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Maintaining Initial Interests: Developing Science, Technology, Engineering, and Mathematics (STEM) Career Aspirations Among Underrepresented Racial Minority Students

Felisha A. Herrera
Sylvia Hurtado
University of California, Los Angeles

Contact: Felisha A. Herrera, 405 Hilgard Ave., 3005 Moore Hall, University of California, Los Angeles, CA 90095-1521; Phone: (310) 825-1925.

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Introduction

Nationally between 1986 and 2006, relative increases in entering college students' interests in science, technology, engineering, and mathematics (STEM) fields have been observed (Higher Education Research Institute [HERI], 2010). Furthermore, the gap between the STEM interests of underrepresented minority (URM) students, specifically African Americans, American Indians, and Latino/a students, and their White and Asian American peers has narrowed (HERI, 2010) URMs' proportionate initial interests in STEM are nearly identical (approx. 34%) to the interests of their White and Asian American peers in 2004, whereas URM students lagged behind their counterparts by over 10 percentage points in initial STEM interest in 1971. Despite increasing interest in STEM disciplines, degree completion rates among URM students continue to lag behind those of White and Asian American students (HERI, 2010; U.S. Department of Education & National Center for Education Statistics, 2000).

URM students' departure from their initial interests in STEM fields and low degree completion rates translate to underrepresentation of these groups within the STEM workforce. It is estimated that STEM-related employment is composed of 77.3% White, 17.2% Asian American, 3.9% Black, and 4.5% Latino (NSF, 2009). The National Science Foundation (2010) states that science and engineering will outpace job growth in other fields, with projected increases of 21 percent; therefore, increasing the number of STEM degrees awarded to domestic students is seen as vital to maintaining national economic competitiveness in a globalized economy (Hira, 2010). Given the need for national competitiveness and innovation, some scholars posit that scientific endeavors can be improved and enhanced by having a greater diversity of perspectives (Blickenstaff, 2005) through a more diverse workforce. In the context of the projected demand for additional science and engineering workers and the need diversifying the STEM workforce, increasing the preparation for science and engineering careers of students from historically underrepresented groups is especially important (NSF, 2006), particularly for higher education initiatives seeking to respond to this call.

Given the disproportionately low numbers of minorities represented in the STEM workforce (National Science Board, 2007), promoting URM interests in STEM careers and recruiting, retaining, and graduating these students within STEM degree programs are essential to diversifying the STEM workforce. In 2006, African American, Hispanic, and Native American students garnered 5%, 6.9% and .5% of engineering degrees while representing 12%, 11.5% and .79%, respectively, of the total U.S. population (National Science Foundation, 2008). This demonstrates the underrepresented share of engineering degrees earned by URM students relative to their representation in the overall population. Although STEM retention and completion goals are highly linked to STEM career interest, it is essential to examine the factors that promote or deter students' career interests specifically, as individuals leave the pipeline at different points to pursue another career field (Blickenstaff, 2005).

The purpose of this study is to examine URM students' development and retention of STEM career aspirations during the college years. Specifically this study examines measures of students' perceptions and motivations, college experiences and institutional contexts, while controlling for student's background characteristics and pre-college preparation. It is important to examine the salient considerations and influences on URM students' retained interest in STEM careers as it may result in key policy implications for higher education initiatives seeking to increase minority participation in the scientific workforce.

Guiding Research and Theory

As with college in general, prior academic achievement, as demonstrated through high school GPA and SAT/ACT tests, serves as one of the strongest predictors of college academic achievement and persistence in STEM (Astin, 1993; Crisp, Nora, and Taggart 2009). Similarly, precollege experiences and academic preparation play a role in students' likelihood to persist in STEM fields (Elliott, Strenta, Adair, Matier, & Scott, 1996). Several studies focusing on Black students have identified competence in pre-college science and mathematics as critical to students' progression in the STEM pipeline from high school to college (Elliott et al., 1996; Russell & Artwater, 2005; Simpson, 2001). Additionally URM students tend to have less access to precollege experiences that better prepare them for college STEM majors, including advanced math and science coursework and resources, such as Advanced Placement (AP) courses (Schneider, 2000; Solorzano, & Ornelas, 2004).

Access to good high school preparation is often linked to socioeconomic status, which is normally measured as a function of income and parental education. Parental education, career choice, and, subsequently, parental influence through communication of career expectations and career-related beliefs contribute to the shaping of students' career interests and pursuits (Tang, Fouad, & Smith, 1999). It is important to consider how student background characteristics influence URM students' success in college and STEM career aspirations, as pre-college characteristics are often cited as a primary explanation of observed outcomes for these students in STEM fields. The question, however, is whether other factors play an important role once student background characteristics are controlled.

For example, the ways in which students make meaning of their degree, career, and life aspirations is another aspect to consider when examining students' interests in STEM careers.

Seymour & Hewitt (1997) found, through ethnographic interviews, that among the most salient differences between students who persisted and students who switched out of the sciences were the attitudes and strategies developed for overcoming the barriers prominent in STEM fields. Highlighting the importance student attitudes and values, Sax (1994) found that “life goals” were significant predictors of persistence in science, math, and engineering. For example, she found that a desire to raise a family was a negative predictor of persistence, while the importance of making a theoretical contribution to science was a positive predictor.

In examining the factors that influence students’ math and science goals, Byars-Winston and Fouad (2008) assert that barriers, perceived or real, can influence undergraduates’ academic or career development if those barriers are assessed as impeding on one’s ability to successfully complete a given outcome or goal. Therefore, the “contextual factors” of the undergraduate experience (Byars-Winston & Fouad), both within college and within students personal life, are important considerations in attempting to determine what might deter students from their initial STEM interests. Perna and associates’ (2009) study on African American women in STEM define these contextual barriers as encompassing four areas: academic, psychological, social, and financial. Therefore it is important to identify the educational interventions and supports can institutions provide to assist students in overcoming these barriers.

Values that are particularly relevant for the field, like a commitment to science (Pascarella & Terenzini, 2005), have been noted as critical attributes for students to possess and to be fostered by undergraduate programs (Villarejo, Barlow, Kogan, Veazy, & Sweeney, 2008). Thus, the undergraduate experience itself is an important venue for fostering the academic, practical, and professional skills that are necessary to persist in a STEM degree program and eventually in a STEM-related career. Mentoring, from both faculty (Maton & Hrabowski, 2004;

Packer, 2004) and advanced student peers, has been noted to acquaint students to scientific norms and provides them with networks to access information and opportunities (Hurtado, Eagan, Cabrera, Lin, Park, & Lopez, 2008; Perna Lundy-Wagner, Drezner, Gasman, Yoon, Bose, & Gary, 2009). Social network theorists have identified critical "institutional agents" (Stanton-Salazar & Dornbusch, 1995) who can promote student's development. For example, faculty in STEM fields orient students toward science research careers (Carter, 2002) and foster their initial career interests (Seymour et al., 2004). Undergraduate research programs are well documented as providing these social and academic networks and research experiences, which helped students to clarify, confirm, and refine their career goals (MacLachlan, 2006; Seymour et al., 2004). Structured research programs help reinforce students' identification with science and help students to overcome the barriers that may detract from their initial STEM interests (Hurtado et al., 2008).

Prior literature indicates that URM students seem to benefit most from intervention programs that promote academic confidence, like undergraduate research programs, because their experiences within math and science course can lead them to doubt their academic ability in these subjects (Perna et al., 2009) and their decisions to remain in a STEM major (Crisp et al, 2009). Some science and math introductory courses have a highly competitive environment that may discourage students to continue with more advanced coursework (Seymour & Hewitt, 1997). Therefore, initiatives that focus on providing URM students with out-of-class support programs, such as supplemental instruction (Bonsangue & Drew, 2006; Villarejo & Barlow, 2007), tutoring (Perna et al., 2009), and career support and development (MacLachlan, 2006) have been cited as increasing STEM persistence and solidifying interests in STEM careers.

Social Cognitive Career Theory

Past research on career development has investigated “what factors influence career choices, how people make career choices, how context influences career choices, and effective interventions” (Fouad, 2007, p. 543). A useful framework developed by Lent, Brown, & Hackett (1994) applied and extended Bandura's (1986) Social Cognitive Theory to the domain of career and academic development. Lent et al.’s (1994) Social Cognitive Career Theory (SCCT) seeks to explain the processes that occur within career development by examining three interlocking models of interest development, career choice, and performance (Lent, Brown, & Hackett, 1994). SCCT is a useful framework for deconstructing and understanding how people make career decisions, develop interests, and deal with the barriers that arise in their educational and career pathways. Although much of higher education research is devoted to assessing the impact of college by measuring students’ experiences, often focused on their behavior and actions, SCCT centers on the psychological processes that influences individual action. Bringing these conceptual insights to our examination of college experiences adds a layer of depth to our inquiry and provides insights into how student’s psychosocial factors impact URM students tendency to gravitate toward or away from STEM fields. Research using SCCT emphasizes the concepts of interests, goals, outcomes, expectations, and measures of self-efficacy as they relate to performance in education and career activities (see Figure 1).

Utilizing SCCT as a lens for examining the career development process among students in STEM fields, this study explores student background characteristics, perceptions, experiences, and institutional environments among students who initially began college with STEM career aspirations. Just as past research has focused on specific aspects of the full SCCT model (Flores Navarro, Smith, & Ploszaj, 2006; Lent Brown, Sheu, Schmidt, Gloster, Wilkins, Schmidt, Lyons,

& Treistman, 2005), this study does not measure performance or attainments, but rather considers students' continued interests in pursuing a STEM career as a *choice goal* that clearly indicates near-future intent to acquire STEM employment (see Figure 2).

SCCT theory guides the conceptual mapping of the variables included in the hypothesized model as visualized in Figure 2. *Person inputs* are represented by the inclusion of race/ethnicity and gender. *Background contextual affordances* are factors that affect the learning experiences through which career-relevant self-efficacy and outcome expectations develop, such as socioeconomic status (SES) and financial concerns. Additionally, early STEM role models are influential, particularly with parents in STEM careers, as past research has shown that parental career can influence children's interests, goals and perceptions of value toward specific careers (Byars-Winston & Foud, 2008). Person input and background contextual affordances are particularly relevant in the examination of URM students, as SCCT posits that differential access to learning experiences is based on gender, race, ethnicity, and socioeconomic status (Lent et al., 1994). Therefore, we control for this differential access with the precollege learning experience variables that are included in this study (e.g., high school GPA, composite SAT scores, and high school math and science courses)

Outcome expectations are defined by Bandura (1977) as beliefs regarding the consequences or outcomes of performing particular behaviors. This study is focusing specifically on student's expectations of career outcomes related to social values, STEM-specific contributions, leadership, and status. *Self-efficacy* refers to a person's beliefs about his or her ability to perform the particular behaviors or courses of action (Bandura, 1986) that are required to attain the desired career performance indicators. In the context of college students pursuing career specific degrees, this study examines academic, math, and leadership self-efficacy in terms of student self-ratings of performance capability in these areas. Leadership self-efficacy has been shown to be predictive of higher-level career aspirations (Yeagleya, Subich, & Tokara, 2010), which may link to students' degree and career aspirations. Past literature focused specifically on students pursuing engineering and science majors has shown that academic self-efficacy is predictive of students' technical career interests (Lent, et al, 2003; Lent, Larkin, & Brown, 1989).

SCCT proposes that students would be expected to develop interests in a career field or domain when they hold favorable beliefs about their performance capabilities and the likely outcomes of their engagement in their chosen career field. Interest refers to "people's pattern of likes, dislikes, and indifferences regarding different activities" (Lent & Brown, 2006, pg 17). This study focuses on *technical interests* or STEM related interests, which is useful for examining an individual student's identification with his or her respective STEM field. Technical interests are operationalized as *science identity* or student's identification with STEM. This measure, is based on previous research on domain identification (Osborne, 1995, 1997; Smith & White, 2001) and science identity (Carlone & Johnson, 2007), is designed to "clearly capture interest in, commitment to, and high performance in a specific [STEM] field" (Chang, Eagan, Lin, & Hurtado, in press, p. 16).

Student's ability to see themselves as science persons or STEM professionals is thought to impact individual career g*oals,* which can be defined as a determination or intention to pursue a career-related action. Although the model controls for other goals, such as degree aspirations, the primary goal and outcome measure is senior year continued interest in pursuing a STEM career. This focus may provide significant insights that can inform future research using the SCCT model "*Performance and Choice Actions*," which would be defined more explicitly as persisting and/or completing a STEM degree and obtaining employment within the STEM workforce.

Lastly, SCCT emphasizes the value of accounting for *contextual supports and barriers* (Lent et al., 1994). Supports are factors that encourage the attainment of successes related to pursuing a STEM related career (e.g., undergraduates' positive interactions with faculty and peers, institutional focus on STEM disciplines). Barriers refer to the aspects of the undergraduate experience that can impede the pursuit of a STEM career (e.g., working full-time during college). Beyond student's actual experiences, we consider student's assessment or personal perceptions of various environmental conditions in alignment with the framework, which focuses on salient psychological measures. In the area of STEM education, we examine specifically satisfaction with science and math courses. Additionally focusing on the experiences of URM student, it was also important to include measures of campus climate.

Methodology

Research Questions

Drawing from the Social Cognitive Career Theory (SCCT) framework and previous research, this study seeks to address the following research questions:

- Among entering freshmen with interest in pursuing a STEM career, what factors predict the retention of STEM career aspirations over four years of college?
- What are the unique predictors of retained STEM career aspirations for URM and Non-URM students?

Sample

This study analyzes a longitudinal sample that comes from the 2004 Freshman Survey (TFS) and 2008 College Senior Survey (CSS), both of which were administered by the

Cooperative Institutional Research Program (CIRP) at the Higher Education Research Institute. CIRP's TFS and CSS are administered annually to college students nationally and collect a wide range of information on students at two key time points in their collegiate experiences (for more information on these surveys see Liu, Ruiz, DeAngelo, & Pryor, 2009). The 2008 CSS had a supplemental administration that targeted institutions that produced high numbers of STEM baccalaureates as well as a select set of minority serving institutions (MSIs). This supplemental administration had a longitudinal response rate of approximately 23%; therefore, the appropriate weights were calculated to account for this low response rate to make the 2008 CSS sample look more like the entering class of 2004, and to reduce the probability of response bias.

The targeted sampling strategy made it possible to obtain a large sample of URM students interested in STEM as well as a comparison group of White and Asian American STEM aspirants. The sample for this study includes 3,165 students who indicated on the 2004 TFS an interest in a STEM-related career upon entering college. Given the study's interest in the effect of racial classification as an underrepresented racial minority (URM), it is important to note that the sample includes approximately 46.8% URM students (n=1477), specifically defined as Latino (23.4%), African American (18.1%), and American Indian students (5.3%), with the remainder of the sample (53.2%) being composed of White and Asian American (Non-URM) students (n=1,688) as a comparison group. In terms of gender, the sample is 63% female. Additionally, institutional data for the 218 institutions included in the study were merged into the database from the Integrated Postsecondary Education Data System (IPEDS) 2004 database to supplement the institutional characteristics provided by the TFS and CSS surveys.

Missing Data

Missing values analysis allowed us to examine the extent to which missing data occurred.

First, listwise deletion was utilized to remove all cases for which no information was available on the outcome variable, demographic characteristics, and/or dichotomous college experiences (i.e. participation in clubs relating to a major, working full time while in school). Also, cases were excluded (three cases total), where relevant institutional data was missing, because the multilevel analysis does not allow for missing data among institution-level variables. For the remaining variables in the model, we applied the expectation-maximization (EM) algorithm. The EM algorithm uses maximum likelihood (ML) estimates to replace missing values when a small proportion of data (less than 11%) for a given variable is missing (McLachlan & Krishnan, 1997). Overall, there was very little missing data and examination of missing data patterns suggested that missing data occurred at random. No variable had more than 8% of cases missing, with the exception of SAT scores, which only slightly surpassed the threshold with 11.4% missing data; therefore, ML estimates were used to impute values, as it is a more accurate method of dealing with missing data than listwise deletion or mean replacement (McLachlan & Krishnan, 1997).

Analyses

This study utilized Hierarchical Linear Modeling (HLM), a multilevel modeling statistical technique to examine student characteristics, perceptions, experiences, in addition to the institutional structures, that may uniquely contribute to college senior's retained STEM career interests. Considering the nature of the binary outcome measure—whether or not a student retained their initial STEM career interests—the most appropriate analysis is that of hierarchical generalized linear modeling (HGLM), a type of HLM that allows for a binary dependent variable, using a binomial sampling model and logit link function (Raudenbush & Bryk, 2002).. Additionally, due to the sampling strategy, HGLM can be used to account for error due to the clusters of the data. In this case, students are nested within institutions, having greater homogeneity in their responses rather than if students had been selected randomly from the entire population, or in other words, individually from _all_ institutions. HGLM represents an appropriate statistical technique to analyze clustered data as it separates variance occurring at the individual (student) level and the group (institutional) level (Raudenbush & Bryk, 2002). By partitioning the variance between individuals and groups, we can more accurately identify significant predictors of the dependent variable for multiple levels of observation and analysis. Additionally, multi-level modeling provides for the examination of cross-level effects or the interaction between individual-level predictors and institution-level variables.

To ensure the use of HGLM was warranted, we ran a fully unconditional model on the full sample of students that had no predictors at either the student-level or institution-level, to assess whether students' average probabilities of retaining STEM career interests varied across the sample institutions. We found that the between-institution variance significantly ($p<.001$) varied across institutions. This between-institution variance component was then used to calculate the Intra-Class Correlation (ICC), which is the proportion of variance that is between groups and is given by the following formula:

$$\mathrm{ICC} = \frac{Var(u_{0j(m)})}{(Var(u_{0j(m)}) + \frac{\pi^2}{3})}$$

In simpler terms, the ICC is calculated by dividing the between-institution variance (level 2 variance) for the outcome variable by the total variance (level 2 variance + level 1 variance). Although the ICC is less informative given dichotomous nature of the outcome variable and the logistic distribution of the level 1 variance, which is heteroscedastic (Raudenbush and Bryk 2002, p. 298), we utilized a threshold model in which the variance at level 1 can be estimated as

$\frac{\pi^2}{3}$ (Grilli & Rampichini, 2007). The ICC turns out to be 0.076, which indicates that about 8% of the variability in students' average probabilities of attainment or persistence is between group variability; therefore, most of the variance is within groups. Although this institutional variation is not extremely large, ignoring an ICC of this size by performing single-level analyses with multi-level data is likely to be problematic, which is particularly concerning with larger sample, (n >1,000), as it has been shown that an ICC of <u>*any size*</u> among large samples can increase the probability of making a Type-I statistical error (de Leeuw & Meijer, 2008; Barcikowski, 1981). Hence, accounting for this between group variability through multi-level analyses, becomes very important in our ability to accurately interpret our results.

The HGLM Model

Based on the study's dichotomous outcome measure, the sampling model is Bernoulli (Raudenbush & Bryk, 2002):

$$\text{Prob}\ (Y_{ij} = |\ \beta_{ij}) = \Phi_{ij}, \tag{1}$$

The level-1, or within-institution, model is:

$$\text{Log}\left[\frac{\Phi_{ij}}{1-\Phi_{ij}}\right] = \beta_{0j} + \beta_{1j} * (\text{PERSON INPUTS})_{ij} \tag{2}$$

$$+ \beta_{2j} * (\text{BACKGROUND CONTEXTUAL})_{ij} + \beta_{3j} * (\text{PRE-COLLEGE LEARNING})_{ij}$$

$$+ \beta_{4j} * (\text{SELF-EFFICACY})_{ij} + \beta_{5j} * (\text{OUTCOME EXPECTATIONS})_{ij}$$

$$+ \beta_{6j} * (\text{TECHNICAL INTERESTS})_{ij} + \beta_{7j} * (\text{GOALS})_{ij}$$

$$+ \beta_{8j} * (\text{COLLEGE EXPERIENCES})_{ij} + \beta_{9j} * (\text{CONTEXTUAL PERCEPTIONS})_{ij} + \mu_{ij}$$

where *i* represents the student and *j* denotes the institution.

Dependent Measure

The dependent variable in this study is a dichotomous variable indicating students' senior year interests in a STEM-related career. Eleven STEM-related careers are included: computer programmer or analyst; conservationist or forester; dentist (including orthodontist); engineer; lab technician or hygienist; nurse; optometrist; pharmacist; physician; scientific researcher; and veterinarian. (See Appendix A for a description and coding of all variables in the model).

Independent Measures

Person inputs account for a student's gender and race/ethnicity (measured URM vs Non-URM) in the initial full sample model, while it is used as a filter variable in the sub-sample models. Background contextual affordances include socioeconomic status measured as parental education level and income and concerns with financing college. Given the literature on the influence of parental career(s) in STEM (Bryan-Winston & Fouad, 2008; Russell & Atwater, 2005) and SCCT theoretical considerations of early career role models, this block also includes a measure indicating parental career(s) in STEM. Pre-college experiences control for prior academic achievement, and high school exposure to math and science. Self-efficacy measures freshman year self-ratings of academic, math, and leadership ability. Career-related outcome expectations involve imagined consequences of a career course (e.g., 'what will happen?') (Lent, 2005) and include such measures as career concerns reflecting social values, status attainment priorities, and financial stability, among others. Technical interests are measures by a latent variable that represents students' level of identification with STEM disciplines or *science identity* (see Chang, Eagan, Lin, & Hurtado, in press). Appendix A reports the alpha reliabilities of the factor for both the URM and Non-URM sub-samples and shows that the factor loadings, remained consistent across the samples. Goal-attainment variables include students' degree aspirations. Student college experiences represent participation in professional clubs, community service, and interactions with their peers and faculty, as well as influential external factors like working full-time during college. Finally, student perceptions of various environmental conditions that can support or hinder the development and attainment of career goals are measure through indicators campus racial climate, student's sense of belonging, and satisfaction with math & science courses and leadership opportunities.

As indicated by the equation, the study's results will be interpreted in terms of the delta-P statistic (see Petersen, 1985 for formula), or the expected change in probability retaining STEM career interests resulting from a one-unit change in a given independent predictor (Peng, So, Stage, & St. John, 2002). The intercept for equation (2) varies between institutions. However, the coefficients for each of the student-level independent variables are restricted to the same values for all institutions. Students' average likelihood of retaining their initial STEM career interests are thought to be different depending on the institutional context. The effects of individual experiences are assumed to be the same regardless of where the student attended college. Additionally, for ease of interpretation,

The institution-level predictors are included in equation (3), which models the intercept term in equation (2):

$$B_{0j} = \gamma_{00} + \gamma_{01} * (\text{INSTITUTIONAL CHARACTERISTICS})_j + \mu_{ij} \qquad (3)$$

where B_{0j} indicates the overall average likelihood of retaining STEM career interests and j denotes the institution. Institutional characteristics include selectivity, type, control, and the percent of students majoring in STEM fields. All of the student and institution-level used in the analysis, along with their coding schemes, are summarizes in Appendix A.

In terms of centering considerations for the multi-level mode1, this study uses grand-mean centering for all variables except for the dichotomous variables. Grand-mean centering subtracts the mean value of a variable for the entire sample from that variable's value for each individual observation (Porter and Umbach 2001), which facilitates the interpretation of the intercept in the model (Raudenbush and Bryk 2002). The intercept can be translated as the average likelihood of retaining STEM career interests for students *with the average characteristics of the sample*.

Limitations

There are several limitations surrounding this research study. The study is limited by the use of secondary data, which relies on proxy measurements of the theory's key concepts rather than the cognitive scale measurements originally developed for the theoretical model. Furthermore, our focused interests in identifying the predictors that are unique to each sub-sample results in smaller sample sizes which limited the number of variables that we were able to include in the model. Not fully disaggregating across all race/ethnicity classifications assumes individuals from African American, American Indian, and Latino backgrounds experience college in similar-enough ways that are aggregated into one overarching group for analysis. However, future research may provide more specific insights by disaggregating the sample and developing separate models for each group.

Results

Descriptive Statistics

Table 1 presents descriptive statistics for the student and institution-level variables included in the analyses. Among students overall, 57.1% of college seniors retained the STEM related career interests that they indicated having in their freshman year. The cross tabulation shown in Figure 3 reflects the percentage of college seniors who retained their STEM related career interests across all races included in the sample. Through this disaggregation, we find that Asian Americans had the highest proportion of retained STEM career interests (70.5%), followed by White (57.9%), African American (53.9%), and American Indian students (53.6%), with Latino/a students with the lowest proportion (51.2%). These results highlight the need for more research on STEM career interests, specifically, as some STEM majors leave the pipeline after graduation to pursue another career field (Blickenstaff, 2005).

--Place Table 1 here--

Full Sample HGLM Results

The first HGLM model was formulated to explore the effects of identification as underrepresented racial minority (URM) on retained STEM career interests, controlling only for gender and socioeconomic status. The results showed a significant effect for students who self-identified as a URM. URM's were significantly less likely to retain their freshman year STEM career interests than were their White and Asian American counterparts. Therefore, to more fully explore the unique impact of background characteristics, college experiences, student perceptions, and institutional context on the retained STEM career interest for each group (URM vs. Non-URM), we ran the full model separately for each of the groups to to compare the results.

HGLM Model Results for URM Sample

An HGLM model was run for the two samples of interest: URM students (n=l,477 at 194 institutions) and Non URM students (N=1,688 at 195 institutions); results for the former will be discussed here, with a discussion on the similarities and differences between the two samples occurring later in the article. Table 2 in presents the results from the full model of the HGLM analysis, for the URM and Non-URM sub-samples and includes the log-odds coefficient, standard error, significance, for each predictor as well as the delta-P statistics for significant parameters. Additionally, we include the model statistics for each sub-sample. The HGLM analyses show that several student-level variables are significantly associated with the likelihood of retained STEM career interests. Person inputs (e.g., gender) and the background conceptual affordances of SES, financial concerns and having a parent with a STEM related career had no significant effect on probability of URM students retaining their STEM career interests. Not surprisingly, our results confirm other researchers' findings with respect to prior academic achievement. As Table 2 indicates, for a unit increase in a student's high school GPA, a URM student's probability of retaining their initial interest in a STEM career will increase by 3.7 percentage points, holding all other variables constant. Considering the prior research on self-efficacy as a predictor of successful college outcomes, particularly for underrepresented students (Anaya & Cole, 2001; Cole & Espinoza, 2008; Torres & Solberg, 2001), we made a concerted effort to address the potential influence of student's career interests. However, student's self-rated judgments about their own academic, math and leadership abilities were not significant predictors of URMs' retained STEM career interests.

--Place Table 2 here--

On the basis of strong theoretical underpinnings and prior research, we included several variables that measured students' career outcome expectations, which may speak to the ways in which student's perceive their long-term roles in the scientific community. Yet only two factors significantly predicted whether URM students maintained their initial interests in a STEM career: the personal importance of enrolling in college to get specific career training and leadership potential within their chosen career path. URM students who find personal importance in enrolling in college to get career specific training were 9.40 percentage points more likely to retain their STEM career interests for every one-unit increase in this conviction. Contrarily, for very one-unit increase in expressing the importance of leadership potential with their career path, URM students were 6.74 percentage points less likely to retain their STEM career interest, possibly suggesting that students who abandoned STEM career goals see this value more probable in alternative career paths.

Contrary to previous studies accounting for degree aspirations among STEM students and underrepresented students, URM students with aspirations for a Master's degree, Ph.D., or M.D., were no more or less likely than those who aspired to a Bachelor's degree to retain their initial STEM career interests. Considering the variables representing students' college experiences, it is encouraging that there are several significant predictors found in terms of contextual influences that clearly indicate the important role of colleges and universities in shaping the experiences that can encourage students to remain on a STEM career path. The college experience that had the strongest influence for URM students was joining a major-related club or organization, as these students are 10.46 percentage points more likely to have continuing interests in a STEM career. Additionally, URM students who studied with other students had a 9.66 percentage point increase in their probability of retaining their initial STEM career interests. Lastly, our findings confirm the growing body of literature that points to impactful benefits of research opportunities for URM students. Unique to the URM subsample results, participation in faculty-sponsored opportunities for research increased students' likelihood of retaining their STEM career interests by 6.60 percentage points.

The analysis also explores both the institutional environments that students interact with as well as their perceptions of those environments as either supports or barriers in their career pursuits. Among the personal perceptions of the environment that were considered, including racial climate, sense of belonging, and satisfaction with leadership opportunities, satisfaction with math and science coursework was the only significant predictor. For every one-unit increase e in satisfaction, URM students experienced an 8.46 percentage point increased likelihood of retained STEM career.

We found three significant predictors among the institution-level variables utilized in the model. Results show that there is a positive effect of the percentage of students in STEM at a given institution, in that for every 10 percentage point increase in the proportion of STEM majors there is 3.56 percentage point increased probability that URMs retained their initial STEM career aspirations for every. URM students attending private colleges and universities are 9.5 percentage points more likely to follow through with their STEM career pathway. By contrast, for every 100-point increase in average SAT scores of entering students at an institution, URM students experienced a 6.15 percentage point *reduction* in their probability of retaining their initial interests in STEM careers. Although there is also a negative effect of institutional selectivity for Non-URM students, the effect was more powerful for URM students. This finding adds to a growing body of literature that suggests that highly selective environments as less supportive of STEM students from underrepresented backgrounds (Chang, et al., 2008; Cole & Barber, 2003, Massey, et al., 2003).

HGLM Results across Both Samples

The unique position and distinctions of URM students within STEM fields results in observable differences that can help us to understand what matters most in career development of these students. Of course, there are also similarities, which speak to the more general dynamics of students navigating the science cultures and disciplines. Table 1 in Appendix B also summarizes the results from the full model of the HGLM analysis, for the Non-URM sub-sample. Additionally, we also summarize the significant predictors across the two groups in Table 3 (Appendix B) to highlight the similarities and differences across the sub-samples. A t-test was conducted to determine if there is a significant difference in the effect of each measure for the two samples when URM and Non-URM students shared significant predictors. Among these shared significant predictors, there was no statistically significant difference in the strength of these effects across groups.

In terms of similarities, the effects of the importance of career leadership potential, satisfaction with college science and math courses, joining a major-related club, institutional selectivity, and percent of students majoring in STEM, are all just as strong for Non-URMs and they are for URM students. There were several significant predictors that were unique to the Non-URM sub-sample. Although high school GPA matters most in terms of pre-college experience for URMs students, composite SAT scores were a significant positive predictor for Non-URM students. For every 100 point incremental increase in SAT scores, Non-URM students have a 3.5 percentage point increased probability of following through with their initial STEM career intentions. An additional background characteristic that was unique to Non-URM students was found to have small yet still significant influence on retained interests in STEM careers—socioeconomic status. Our model suggests that students from higher SES backgrounds were 0.7 percentage points less likely to continue pursuing a STEM career after four years of college, which may suggest that other careers are more attractive to these students. For example, we know that a number of engineers opt to go into business rather than into engineering once they complete their degree; thus, higher SES non-URM students may be deciding to pursue more financially lucrative career opportunities. Another related factor unique to Non-URM students was the negative impact of working full-time during college. Non-URM students who worked full-time at any point during college were over 14 percentage points less likely to retain interest in a STEM career than were those who never worked full-time. Finally, in terms of career outcome expectations, the importance of a career attribute that reflecting discovery and enhancing knowledge has a significant positive impact for Non-URM students. For every one-unit increase in this conviction, Non-URM students' chances of continuing to pursue a STEM career were increased by nearly 10 percentage points.

Variance Explained by HGLM Models

Included in Table 1 are the estimated variance components for the HGLM models across the two sub-samples. Given the dichotomous outcome measure, we present the variance explained at the institutional level and used the Raudenbush and Bryk (2002) suggested equation:

$$[t00(\text{unconditional}) - t00(\text{conditional})]/t00(\text{unconditional}) \qquad (4)$$

In comparing across groups, the full URM model has a slightly higher explained variance than the Non-URM model, 81% as compared to 77% explained variance at level-2 students' likelihood to retained STEM career interests.

Discussion & Implications

In summary, there were both similarities and differences across groups. Specific to URM students, high school GPA, the importance of enrolling in college to get training for a specific career, working with faculty on research, and attending a private college or university have a significant positive influence on the odds of retaining STEM career interests. For Non-URM students SAT scores and the importance a career attribute reflecting discovery and enhancing knowledge were significant positive predictors. Higher socioeconomic status and working full-time during college negatively predicted Non-URM students' chances of intending to pursue a STEM-related career after four years of college. For the full sample of students across all race/ethnicities, the effects of the importance of career leadership potential, satisfaction with college science and math courses, joining a major-related club, and percent of students majoring in STEM significantly increased a student's probability of intending to follow through with their initial STEM career aspiration, while attending a highly selective institution negatively predicted this outcome.

Although several of the unique predictors for Non-URM and URM subsamples encompass precollege characteristics, which are often outside of the control of the institution, there are several significant findings unique to URM students that provide insights into the educational interventions that matter most for URM students. URM students' intent to obtain career specific training from college enrollment and involvement in a professor's research project constitute two significant influences in maintaining URM students' initial STEM career interests. Additionally the descriptive statistics indicate that URM students do research with faculty less frequently than non-URMs. However, the benefits they derive from these experiences far outpace the benefits that Non-URMs receive.

These findings reaffirm the significant investments of NSF, NIH, and HHMI programs to help students prepare for careers and develop appropriate skills, social networks, and social capital for work and graduate and professional school in STEM fields. Furthermore, NSF and NIH should consider funding additional undergraduate research opportunities targeted toward students from diverse backgrounds, given the evidence of their success suggested by these findings. Early college experiences that focus on professional skills and deliberately linking STEM-related academic work to applicable career objectives may reinforce URM students' confidence in their ability to succeed in STEM careers. Similarly, these findings link to the underlying notions of SCCT suggesting psychological processes that influences individual action are very important considerations in seeking to understand the career development. Furthermore, the significant career considerations, being career specific training for URM students and discovery and enhancement of knowledge for Non-URM students, suggests there may be varying emphasis on career related expectations across groups. Or in other words, students from particular groups may tend to have similar reasoning and motivation for pursing specific types of careers. Considering the many higher education initiatives to recruit students to the STEM fields, it may be advantageous to better understand these motivations as these can be indicator of students' personal reasoning for both choosing STEM careers and persisting in their field of study despite substantial barriers.

Departure from the STEM pipeline occurs at different points (Blickenstaff, 2005); therefore, this study focused particularly on career interests in STEM, rather than persistence in a STEM major. Considering the national drive to increase participation among URM students in the STEM workforce, examining what influences these student populations specifically and how URM students distinctively make meaning of their collegiate experiences to develop their career aspirations is important for furthering these workforce initiatives. The theoretical perspective of SCCT provides a framework for understanding how students' precollege experiences continue to influence educational outcomes. Additionally, these theoretical perspectives are useful for predicting how the complexity of URM students' career outcome expectations contributes to their career aspirations and goals by influencing their identification with STEM disciplines. The study included career considerations to understand how URM students' unique backgrounds and experiences influence their values and interpretations, which shape their developing educational and career trajectories. Utilizing this theoretical perspective broadly to identify and analyze key influences on student's science identity development allows for an interpretation that is more descriptive of URMs' unique experiences, which informs student support programs and future research in this area.

How might institutions sustain students' interest in scientific careers? The study has clear implications for practice. Specifically, students' satisfaction with math and science coursework is one of the primary predictors. Innovations in introductory coursework, and connections with specific careers in a variety of fields, sustain student motivation and interest. Building both peer and faculty support networks associated with specific science careers also appear to be effective. Finally, because the most talented students seek to attend the most selective institutions, it is incumbent on these institutions to engage in further nurturing of student talent among underrepresented groups. Each institution must redouble efforts to prepare a diversified scientific workforce for the future.

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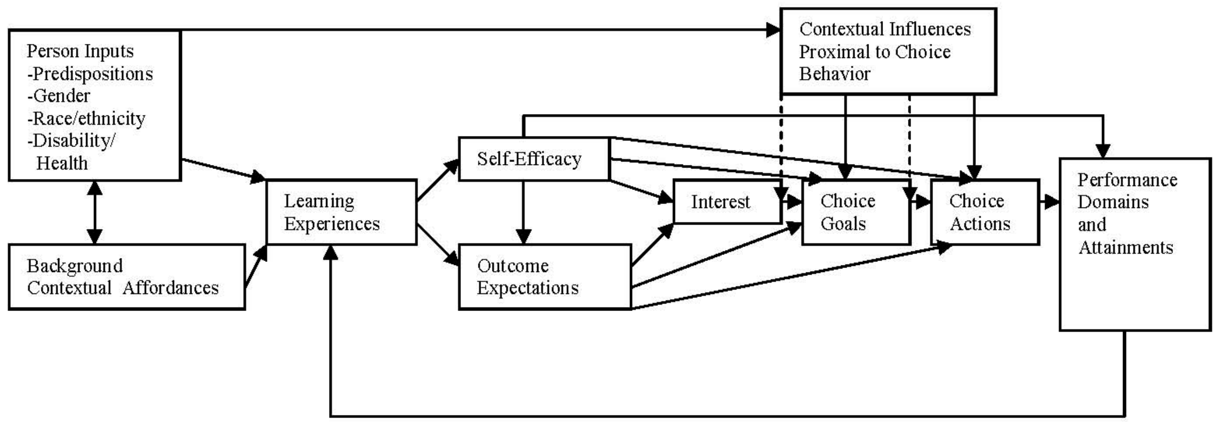
Figure 1. Social Cognitive Career Theory



Lent, Brown, & Hackett (1994)

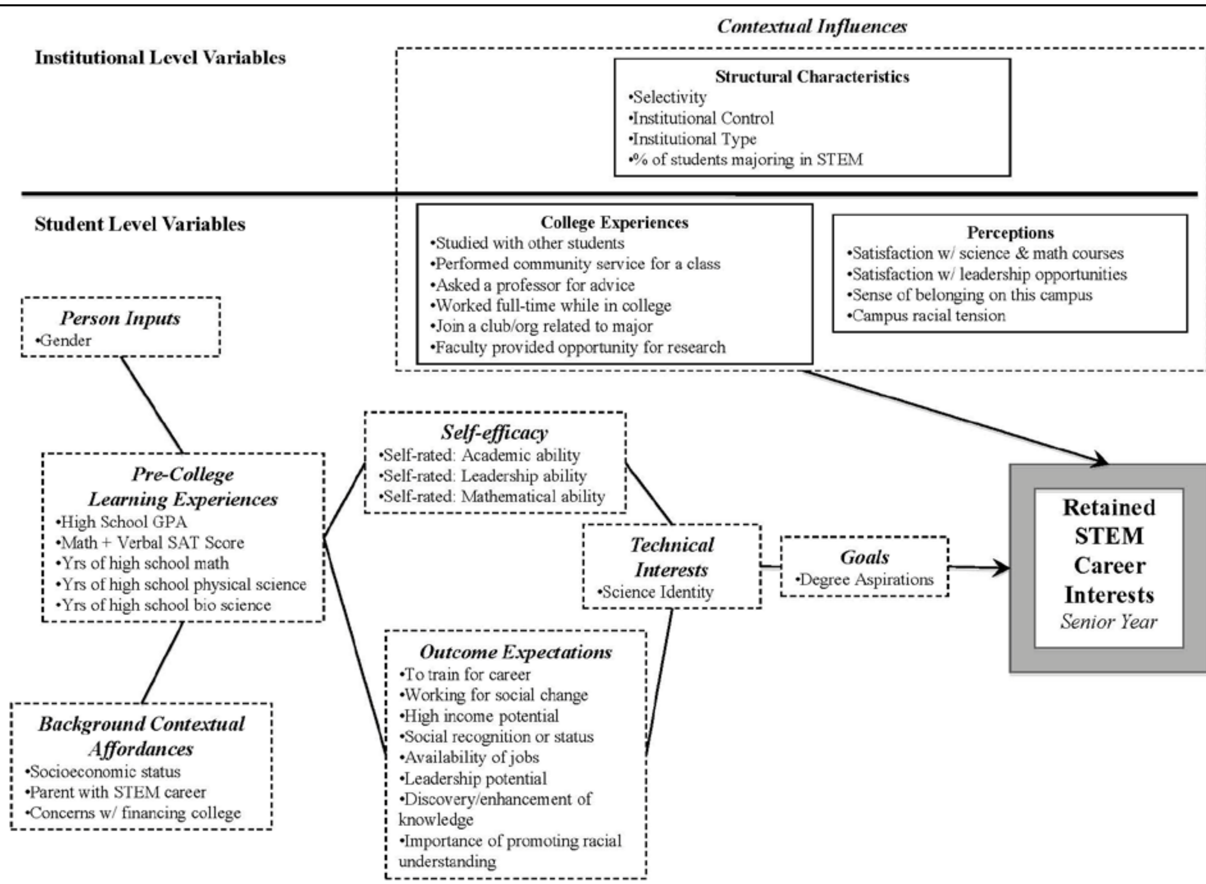
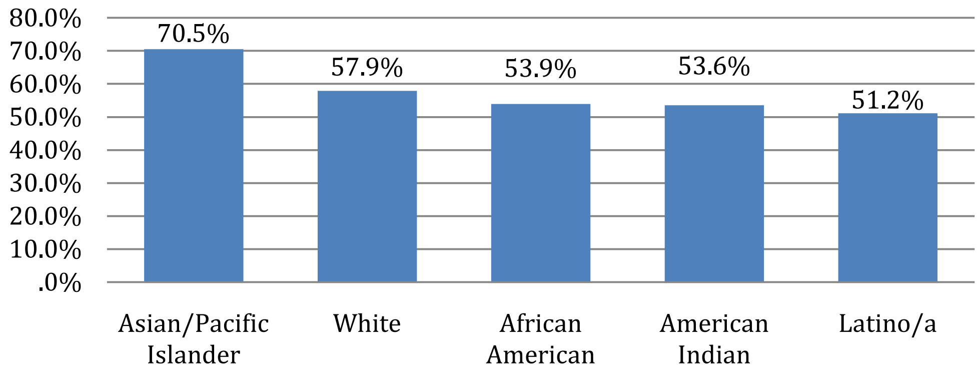


Figure 2. Conceptual Model Utilizing SCCT Framework

Figure 3. Proportion of students with retained STEM career interests by race/ethinicity



Appendix A

Variables and Measures

Variables	Description
<u>Dependent variable</u>	
Senior year career interests in STEM	0=no 1=yes 11 STEM Related Careers: Computer programmer or analyst; Conservationist or forester; Dentist (including orthodontist); Engineer; Lab technician or hygienist; Nurse; Optometrist; Pharmacist; Physician; Scientific researcher; Veterinarian
<u>Independent Variables</u>	
Inputs	
Student's gender	1=male 2=female
Background Contextual Affordances	
Socioeconomic status	
Parent with STEM career	0=no 1=yes
Concerns about financing college	1=none, 3=major
Pre-College Learning Experiences	
High School GPA	1=D, 8=A or A+
Math + Verbal SAT Score (in 100-point increments)	Continuous, min =, max =
Years of high school mathematics courses	1=none, 7=5+ years
Years of high school physical science courses	1=none, 7=5+ years
Years of high school biological science courses	1=none, 7=5+ years
Self-efficacy	
Self-rated: Academic ability	1=Lowest 10%, 5=Highest 10%
Self-rated: Leadership ability	1=Lowest 10%, 5=Highest 10%
Self-rated: Mathematical ability	1=Lowest 10%, 5=Highest 10%
Outcome Expectations	
Reason for enrollment: to make money	1=not important, 3=very important
Reason for enrollment: to train for career	1=not important, 3=very important
Career consideration: working for social change	1=not important, 4=essential
Career consideration: high income potential	1=not important, 4=essential
Career consideration: social recognition or status	1=not important, 4=essential
Career consideration: availability of jobs	1=not important, 4=essential
Career consideration: leadership potential	1=not important, 4=essential
Career consideration: discovery/enhancement of knowledge	1=not important, 4=essential
Importance of promoting racial understanding	1=not important, 4=essential
Technical Interests	
Science Identity	Continuous, min =-2.03, max =1.84
Goals	
Aspire to Master's degree (reference group bachelors)	0=no 1=yes
Aspire to Master's doctoral degree (reference	0=no 1=yes

group bachelors)	
Aspire to medical degree (reference group bachelors)	0=no 1=yes
Contextual Influences-College Experiences	
Studied with other students	1=not at all, 3-frequently
Performed community service for a class	1=not at all, 3-frequently
Asked a professor for advice	1=not at all, 3-frequently
Worked full-time while in college	0=no 1=yes
Join a club/org related to major	0=no 1=yes
Faculty provided opportunity for research	1=not at all, 3-frequently
Contextual Influences-Perceptions	
Satisfaction w/ science & math courses	1=can't rate/don't know, 6=very satisfied
Satisfaction w/ leadership opportunities	1=can't rate/don't know, 6=very satisfied
I feel I have a sense of belonging on this campus	1=strongly disagree, 4=strongly agree
Campus racial tension	1=strongly disagree, 4=strongly agree
Contextual Influences-Structural Characteristics	
Institutional selectivity (in 100-point increments)	Continuous, min=, max=
Institutional Control	1 = public, 2 = private
Institutional Type	1 = university, 2 = four-year
Percent of students majoring in STEM in 2006 (in 10-point increments)	Continuous, min =, max =

Factor Loadings

Factor	Items*	URM (*alpha*) Loading	Non-URM (*alpha*) Loading
Science Identity—Freshman Year		(α=.692)	(α=.700)
	Becoming an authority in my field	.663	.651
	Obtaining recognition from my colleagues…	.685	.793
	Making a theoretical contribution to science	.625	.592
	Working to find a cure for health problems	.454	.436

*All items on a 4-point scale, 1=Not important, 4=Essential
See Chang, Eagan, Lin, & Hurtado (in press) for more information

Table 1. Descriptive Statistics

Variables	URM (N=1,477; Institution N=194)				Non-URM (N=1,688; Institution N=195)			
	Mean	S.D.	Min.	Max	Mean	S.D.	Min.	Max
<u>Dependent Variable</u>								
Retained STEM career interest (senior year)	0.53	0.50	0.00	1.00	0.61	0.49	0.00	1.00
<u>Independent Variables</u>								
Inputs								
Student's gender (female)	1.66	0.47	1.00	2.00	1.60	0.49	1.00	2.00
Background Contextual Affordances								
Socioeconomic status	17.64	6.08	3.00	30.00	20.75	5.45	3.94	30.00
Parent with STEM career	0.27	0.44	0.00	1.00	0.27	0.44	0	1.00
Concerns about financing college	1.98	0.63	1.00	3.00	7.17	1.08	1.00	8.04
Pre-College Learning Experiences								
High school GPA	6.79	1.23	2.00	8.00	7.17	1.08	1.00	8.04
Math + Verbal SAT Score (in 100-point increments)	11.44	1.69	6.10	16	12.55	1.60	5.00	16.00
Years of high school mathematics courses	6.00	0.55	2.00	7.00	6.03	0.51	1.00	7.00
Years of high school physical science	3.86	1.27	1.00	7.00	4.12	1.25	1.00	7.00
Years of high school biological science	3.74	1.07	1.00	7.00	3.82	1.03	1.00	7.00
Self-efficacy								
Self-rated: Academic ability	4.08	0.68	1.00	5.00	4.28	0.64	2.00	5.00
Self-rated: Leadership ability	3.73	0.89	1.00	5.00	3.60	0.94	1.00	5.00
Self-rated: Mathematical ability	3.65	0.94	1.00	5.00	3.91	0.90	1.00	5.00
Outcome Expectations								
Reason for enrollment: to train for career	2.78	0.48	1.00	3.00	2.35	0.96	1.00	4.00
Career consideration: working for social change	2.68	0.97	1.00	4.00	2.78	0.90	1.00	4.00
Career consideration: high income potential	2.98	0.87	1.00	4.00	2.29	0.91	1.00	4.00
Career consideration: social recognition or status	2.36	0.94	1.00	4.00	3.04	0.76	1.00	4.00
Career consideration: availability of jobs	3.25	0.75	1.00	4.00	2.73	0.88	1.00	4.00
Career consideration: leadership potential	2.88	0.89	1.00	4.00	3.17	0.79	1.00	4.00
Career consideration: discovery/enhancement of knowledge	3.25	0.78	1.00	4.00	2.10	0.90	1.00	4.00
Importance of promoting racial understanding	2.65	0.97	1.00	4.00	2.35	0.96	1.00	4.00
Technical Interests								
Entering Science Identity	0.04	0.86	-2.03	1.84	-0.04	0.85	-2.03	1.84

Goals								
Aspire to Master's degree (reference group bachelors)	0.21	0.41	0.00	1.00	0.25	0.43	0.00	1.00
Aspire to doctoral degree (reference group bachelors)	0.27	0.44	0.00	1.00	0.34	0.47	0.00	1.00
Aspire to medical degree (reference group bachelors)	0.32	0.47	0.00	1.00	0.23	0.42	0.00	1.00
Contextual Influences-College Experiences								
Studied with other students	2.43	0.58	1.00	3.00	2.43	0.57	1.00	3.00
Performed community service for a class	1.57	0.70	1.00	3.00	1.48	0.63	1.00	3.00
Asked a professor for advice	2.01	0.63	1.00	3.00	1.98	0.64	1.00	3.00
Worked full-time while in college	1.22	0.42	1.00	2.00	1.16	0.36	1.00	2.00
Join a club/org related to major	1.62	0.49	1.00	2.00	1.61	0.49	1.00	2.00
Faculty provided opportunity for research	1.92	0.74	1.00	3.00	1.99	0.75	1.00	3.00
Contextual Influences-Perceptions								
Satisfaction w/ science & math courses	4.90	0.98	1.00	6.00	4.97	0.98	1.00	6.00
Satisfaction w/ leadership opportunities	4.74	1.33	1.00	6.00	4.58	1.41	1.00	6.00
I feel I have a sense of belonging on this campus	3.09	0.72	1.00	4.00	1.90	0.71	1.00	4.00
Campus racial tension	2.00	0.77	1.00	4.00	3.11	0.69	1.00	4.00
Contextual Influences-Structural Characteristics								
Institutional selectivity (in 100-point increments)	11.53	1.41	7.80	15.10	11.76	1.26	8.32	15.10
Institutional Control (private keyed higher)	1.46	0.50	1.00	2.00	1.44	0.50	1.00	2.00
Institutional Type (4 year keyed higher)	1.41	0.49	1.00	3.00	1.38	0.48	1.00	2.00
Percent of students majoring in STEM in 2006 (in 100-point increments)	2.10	1.64	.00	8.90	2.03	1.55	0.00	8.90

Table 2. Hierarchical Generalized Linear Modeling—Results for retained STEM Career Interests (senior year)

Variable	URM (N=1,477) (Institution N=194			Non-URM (N=1,688) (Institution N=195		
	Log Odds	S.E. (sig)	Delta P	Log Odds	S.E. (sig)	Delta P
Inputs						
Student's gender (female)	-0.27	0.14		-0.16	0.17	
Background Contextual Affordances						
Socioeconomic status	0.01	0.01		-0.03	0.01*	-0.73%
Parent with STEM career	0.18	0.18		0.18	0.15	
Concerns about financing college	0.19	0.12		-0.01	0.11	
Pre-College Learning Experiences						
High School GPA	0.15	0.06*	3.72%	0.13	0.08	
Math + Verbal SAT Score (in 100-point increments)	0.05	0.07		0.14	0.07*	3.51%
Years of high school mathematics	0.08	0.14		0.07	0.13	
Years of high school physical science	0.03	0.06		0	0.05	
Years of high school biological science courses	0.04	0.07		0.06	0.07	
Self-efficacy						
Self-rated: Academic ability	0.11	0.11		0.05	0.13	
Self-rated: Leadership ability	0.04	0.09		-0.11	0.09	
Self-rated: Mathematical ability	0.15	0.09		0.17	0.10	
Outcome Expectations						
Reason for enrollment: to train for career	0.39	0.17*	9.40%	0.16	0.14	
Career consideration: working for social change	-0.17	0.10		-0.07	0.09	
Career consideration: high income potential	0.06	0.10		0.14	0.11	
Career consideration: social recognition or status	-0.10	0.09		-0.04	0.08	
Career consideration: availability of jobs	0.16	0.12		0.10	0.10	
Career consideration: leadership potential	-0.27	0.12*	-6.74%	-0.22	0.10*	-5.43%
Career consideration: discovery/enhancement of knowledge	0.2	0.14		0.41	0.10***	9.85%
Importance of promoting racial understanding	-0.01	0.09		0.07	0.10	
Technical Interests						
Entering Science Identity	-0.03	0.09		-0.07	0.09	

Goals						
Aspire to Master's degree	0.18	0.21		-0.05	0.23	
Aspire to doctoral degree	-0.28	0.25		0	0.22	
Aspire to medical degree	-0.02	0.23		0.08	0.21	
Contextual-College Experiences						
Studied with other students	0.4	0.14***	9.66%	0.28	0.14*	6.80%
Performed community service for a class	-0.16	0.13		0.01	0.12	
Asked a professor for advice	-0.21	0.13		-0.13	0.12	
Worked full-time while in college	-0.28	0.18		-0.58	0.18***	-14.38%
Join a club/org related to major	0.43	0.15**	10.46%	0.42	0.14***	10.24%
Faculty provided opportunity for research	0.27	0.10**	6.60%	0.12	0.10	
Contextual Influences-Perceptions						
Satisfaction w/ science & math courses	0.35	0.09***	8.56%	0.07	0.07***	7.51%
Satisfaction w/ leadership opportunities	-0.01	0.06		0.05	0.05	
I feel I have a sense of belonging on this campus	-0.06	0.11		0.10	0.10	
Campus racial tension	0.08	0.10		0.10	0.10	
Contextual - Structural Characteristics						
Institutional selectivity (in 100-point increments)	-0.25	0.08***	-6.15%	-0.18	0.08*	-4.41%
Institutional Control (private—higher)	0.39	0.18*	9.54%	0.3	0.15	
Institutional Type (4 year—higher)	-0.13	0.18		0.11	0.16	
Percent of students majoring in STEM in 2006 (in 100-point increments)	0.14	0.06*	3.56%	0.19	0.07**	4.60%
Intercept	0.23	0.39		0.73	0.46	
Model Statistics						
Chi-square	301.34			345.71		
Intercept reliability	0.08			0.06		
Explained variance at level 2	0.814			0.774		
Baseline probability of retained STEM career interest	0.53			0.61		

*** p<0.001, ** p<0.01, * p<0.05

Table 3. HGLM Model Predicting Retained STEM Career Interests—Cross-sample Comparison

	URM (N=1,477; Institution N=194)			Non-URM (N=1,688; Institution N=195)			
	Log Odds	S.E. (sig)	Delta P	Log Odds	S.E. (sig)	Delta P	Equality of Coefficients t-value
Background Contextual Affordances							
Socioeconomic status	0.01	0.01		-0.03	0.01*	-0.73%	n/a
Pre-College Learning							
High School GPA	0.15	0.06*	3.72%	0.13	0.08		n/a
Math + Verbal SAT Score	0.05	0.07		0.14	0.07*	3.51%	n/a
Outcome Expectations							
Enrolled to train for career	0.39	0.17*	9.40%	0.16	0.14		n/a
Career leadership potential	-0.27	0.12*	-6.74%	-0.22	0.10*	-5.43%	-0.35
Career concern discovery/ enhancement of knowledge	0.2	0.14		0.41	0.10***	9.85%	n/a
Contextual-College Experiences							
Studied with other students	0.4	0.14***	9.66%	0.28	0.14*	6.80%	1.18
Worked full-time while in college	-0.28	0.18		-0.58	0.18***	-14.38%	n/a
Join a club related to major	0.43	0.15**	10.46%	0.42	0.14***	10.24%	0.05
Faculty provided opportunity for research	0.27	0.10**	6.60%	0.12	0.10		n/a
Contextual Perceptions							
Satisfaction w/ science & math	0.35	0.09***	8.56%	0.07	0.07***	7.51%	0.38
Structural Characteristics							
Institutional selectivity	-0.25	0.08***	-6.15%	-0.18	0.08*	-4.41%	-0.60
Percent of students majoring in STEM in 2006	0.14	0.06*	3.56%	0.19	0.07**	4.60%	-0.46

Note: *** p<0.001, ** p<0.01, * p<0.05. t-tests calculated for variables that are significant for both groups