, and math SAT scores, being Hispanic was not found to decrease the odds of a student's majoring in STEM when compared to White students. In fact, in our model, Hispanic ethnicity was found to increase the odds of declaring a major in a STEM at the HSI. While qualitative and quantitative work is needed to better understand the complex set of variables impacting Hispanic students' decisions to major in and persist in STEM at an HSI, we are hopeful that recruitment plans to higher education access initiatives (e.g., Achieving the Dream, GEAR UP) may be influencing the number of Hispanic students who are interested in pursuing a STEM career (at least at HSIs).

Recent discourse on affirmative action, percent plans, and narrowing academic gaps has focused on opportunity for everyone, regardless of gender, racial/ethnic background, or other characteristics. The goal of such discourse is to increase the desire to go to college and the number of underrepresented groups among different facets of society. It is hopeful that this encouragement is also serving to increase interest in STEM careers, void any serious self-appraisal of a student's ability to succeed in that field. Findings from this study suggest that Hispanic students attending an HSI may not be discouraged from considering a STEM major based on their family income or standardized test scores. As such, contrary to recent findings by Contreras, Malcom, and Bensimon (2008), HSIs (or at least the HSI utilized in the present study) may also provide the opportunity for more equitable outcomes for Hispanic students.

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