Supporting Future Scientists: Predicting Minority Student Participation in the STEM Opportunity Structure in Higher Education

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The National Association for Research in Science Teaching (NARST)
April 2013
Rio Grande, Puerto Rico

This study was made possible by the support of the National Institute of General Medical Sciences, NIH Grant Numbers 1 R01 GMO71968-01 and R01 GMO71968-05 as well as the National Science Foundation, NSF Grant Number 0757076. This independent research and the views expressed here do not indicate endorsement by the sponsors.

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The United States' ability to achieve its national goals has historically depended on its global leadership in science and engineering. The nation is at risk, however, of losing its competitive edge, demonstrated by recent reports revealing that the domestic investment by other countries in STEM programs now surpasses that of the United States (National Academy of Sciences, 2011). As a result recent national imperatives advocate the need to confer an additional one million STEM degrees over the next decade to ensure the technological innovation necessary for national competitiveness in a global market (PCAST, 2012). If postsecondary institutions are to meet national calls to diversify and bolster the STEM workforce, they must increase the enrollment, retention and graduation of Black, Latino, and American Indian students. Since students from these groups are among the least likely to complete a STEM major (HERI, 2010), the National Academy of Sciences (2011) designates them as underrepresented racial/ethnic minority (URM) students. Improving the persistence of URM students is also a social justice concern, as unequal hierarchies and oppressive structures (Lewis, 2001) impede the academic progress and success of URM students in higher education (Hurtado & Carter, 1997), especially for those who pursue STEM majors (Massey, Charles, Lundy, & Fischer, 2002).

The first two years of college are critical to college persistence and represent a particularly vulnerable time for students (Tinto, 1993). Indeed 40-60% of STEM aspirants switch out of a STEM major within the first two years of taking their first science or math class (Seymour & Hewitt, 1997). There are a number of reasons why students turn away from STEM. For some, unsatisfactory grades - attributed to poor academic preparation in math and science during high school (Henderson & Broadbridge, 2007; Schneider, 2000) and a lack of academic confidence (Armstrong et al., 2011) – prompt students to withdraw from a particular class or from school completely (Arendale, 1998). For many others, including those with strong precollege academic preparatory experiences, poor achievement can be attributed to the pedagogical practices of introductory classes that weed out students instead of harvesting and nurturing talent (Seymour & Hewitt, 1997). Notably even successful students feel discouraged from pursing STEM majors after early encounters with professors who seem unapproachable and inaccessible or appear to lack an overall ethic of care (Eagan, Figueroa, Hurtado, & Gasiewski, 2012). These studies suggest that students' decisions to remain in STEM are in a large way impacted by the educational environment in which they learn.

URM students in particular face a number of challenges that put them at a disadvantage when pursuing a STEM major compared to their majority peers that have much to do with institutional structures that reinforce inequality. According to Massey et al., (2002), URM students are less likely to have the skills needed to navigate the college environment. They also are less likely to have attended a quality school and to have had exposure to rigorous academic preparation in high school that would facilitate the transition into college coursework (Adelman, 2006; Elliott, Strenta, Adair, Matier, & Scott, 1996; May & Chubin, 2003). URM students are more likely to question their academic ability due to negative stereotypes about URM students (Aronson & Inzlicht, 2004). Further, the racial climate can make it difficult for URM students to feel a sense of belonging in college, especially if they are severely underrepresented (Hurtado, Han, Saenz, Espinosa, Cabrera, & Cerna, 2007; Johnson, 2012), which makes them more vulnerable to attrition in the face of personal burdens (Inzlicht & Good, 2006; Walton & Cohen, 2007).

Knowing that students contend with a number of barriers to persistence, it is important to know more about the factors that mitigate the effect of these barriers and help students achieve and persist in STEM majors. The literature on STEM education demonstrates that extracurricular and co-curricular activities boost students' self-confidence, help students define their goals (Link, 2003), provide academic enrichment, offer a sense of guidance and support (Barlow & Villarejo, 2004), and grant students the opportunity to become academically and socially integrated in college life (Astin, 1993). These activities are also associated with greater academic achievement, retention, and persistence. Such co-curricular activities and programs comprise what we refer to as the "STEM opportunity structure," because they support and enhance students' participation in a STEM major, serve as pathways into STEM-related careers, or motivate students to pursue graduate work. Scant research, however, has identified the individual and institutional factors that affect the likelihood that students will have access to and/or become involved in these key co-curricular experiences during their undergraduate career.

The purpose of this paper is to examine predictors of the likelihood that science-oriented students would participate in or have access to different components of the STEM opportunity structure: namely undergraduate research programs, supplemental instruction, major-related clubs or organizations, internship programs, and faculty mentorship and support. This study will be of interest to STEM faculty and student affairs professionals who play an active role in providing these STEM-related opportunities to students with the goal of improved academic success and retention. By identifying the factors that predict access to key college experiences, practitioners can ascertain whether underrepresented racial minority students and other students vulnerable to underachievement in STEM are benefiting from these opportunities. Discrepancies in participation may indicate a need for proactive and early outreach to these students. This study will also advance the existing body of knowledge about how to facilitate the success of STEM students, especially those who come from underrepresented backgrounds.

Literature Review

Co-curricular experiences contribute to students' success in STEM degree programs and open pathways to a career in STEM or graduate work in STEM. The next section of this paper will provide a brief overview of the research regarding undergraduate research, supplemental instruction, major-related clubs and organizations, internships, and faculty mentoring. Institutions provide these activities to help with STEM retention. This study is interested in these interventions because they provide both academic enrichment along with peer and/or faculty support and are therefore part of the STEM opportunity structure.

Undergraduate Research

Of all of the activities within the STEM opportunity structure, the most widely documented in the higher education literature is undergraduate research. An essential component of any research program includes the socialization of students into the culture of a research career thereby increasing students' confidence and skills as a researcher and improving their ability to apply their understanding of science in an experiential setting (Kardash, 2006; Kinkead, 2003; Lopatto, 2003; 2004; Russell, Hancock, & McCullough, 2007; Seymour et al., 2004). Undergraduate research contributes especially to the success of underrepresented minority STEM students; specifically participation increases their likelihood of degree completion, of graduating with a high GPA, and enhances aspirations to pursue a STEM career or graduate degree (Eagan, Hurtado, Chang, Garcia, Herrera, & Garibay, in press; Jones, Barlow, & Villarejo, 2010; Pender, Marcotte, Sto. Domingo, & Maton, 2010; Strayhorn, 2010).

A study by Hurtado, Eagan, Cabrera, Lin, Park, and Lopez (2008) is presently the only study that has identified the factors that predict first-year participation in undergraduate research. Findings from the study indicated that students who participated in first-year experience courses and pre-professional departmental clubs were significantly more likely to participate in health science research in their first year of college. Black students were also more likely to participate in research when they attended institutions that offered undergraduate research experiences to first-year students as part of a structured program.

Supplemental Instruction (SI)

Supplemental instruction is structured time outside of class that complements a traditionally difficult course and provides an enriched learning environment in which an instructor facilitates deeper understanding of course content (Wilson et al., 2011). In contrast to remedial coursework, SIs target courses covering challenging topics, and participation is voluntary, avoiding the stigmatization of mandatory remediation (Arendale, 1997). Some research indicates that students who participate in SI are not significantly different from non-participants with respect to high school grades (Malm et al., 2010), gender, age, standardized test scores, or ethnicity (Arendale, 1998); alternatively other research contends that SI participants have weaker academic backgrounds (Rath et al., 2007) and are more likely to be female (Coletti et al., 2012) or come from URM backgrounds (Peterfreund et al., 2008).

The benefits associated with SI participation are particularly important for students in STEM majors (Armstrong et al., 2011; Blat & Nunnally, 2004; Hands, Reid & Younger, 1997) and provide a positive first experience to students new to the discipline (Malm et al., 2010). Students who have less confidence in their academic preparation and less exposure to the material taught in class are the most likely to benefit from the extra academic help provided by SIs targeting STEM courses (Coletti et al., 2012), with gains being particularly great for URM students (Peterfreund et al., 2008; Rath et al., 2007). SIs offer a significant tool for STEM students to overcome challenges resulting from poor academic preparation in high school (Barlow & Villarejo, 2004). When compared to non-participants, SI participants earn higher final grades (Armstrong et al., 2011; Blat & Nunnally, 2004; Rath et al., 2007) and are less likely to repeat a course (Peterfreund et al., 2008). Since passing introductory STEM classes is necessary for degree progress and the completion of a STEM degree, it is no surprise that SI participants are more likely to progress to subsequent STEM classes in a sequence, (Peterfreund et al., 2008), complete their first year of college (Malm et al., 2010), and graduate in science majors (Rath et al., 2007).

Major-Related Clubs

Participation in STEM-related student clubs or organizations enhances students' educational experiences and is important to the career development of students (Bohlscheid & Clark, 2012). Durham and Marshall's (2012) study on engineering college students demonstrated that major-related clubs provided students with opportunities to befriend, socialize, and study with other members and thereby access more social and academic support, ask questions, and network with professions in their field. Students participating in the engineering clubs stated that they more enjoyed learning, had higher motivation and self-confidence, and more clear educational and career goals as a result of participating in these clubs (Durham & Marshall, 2012). Involvement in major related clubs also gives students access to networks of people who can teach them the rules of science participation (Do et al., 2006).

Another benefit of participation in clubs and internships related to one's STEM major, is that it provides students with critical information on issues facing the profession (Bohlscheid & Clark, 2012). Further, students holding leadership positions in STEM-related clubs develop interpersonal skills and gain skills in time and conflict management, all of which are transferable in the job market and better prepare students for entry-level positions after college (Durham & Marshall, 2012). This might explain why students who participate in clubs and internships tend to secure jobs sooner after graduation (Sagen et al., 2000). Joining a major-related club or organization also has a strong influence on the likelihood that URM students will continue to have an interest in a STEM career (Herrera, Hurtado, & Chang, 2011). Several studies show the importance of participation in departmental clubs for the retention for women of color (Espinosa, 2011) and underrepresented groups (Chang, Hurtado, Sharkness, and Newman, in review).

Internships

Participation in hands-on work experiences related to one's respective STEM discipline enhances the academic experience (Perna, Cooper, & Li, 2007) as students apply what they have learned in the classroom to real-world practical situations and gain an improved understanding of their particular field (Jaeger et al., 2008). Involvement in internships may also give students an opportunity to feel like they are contributing meaningfully to the field, help students learn the norms of science, and decrease feelings of marginalization by integrating the student into the STEM community (Hunter, Laursen, & Seymour, 2007). In one study on engineering students, internships were found to support an engineering student identity, enhance students' self-confidence, and increase their motivation to finish school (Do et al., 2006).

STEM-related work experiences, like cooperative education, can also strengthen a student's commitment to their major and have a positive influence on STEM persistence if the student decides that their major coincides with their career interest (Jaeger et al., 2008). Students who participated in cooperative education (i.e. a short-term real-world professional work experience removed from the university environment) had higher final GPAs and were more than five times more likely than non-participants to persist in their STEM major (Jaeger et al., 2008). Internships can additionally be a gateway to gainful employment after graduation for STEM students (Do et al., 2006), and URM students in particular (Inroads, 1993), as they help students build a professional network (Do et al., 2006), and better prepare students for their first job in STEM (Jaeger et al., 2008).

Faculty Mentoring and Support

Although a plethora of studies examine student-faculty interactions broadly, we do not consider happenstance and haphazard interactions to be part of the opportunity structure because these types of interactions do not have a significant impact on students' academic and career trajectories in STEM. Instead, this study is interested in deliberate mentoring and support from faculty, in which faculty sponsor (i.e. provide letters of recommendation), coach, role model, and counsel (Kram, 1983) students. Indeed researchers have linked faculty mentorship and support to increased student GPAs (Strayhorn, 2009), improved performance in introductory STEM courses (Tsang et al., 2006), and improved overall retention in science (Packard, 2004). The mentoring relationships students establish with their undergraduate research advisors also have a great impact on the effectiveness of undergraduate research experiences (Thiry & Laursen, 2011).

Although there are a variety of studies exploring the benefits of faculty mentorship, only one examines the factors that predict the likelihood of students receiving such support (Eagan, Herrera, Garibay, Hurtado, & Chang, 2011). Findings demonstrated that high achieving students and students who were already more likely to be successful in STEM (such as those who enter college with high SAT scores, have graduate school aspirations, or a strong science identity) were most likely to have access to faculty mentoring and support. As a result of the findings, the authors encourage faculty to reach out and provide mentorship to a wider pool of students, especially those that don't fit the typical notion of a "high-achieving" student.

Conceptual Framework

We draw from frameworks regarding goal setting, social capital, and institutional context to investigate the factors that promote and reduce a student's likelihood of engaging in different experiences within the opportunity structure during college.

Individual Factors

Various student demographic characteristics impact the degree to which students engage in certain activities in college. Students who demonstrate high levels of academic achievement, aspirations, and savvy have a greater propensity to seek out and access opportunities that will help them achieve their career or educational goals (Green & Bauer, 1995; Wanber, Welsh, & Hezlett, 2003). This phenomenon is known as the “rising star” hypothesis (Ragins, 1999; Singh, Ragins, & Tharenou, 2009).

Individual effort alone however does not explain why some students are highly involved in college and why others are not (Braxton, 2000; Tierney, 1992). URM undergraduate students in particular confront multiple structural barriers to academic success including little explicit guidance on how to navigate the college environment (Massey et al., 2002), negative perceptions of underrepresented racial groups (Schwitzer, Griffin, Ancis, & Thomas, 1999), and inadequate financial aid prompting serious concerns about financing college (Hurtado, Han, Saenz, Espinosa, Cabrera & Cerna, 2007). Many of these barriers are also reflected within the social and institutional factors that either ease or restrict access to the structure of opportunity for different students.

Social Factors

Students with expansive social networks are more likely to identify and access activities within the opportunity structure. Indeed institutional agents (like faculty and administrators) equip students with the knowledge, social networks, resources, and experiences to which they would not typically have access (Stanton-Salazar, 1997; 2001; 2010). Stanton-Salazar’s (2010) Institutional Agents framework acknowledges that there are inequalities in access to valued resources and opportunities due to differences in social capital (Stanton-Salazar, 1997) and cultural capital, which are largely influenced by class, race, and gender (Bourdieu, 1986, Bourdieu & Passeron, 1977). This theory illuminates the privileged position of some students in relation to others and demonstrates the importance of these support agents in empowering and advocating for students, and broadening access to opportunities for students from disadvantaged social positions. Faculty, as the primary agents of socialization, also have the ability to orient students to institutional and disciplinary norms and the acceptable dispositions within science (Becher, 1989), thereby better positioning students to navigate higher education institutions.

Institutional/Structural Factors

Various institutional characteristics including selectivity, size, research orientation, and type shapes the availability of structured opportunities available to students (Porter, 2006), the extent to which institutions are culturally responsive to student needs (Outcalt & Skewes-Cox, 2002), and the culture around student engagement (Merkel, 2003). Ultimately institutional contexts matter, and matter greatly, with regard to how productive institutions are relative to others in engaging students, integrating them into campus life, and developing their talent in STEM (Porter, 2006; Chapman & Pascarella, 1983; Hamrick, Schuh, & Shelley, 2004).

Methods

Data and Sample

The data for this sample is drawn from the Cooperative Institutional Research Program (CIRP) 2004 Freshman Survey and follow-up 2008 College Senior Survey. The Freshman Survey (TFS) is administered to first-time freshmen students during freshman orientation or during their first term in college and collects demographic information and information about students' precollege experiences, attitudes, values, goals, self-perceptions, and expectations for college. College seniors complete the College Senior Survey (CSS) in the spring of their fourth year, and this instrument collects information about the experiences students had while in college as well as their self-perceptions, values, attitudes, career aspirations, and post-graduation plans. The longitudinal response rate for the 2004 TFS and 2008 CSS was approximately 23%. Response weights were calculated to adjust for potential non-response bias. The full longitudinal dataset includes information from 6,224 students at 238 institutions. Institutional data for the 2006-2007 academic school year was taken from the Integrated Postsecondary Education Data System (IPEDS) and merged into the longitudinal data set.

Eagan et al. (in press) provides more information on the sampling and weighting strategies applied to this dataset. The final analytic sample included 4,046 students attending 212 institutions who indicated that they aspired to a STEM major at the start of their undergraduate studies.

Variables

This study analyzes five dependent variables: 1) participated in an internship program, 2) participated in an undergraduate research program, 3) joined a club or organization related to one's major, 4) had instruction that supplemented coursework; and 5) frequency study received faculty mentorship and support. For dependent variables one through three, students had the option of marking yes or no to indicate whether they participated in the respective activity. For the fourth dependent variable, students marked how often they had instruction that supplemented coursework (not at all, occasionally, or frequently). The faculty mentorship and support construct measured the extent to which students and faculty interacted in relationships that fostered mentorship, support, and guidance, in both academic and personal domains. This score was determined by CIRP using item response theory, and items included students' reports of the frequency with which faculty provided nine support activities (see Appendix B for a list of these items). Responses were on a three-point scale: not at all, occasionally, and frequently. A higher score on faculty mentorship indicated a greater degree of a mentoring relationship with faculty. (See Sharkness, DeAngelo, and Pryor, 2010, or CIRP Construct Technical Report, 2010, for more information on the creation of the various constructs used in this paper.)

To analyze each of the five outcomes described above, we relied on a common set of predictor variables. Prior literature on student engagement and our conceptual frameworks on goal setting, social capital, and institutional context guided selection of the variables used in the models. In our analyses, we added variables in conceptually related, temporally sequenced blocks. First, we included student demographic characteristics (e.g., sex, racial/ethnic background, and socioeconomic status) in the models. Next, we added several pre-college measures (e.g., prior academic preparation, high school activities, and degree aspirations) to the models to see if any observed differences between groups could be accounted for by differences in these areas. Third, we added students' college experiences and attitudes measured on the CSS to the models. Finally, institution-level variables were added in the last block, and these measures included structural characteristics of the institution such as size, selectivity, and control. We ran identical models for each of the five dependent variables, with the exception that we used each dependent variable as an independent predictor in the models for the other four outcomes. Appendix A contains a complete list of variables in the analysis and their corresponding coding schemes, and Appendix B provides the individual items included in the model.

Analysis

Missing Data

In order to maximize the sample available for analysis, missing data were replaced, wherever appropriate, in a multi-step process. First, we removed from our sample all students who had missing data on one of the dependent variables and students who were missing information on key demographic characteristics such as gender, race, or native language. In total, 19 students were missing information in one or more of these areas (< .5%). For the remaining variables of interest, we analyzed the extent to which missing data occurred. Overall, there was very little missing data; only three variables had more than 3% of its cases missing. The variable with the highest proportion of missing data was students' degree aspirations at college entry at 9.4%, followed by parental income at 8% (used to create the SES factor) and SAT composite score at 6.5%.

Given the relatively few instances of missing data across the variables used in the analysis, we imputed missing data using the expectation-maximization (EM) algorithm in SPSS. The EM algorithm employs maximum likelihood estimation techniques to impute values for cases with missing data. Because EM uses most of the information available in the dataset to produce the imputed values, it is a more robust method of dealing with missing data than listwise deletion or mean replacement (Allison, 2002; Dempster, Laird, & Rubin, 1997; McLachlan & Krishnan, 1997). Distributions of variables were compared before and after missing values were imputed, and were found to be virtually identical.

Multi-level Analysis

The clustered, multi-level nature of our data necessitated the use of hierarchical linear modeling (HLM) for the continuous dependent variables and hierarchical generalized linear modeling (HGLM) for the dichotomous dependent variables. Performing single-level analyses with multi-level data can underestimate the standard errors of model parameters, increasing the likelihood of committing Type-I statistical errors (de Leeuw & Meijer, 2008; Raudenbush & Bryk, 2002). To ensure the use of multi-level techniques was justified, a fully unconditional model (i.e., a model with no predictors) was run to assess the extent to which our outcomes varied across the institutions in our sample. For the dichotomous outcome variables (participated in research, a major-related club, and internships), the null models showed that the between-institution variance components for all three outcomes significantly varied across institutions. Given this significant variation and our interest in the examining how institutional contexts both directly affect students' likelihood of participation in the opportunity structure and moderate individual-level relationships, we proceeded with the use of HGLM. For the continuous outcome variables (i.e. faculty mentorship and participation in SI) we calculated the amount of the variance that was due to differences between institutions. For faculty mentorship, roughly 11.7% of the variation in scores is attributable to differences between institutions. Although only 2.4% of the variation in students' frequency of participation in SI was attributable to institutional differences, we proceeded with HLM analyses for this outcome due to our interest in examining the role of institutional context.

Since we were interested in the average effect of each predictor on students' participation across the five activities in the opportunity structure that we examine, we chose to grand-mean center all continuous and ordinal variables. Dichotomous variables were left un-centered because a zero value on these variables is meaningful.

Limitations

One of the primary limitations with this data set is that it only includes the responses of students who persisted to the fourth year of college. The students in this dataset, who successfully managed to stay in college until their senior year, were probably very different from the students who aspired to major in STEM during their freshman year of college but transferred to another university or dropped out of school completely. Regrettably, no data is available on these students. There is a possibility that student dropouts or transfers had differential patterns of participation in the various activities in the opportunity structure and had different college experiences than those who persisted at the same institution after four years.

A related limitation of our study is that the CSS had a relatively low longitudinal response rate (23%), and thus the extent to which our results can be generalized to a larger group of students may be limited. Although we attempted to correct for non-response bias that may have been introduced by the low response rate, our correction was necessarily limited to the information we had available, and we may not have taken all of the important factors into consideration. Also, a number of the independent variables in this study are self-reported (i.e. GPA, SAT scores) and it is possible that students' answers do not accurately reflect what actually occurred. Previous research however demonstrates high overall validity of self-reported scores on academic performance (Cole & Gonyea, 2010).

Finally, as our dependent variables were taken from the 2008 CSS, our dependent variables were measured at the same point in time as many of our independent variables. Therefore we cannot assume a causal relationship between the dependent variables and those independent variables measured in 2008. Our purpose is to identify the experiences that are associated with a greater or lesser probability of participating in the STEM opportunity structure; thus the establishment of causation is not necessary to address the focus of our study.

Results

Descriptive Statistics

Table 1 provides descriptive statistics for variables in the model. Roughly 40% of students self-identified as White, 16% as Latino, 15% as Black, 12% as Asian, and 15% as belonging to two or more racial groups. Less than 1% of students identified as American Indian or indicated “other.” Approximately 62% of the students were female. The results show that 46% of students who aspired to major in STEM at college entry participated in an internship program by the fourth year of college, 20% participated in an undergraduate research program, and 60% joined a club or organization related to their major. The average faculty mentorship score for STEM aspirants was 48.43 (which is slightly below the population average for faculty mentorship) and 85.6% of students had instruction that supplemented their coursework at least occasionally.

HLM and HGLM Models

We begin by presenting the HLM results for supplemental instruction and faculty mentorship, found in Tables 2 and 3, respectively. We summarize the results for the three dichotomous dependent variables in Table 4. For significant parameter estimates in Table 4 we have corresponding delta-p statistics, which represent the expected change in probability associated with a one-unit increase from the mean of the independent variable (Cruce, 2009; Petersent, 1985).

Supplemental Instruction (SI)

Demographic characteristics account for 0.68% of the student-level variance in the frequency of participation in SI. This proportion rises to 1.8% after adding students' precollege experiences into the model and jumps to 16.1% once college experiences are accounted for. The level-one variance drops to 5.74%, however, once institutional-level variables are added to the model, which indicates a poorer fit model at the student-level. Further, none of the institutional variables reaches significance in the final model, meaning differences in the probabilities of participating in supplemental instruction is not explained by attendance at different types of institutions. Although we do not discuss the results from the model containing institutional variables, we include the results from this model in Table 2 so that readers can see the coefficients and p-values for the various institutional variables that we examined. Below is a discussion of the best-fit model, which accounts for 16.1% of the student-level variance.

Students who are non-native English speakers utilize supplemental instruction more frequently than native English speakers; no other demographic characteristics are significant. It's possible that some of the assistance non-English native speakers receive in SI is related to learning new concepts in a language they are still learning. Further, students who had participated in summer research programs during high school tend to participate in SI more often than those who do not. A handful of college experiences also seem to matter in predicting how frequently students utilize SI. Students who work on independent study projects, study with or tutor their peers, or ask a professor for advice outside of class tend to engage more frequently in supplemental instruction. Further, joining a club or organization related to one's major, participating in an academic program for racial/ethnic minorities, and spending more hours per week socializing with friends are associated with more frequent use of supplemental instruction. Perhaps peers influence each other to seek out the resources needed to succeed academically. Student perceptions of faculty also matter: higher agreement with the statement that faculty at the institution care about students' academic problems is associated with more frequent use of SI. Students who are more academically disengaged also more frequently use SI. This is a curious finding given that we would expect a student who enters coursework more disengaged to be less likely to seek out supplemental instruction. This finding indicates that students who are disengaged and unsuccessful in the regular classroom have to seek additional help in supplemental instruction. Thus SI serves both students who are really engaged and students who are not very involved in the regular science classroom. Finally students who are more satisfied with the courses in their major, have a higher sense of belonging, have more positive cross-racial mentorships, and receive higher levels of faculty mentorship tend to more frequently engage in supplemental instruction.

Faculty Mentoring and Support

Demographic variables explain a very small percentage (0.57%) of the student-level variation in the frequency with which students receive faculty mentorship, which increases slightly to 3.72% with the addition of precollege experiences into the model. Including college experience variables to the model increases the proportion of level-1 variance explained by the model to 50%, which then drops to 43.9% when institutional variables are added. A number of institutional variables significantly predict the frequency with which student received faculty mentoring. Students attending smaller institutions, master's comprehensive universities (compared to liberal arts colleges), and HBCUs tend to receive more frequent faculty mentorship. Students also tend to receive more frequent faculty mentorship at institutions where the student body agree more strongly that the faculty at their institution are interested in students' personal problems. Students at institutions that have a higher proportion of White students and lower proportion of STEM students also have higher faculty mentorship scores; this was over and above institutional size and HBCU status.

Although there are no significant differences by gender in the final model, we did detect significant differences by race/ethnicity with regard to the frequency with which students receive faculty mentorship and support. Multiracial students appear to have less frequent mentorship activity from faculty than their White peers. Further, a greater concern about financing college and higher SAT scores predict receiving less mentorship from faculty. Students who spent more hours per week talking to teachers outside of class in high school also have more frequent mentorship from faculty in college, likely because they continue this behavior in college, a finding that supports the rising star hypothesis. Student aspirations at college entry also have a significant impact on the extent to which they receive mentorship from faculty. Compared to their peers who aspire to a bachelor's degree, students who are interested in an associate's degree or no degree have less frequent mentorship from faculty, while those who aspire to a master's degree have more frequent mentorship interactions with faculty. The latter finding is important because students who plan to apply to graduate school need guidance and sponsorship from faculty to increase their chances of gaining admission into top programs.

The college environment and a number of college experiences also matter when it comes to the extent to which students receive mentoring from faculty. Students majoring in engineering and mathematics have less frequent mentoring and support from faculty than their peers who switch to non-STEM majors—a finding with important implications for retention in these majors. Having a higher college GPA and placing a higher importance on the discovery or enhancement of knowledge to one's career path are both associated with more frequent faculty mentorship. Students who at some point in their college career enroll in an honors or advanced college course, participate in a program to prepare for graduate school, or present research at a conference typically receive more frequent faculty mentorship. Students who more often work on independent study projects, meet with an advisor or counselor about their career plans, ask a professor for advice outside of class, or utilize supplemental instruction, tend to be the recipients of more frequent faculty mentorship and support. Since many of these activities are help-seeking behaviors, it is not surprising that they relate to receiving more frequent support from faculty. Alternatively students tend to receive less faculty mentorship if they more frequently feel intimidated by their professors or feel isolated from campus life. Students' opinion of the faculty in their institution also significantly associates with the extent to which they receive mentoring from faculty: students who more strongly agree with the statements that faculty at their institution are interested in both students' academic and personal problems tend to receive greater mentorship. This finding was expected as students who receive more support ought to perceive greater faculty concern for their academic welfare. Students who report greater satisfaction with the racial/ethnic diversity of the student body and with the courses in their major field tend to enjoy more frequent mentoring from faculty. Finally students who are more academically disengaged tend to receive less faculty mentoring. Although we can't be sure, it is possible that students start to disengage in college after having experienced a lack of faculty attention.

Internship Programs

Two institutional variables significantly predict students' likelihood of participating in an internship program. Specifically, a 100-point increase in the average SAT score of an institution's incoming freshman class (indicating greater institutional selectivity) increases STEM aspirants' likelihood of participating in an internship program by 4.51%. Even more pronounced is the effect of institutional control; enrolling in a private as opposed to a public institution increases the probability of participating in an internship program by 13.89%.

In addition to institutional characteristics, several background attributes significantly predict STEM aspirants' probability of participating in an internship. Students from higher SES backgrounds are more likely to participate in an internship program. Students are less likely to participate in an internship program if they place a greater importance on enrolling in college to prepare for graduate or professional school (-5.21%) or score higher than average on the SAT (-2.53%). Internship participation may be strongly linked to students' goals, with students having aspirations for graduate school and higher SAT scores potentially having career or educational goals that do not necessitate participation in internships. There are no differences by race or gender in the likelihood of participating in an internship program.

We saw significant variation in participation in internships across student major. Students in majors not included in our broader aggregated categories but still classified as STEM (7.71%), and engineering students (26.57%) are more likely to participate in an internship than their peers who switch to a non-STEM major. This suggests that internships are more characteristic of the training students receive in engineering – perhaps because internships are connected to the acquisition of jobs - compared to the training received in other major field. Alternatively those who major in a health profession program (i.e. nursing, pre-med, pre-pharmacy, pre-dental, pre-vet) are 12.05 percentage points less likely to participate in an internship program than students who switch to non-STEM majors. Further, higher average grades during college are associated with a greater probability (2.81%) of participating in an internship program, which may be due to a selection process in which the more competitive internships take only the highest achieving students.

Student experiences in college have particular salience in predicting whether they participate in an internship program. Students who fail one or more courses (-10.42%) or work full-time while attending school (-6.56%) are less likely to participate. Alternatively, students have higher probabilities of participating in an internship if they enroll in honors or advanced level college courses (7.18%), participate in an academic program for racial/ethnic minorities (10.05%), join a club or organization related to their major (10.9%), or present research at a conference (10.11%). Spending more hours per week working for pay off campus (1.03%) and career planning (7.25%) is associated with a higher likelihood of participating in an internship program, which is an expected outcome given that some internships are paid. Interestingly, students who more strongly agree that faculty at their institution are interested in students' academic problems (-4.46%) and who are more satisfied with the racial/ethnic diversity of the student body (-2.87%) are less likely to participate in an internship. Further exploration will be necessary to explain these preliminary findings. Finally every one-standard deviation (S.D.=10) increase from the mean in students' academic self-concept predicts a 4.48 percentage point increase in students' probability of participating in an internship.

Undergraduate Research Program

The same institutional variables that predict participation in an internship also predict participation in an undergraduate research program: a 100-point increase in the average SAT scores of an institution's incoming freshman class is associated with a 4.55% increase in likelihood that a student participates in a research program. In contrast to the likelihood of having an internship, students at private institutions are 8.65% percent less likely to participate in research programs in comparison to their peers attending public colleges and universities. Student demographics and background characteristics also matter. Black students are much more likely (16.27%) than White students to participate in undergraduate research programs. This finding is especially encouraging given previous research on the importance of undergraduate research for the persistence of underrepresented racial minority students in STEM (Russell et al., 2007). Students whose parents do not work in a STEM-related occupation have a higher probability (4.6%) of participating in research programs. High school academic preparation and achievement also play significant roles in students' chances of being engaged in research programs. Students' probability of participating in a research program increases by 2.58% for every 100-point increase in their SAT score from the mean. Oddly, students who took more years of physical science courses in high school are less likely (-1.54%) to participate in an undergraduate research program during college. Degree aspirations are a significant and large predictor of participation in a research program. Specifically, students who upon college entry reported that they aspired to attain a doctoral degree are 9.51% more likely to participate in a research program.

Student major also significantly predicts participating in an undergraduate research program. Students majoring in the biological sciences (13.89%) and the physical sciences (23.54%) have much higher probabilities of engaging in an undergraduate research program than their peers who switch to a non-STEM major. Alternatively, students majoring in a health profession field are 9.93 percentage points less likely to engage in an undergraduate research program. Difference in participation in research may be in part due to differences by department in faculty involvement in research programs; departments that are funded by external grants from NIH and NSF may offer more opportunities for students to participate in research. Further a greater importance placed on the discovery or enhancement of knowledge to one's planned career and a higher college GPA are associated with increased chances of having participated in an undergraduate research program. A selection process that exists on some campuses, in which students with higher GPAs are more likely to be selected to participate in undergraduate research programs, may explain the GPA finding.

Various college experiences also significantly predict the likelihood of participating in a research program. Working full-time while attending school (-7.98%) is associated with a reduced likelihood of participating in an undergraduate research program. In contrast, students who participate in a program to prepare for graduate school (20.61%) and present research at a conference (35.02%) tend to have a greater likelihood of engaging in an undergraduate research program. It may, however, be the case that research participation later leads to presenting research and preparing for graduate school, instead of vice versa. Additionally, the more frequently students work on an independent study project the more likely (6.12%) they are to engage in undergraduate research. Student perceptions also contribute to the likelihood that students engaged in research. Specifically a one-unit increase in agreement (signifying greater agreement) with the statement that faculty at the institution are interested in students' academic problems is associated with a 5.06 percentage point increase in the probability of participating in a research program. Conversely a one-unit increase in agreement in the statement that there is strong competition among most students for high grades at the institution is associated with a 2.6% decrease in the odds of engaging in an undergraduate research program. Previous research has linked perceived competitiveness of the campus academic environment with more difficulty in adjusting and transitioning to the science environment for first year students (Hurtado et al., 2007) and diminished STEM persistence for students (Hurtado, Eagan, & Hughes, 2012); perhaps some of this effect results from having to compete with other students for limited opportunities like undergraduate research.

Major-related club or organization

Institutional selectivity is the only institutional variable that significantly predicts a student's likelihood of joining a major-related club or organization. Specifically a 100-point increase in the average SAT score of the incoming freshman class is associated with a 7.98% *decrease* in students' probabilities of participating in a major-related club. Stated another way, students at less selective institutions are more likely to participate in major-related clubs and organizations than those at more selective institutions. Students who had higher high school GPAs and research experience prior to college have an advantage in participating in a major-related club: a one-unit increase in high school GPA is associated with a 3.98% increase in one's odds of participation. Students who during high school participated in a health science research program sponsored by a university are 14.47 percentage points more likely to join a major-related club.

Although working full-time decreases students' odds of joining a major-related club by 6.36%, enrolling in honors or advanced college courses (5.66%), presenting research at a conference (8.33%), participating in an internship program (10.77%), taking part in a program to prepare for graduate school (7.77%), and being involved in an academic program for racial/ethnic minorities (8.63%) all increase students' likelihood of joining a club or organization related to their major. A one-unit increase in the frequency (indicating a greater frequency) with which students discuss course content outside of class (6.87%), tutor another college student (4.69%), ask a professor for advice outside of class (5.32%), or utilize supplemental instruction (4.07%) augment the odds a student participates in a major-related club. Time spent on various activities also significantly predicts students' chances of participating in a major related club. Students who spend more time commuting to campus are less likely (-2.37%) to participate in major-related clubs. Alternatively, students who spend more time talking with faculty outside of class (3.69%) or career planning (2.13%) are more likely to participate in these clubs or organizations. Students who more strongly agree with the statement that there is strong competition among students for high grades are more likely (4.64%) to join a major-related club. Finally, a stronger sense of belonging is associated with a higher probability of joining a major-related club: specifically a one-standard deviation increase in sense of belonging is associated with a 3.58% increase in the chances that students are involved in such a club. This could be evidence that major-related clubs and organizations, like other opportunities for student involvement with peers and faculty, create a sense of community and increase students' sense of belonging on campus.

Discussion and Conclusion

Activities that boost student's self-confidence, help them define their goals (Link, 2003), provide academic enrichment, a sense of guidance and support (Barlow & Villarejo, 2004), and the opportunity to become academically and socially integrated in college life (Astin, 1993) are associated with greater academic achievement, retention, persistence. Such activities comprise what we have termed the "STEM opportunity structure," because they support and enhance students' participation in a STEM major, and serve as pathways to STEM-related careers or motivate students to pursue graduate work. With this in mind there, are several findings from our study that merit discussion.

First, out of all the variables we tested, the most reoccurring college experience that was detrimental to students' ability to participate in the opportunity structure is working full-time while attending school. Indeed, working full-time while attending school significantly reduces the chances that students participate in an internship program, engages in an undergraduate research program, or joins a major-related club or organization. Previous research offers an explanation as to why this is the case: more time spent in paid employment means less time to participate in co-curricular opportunities that integrate students into college life (Pascarella & Terenzini, 2005; Riggert et al., 2006). When considering this finding in light of other findings from our study—namely that students from lower socioeconomic backgrounds are less likely to participate in internship programs and more serious concerns about one's ability to finance college translate to less frequent faculty mentorship—it becomes clear that financial barriers are a considerable issue for some students. As outlined in our conceptual framework, we fully expected financial concerns to be a barrier for underrepresented students (Hurtado, Han, Saenz, Espinosa, Cabrera & Cerna, 2007); however, the findings from this study indicate that financial issues burden students more broadly. Since careers in STEM tend to be among the most prestigious and lucrative, it is a shame that students pursuing STEM as a means to upward social mobility are the very students that may be the least likely to access activities that support their success and increase their chances of securing a career in STEM. Thus, institutions must investigate how they can better support students who likely have the capability to succeed in college, but have unmet financial need. It might be the case that students who work full-time are unaware of the financial assistance they are eligible to receive or do not know how to apply for it, and therefore are not taking advantage of the available aid (Torres et al., 2010). The shift from need-based aid to merit-based aid is worrisome given that low-income students also tend to be academically average students (Torres et al., 2010), which has great implications for socioeconomic equity in access to higher education and the opportunity structure in STEM on college campuses.

Second, entering college with higher degree aspirations set the stage for future engagement in the opportunity structure. Specifically, all else being equal, students who aspire to attain a graduate or professional degree are more likely to participate in the co-curricular activities we investigated. Contrary to expectations, however, pre-college academic achievement is not a consistent positive predictor of participation in the opportunity structure. For example although SAT score is a positive predictor of participation in an undergraduate research program, having higher SAT scores reduces the likelihood that students will be involved in an internship program and reduces the frequency with which students receive mentorship from faculty. Differential involvement in internships, however, may be indicative of the different types of goals students possess and the types of internships offered on a college campus.

Although pre-college academic achievement doesn't appear to make a significant difference in participation in the opportunity structure, academic achievement once in college matters a great deal. Specifically, high achieving college students (as measured by overall college GPA) are notably more likely to participate in an internship program or an undergraduate research program and more frequently receive faculty mentorship and support. Similarly, students who enroll in honors or advanced courses are significantly more likely to participate in an internship program or join a major-related club or organization, and also tend to receive more frequent faculty mentorship. These findings suggest that students who are already best prepared and possess the requisite social capital for STEM success are more likely to access the structure of opportunity in STEM. This *is* consistent with the rising star hypothesis -

the assertion that the best-prepared and high-achieving students will be the most likely to engage in these activities, (Singh, Ragins, & Tharenou, 2009). Perhaps institutions and institutional agents should better leverage their resources to support the talent development of STEM aspirants, as participation in activities within the opportunity structure appear to be driven by selection effects that prefer only the most talented students. Further, perceptions of competition diminish the involvement of students who can do well in science, have great STEM aspirations and ambition, and could thus benefit greatly from these opportunities.

Third, when all else is held constant, demographic variables in the final models did not seem to have a consistent and large predictive role in determining whether or not, or the extent to which students participated in various activities within the educational opportunity structure. It is noteworthy that although demographics aren't significant, experiences and traits that tend to be correlated with certain demographic characteristics are determinative of students' participation in the opportunity structure.

Fourth, we saw demonstrated differences in participation in the opportunity structure by major: engineering students have higher probabilities of participating in internships than students who switch out of STEM, which is expected given that an engineering bachelor's degree is a professional degree and thus those pursuing one are likely to be career-oriented (IEEE, 2007). By contrast, biological and physical science students have a greater likelihood of engaging in undergraduate research, which corresponds to a greater likelihood of pursuing graduate school within these fields (Hathaway, Nagda, & Gregerman, 2002). Engineering and math majors tend to receive a lesser amount of faculty mentorship compared to STEM aspirants who later switched out of STEM. Students in health professional majors are more likely to join a major-related club or organization, which may be indicative of the plethora of student chapters of professional associations in the health sciences on today's campuses.

Fifth a handful of key college experiences open the door to increased participation in the opportunity structure. These college experiences include being involved in independent student projects, partaking in graduate school preparation programs, participating in academic programs for racial/ethnic minorities, and presenting research at a conference, all of which are associated with an increased participation in at least three of the five dependent variables. It is important to keep in mind however, that involvement in these college experiences may have occurred as a result of participating in other activities within the opportunity structure. That is many of the STEM interventions are designed to capture these activities. Moreover, faculty and other STEM practitioners are often involved in activities available in the opportunity structure. Participation in these activities thus provides students more intimate access to institutional agents who can assist in their socialization into the STEM discipline (Stanton-Salazar, 1997; 2001; 2010). These experiences also help students develop a broad support network of peers and thereby help students cultivate the requisite cultural and social capital needed to succeed in STEM.

Given the poor retention and graduation rates of underrepresented minorities in STEM disciplines (HERI, 2010), it was encouraging to find that involvement in an academic program for racial/ethnic minorities promotes student participation in internship programs, membership in clubs or organizations related to one’s major, and more frequent utilization of supplemental instruction. Academic programs for racial/ethnic minorities may open the doors to other beneficial opportunities by helping URM students overcome the challenges that they are more likely to face such as negative stereotypes (Aronson & Inzlicht, 2004) and little knowledge of how the college system functions and how to navigate it (Torres, Gross, & Dadashova, 2010). These programs may also provide crucial social support to students who participate in them. Although, our variable measuring involvement in academic programs for racial/ethnic minorities does not provide any specific information about the type of support students receive in these programs, our findings demonstrate that academic programs targeting racial/ethnic minorities increase involvement in activities that support STEM success. Future research should investigate which elements of these academic programs propel participants to become increasingly engaged. It would also be interesting to determine whether these programs have a differential impact on students by race, gender, or SES.

Finally, given our interest in the examining how institutional contexts impact participation in the opportunity structure, it is informative to find that different types of institutions appear to better facilitate student involvement in activities within the opportunity structure compared to others. Specifically, private institutions and more selective institutions are better positioned to promote participation in internship programs. It's possible that these types of institutions, which already have vast amounts of institutional resources, have strong relationships with local industry that ease placement. More selective public institutions alternatively increase the odds that students participate in undergraduate research programs. This is an expected finding given that selective, public institutions tend to be land-grant institutions or large public research universities, which in turn are well resourced for research (Mumper, Gladieux, King, & Corrigan, 2011). Students at less selective institutions alternatively are more likely to join a club or organization related to their major, which may be indicative of students placing a heavier reliance on informal sources of support and professional development in the face of fewer formal opportunities to support their success in STEM. Taken together, these findings support the assertion that context matters with respect to student engagement in the opportunity structure.

This study extends research on STEM persistence by identifying the educational experiences and institutional contexts that contribute to student access and involvement in the opportunity structure. Such research is especially timely given the inequitable educational outcomes of certain groups of students – namely underrepresented racial minority students – in STEM education. An overarching finding is that students who participate in one aspect of the opportunity structure are also more likely to participate in other opportunities. The fact that the advantages and benefits associated with the activities in the opportunity structure accrue (Hurtado, Eagan, Cabrera, Lin, Park, & Lopez, 2008), underscores the need for early student access to and participation in these experiences. Further, although it is ultimately up to individual students to decide to become involved in those activities within the opportunity structure, it is the institution's responsibility to first create campuses that "are ripe with opportunities for students to be engaged" (Wolf-Wendel et al., 2009, p. 425) and to actively and aggressively encourage students from vulnerable backgrounds to participate. To this end, institutions should early on disseminate information widely that informs students about such opportunities, outlines the career and educational benefits resulting from involvement, and ensures that students have the navigational skill to equitably take advantage of the opportunities and become involved. In this way STEM educators can better ensure that all students who aspire to pursue study in a STEM field, especially those who stand to benefit the most, receive varied and multiple forms of exposure to activities that can help them succeed academically, develop their talent, and secure a future in STEM.

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Table 1. *Descriptive statistics* n=4046 students; n= 212 institutions

Variable	Mean	S.D.	Min.	Max
Dependent Variables				
Participated in an internship program	0.46	0.5	0	1
Participated in an undergraduate research program (e.g. MARC, MBRS, REU)	0.2	0.4	0	1
Joined a club or organization related to major	0.6	0.49	0	1
Had instruction that supplemented course work	2.14	0.64	1	3
Faculty mentorship	48.43	9.62	27.33	66.99
Demographic Characteristics				
English native language	0.85	0.36	0	1
Gender (Female)	0.62	0.48	0	1
Native American	0.01	0.09	0	1
Asian American	0.12	0.32	0	1
Black	0.15	0.36	0	1
Latino	0.16	0.36	0	1
White	0.4	0.49	0	1
Other	0.01	0.09	0	1
Multiracial	0.15	0.36	0	1
Socioeconomic Status (SES)	0	1.1	-2.85	1.72
Pre-college preparation, achievement and experiences (Responses taken from 2004 TFS)				
High School GPA	6.96	1.19	1	8
Years of Mathematics in H.S.	6.01	0.53	1	7
Years of Physical Science in H.S.	4.03	1.26	1	7
Years of Biological Science in H.S.	3.79	1.04	1	7
Participated in a summer research program	0.13	0.33	0	1
Participated in a health science research program sponsored by a university	0.06	0.24	0	1
Enrolled in college to prepare for graduate/professional school	2.69	0.58	1	3.12
Hours per week: Talking with high school teachers outside class	2.68	1.01	1	8
Concerns about ability to finance college education	1.87	0.64	1	3
Parent Occupation In STEM	0.33	0.47	0	1
SAT composite score	1201.68	181.46	500	1600
Degree aspiration: Less than bachelors degree	0.01	0.07	0	1

Degree aspiration: Bachelors degree	0.09	0.29	0	1
Degree aspiration: Masters	0.27	0.44	0	1
Degree aspiration: Ph.D. or Ed.D.	0.32	0.47	0	1
Degree aspiration: MD	0.3	0.46	0	1
Degree aspiration: Other professional degree (law, divinity, other)	0.02	0.14	0	1
College Experiences (Responses taken from the 2008 CSS)				
Worked on independent study projects	2.12	0.77	1	3
Discussed course content with students outside of class	2.67	0.51	1	3
Studied with other students	2.42	0.58	1	3
Tutored another college student	1.72	0.69	1	3
Met with an advisor/counselor about your career plans	2.01	0.6	1	3
Asked a professor for advice outside of class	2	0.64	1	3
Felt intimidated by your professors	1.66	0.61	1	3
Felt isolated from campus life	1.62	0.66	1	3
Failed one or more courses	0.31	0.46	0	1
Worked full-time while attending school	0.19	0.39	0	1
Enrolled in honors or advanced courses	0.38	0.49	0	1
Participated in a program to prepare for graduate school	0.19	0.39	0	1
Participated in an academic program for racial/ethnic minorities	0.17	0.37	0	1
Presented research at a conference	0.18	0.39	0	1
Hours per Week: Socializing with friends	5.14	1.48	1	8
Hours per Week: Talking with faculty outside of class or office hours	2.1	1.03	1	8
Hours per Week: Working for pay off campus	3.17	2.75	1	8
Hours per Week: Commuting	2.58	1.48	1	8
Hours per Week: Career planning (job searches, internships, etc.)	2.71	1.33	1	8
Faculty here are interested in students' personal problems	2.63	0.75	1	4
There is strong competition among most students for high grades	2.86	0.79	1	4
Faculty here are interested in students' academic problems	2.99	0.68	1	4
Satisfaction: Courses in your major field	4.16	0.86	1	5

Satisfaction: Racial/ethnic diversity of the student body	3.56	1.02	1	5
Career Concern: Discovery/enhancement of knowledge	3.19	0.8	1	4
Overall College GPA	5.66	1.66	1	8
Academic Disengagement	52.36	8.08	36.29	75.71
Academic Self-Concept	51.58	8.58	12.65	66.92
Negative Cross-Racial Interactions	53.13	7.73	41.66	76.57
Positive Cross-Racial Interactions	53.89	8.6	29.06	68.39
Sense of Belonging	49.86	8.47	25.97	62.22
Social Self-Concept	49.87	8.55	19.36	67.26
Biological Sciences Major	0.28	0.45	0	1
Engineering Major	0.17	0.38	0	1
Professional Health Major	0.08	0.27	0	1
Math Major	0.02	0.13	0	1
Physical Science Major	0.05	0.23	0	1
Other Stem Major	0.08	0.28	0	1
Switched out of STEM into a non-STEM major	0.4	0.49	0	1
Institutional Variables				
Historically Black College/University (vs. non-HBCU)	1.09	0.29	1	2
Institution offers a medical degree (vs. not)	1.23	0.42	1	2
Percentage of STEM undergraduates	0.16	0.15	0	0.89
Percent White undergraduates	0.58	0.25	0	0.96
Undergraduate full-time enrollment	8087.02	7259.43	404.5	36730.5
Institutional control: Public (vs. private)	1.57	0.5	1	2
Masters granting institution	0.36	0.48	0	1
Liberal arts institution	0.19	0.39	0	1
Doctoral granting institution	0.45	0.5	0	1
Selectivity (100-point increments)	11.14	1.46	7.75	15.1
Student peer mean: Faculty here are interested in students' personal problems	2.71	0.36	1.6	4

Table 2. *Results of hierarchical models predicting frequency of engagement in supplemental instruction*

	Model 1			**Model 2**			**Model 3**			**Model 4**		
Variables	**b**	**SE**	**Sig.**	**b**	**SE**	**Sig.**	**b**	**SE**	**Sig.**	**b**	**SE**	**Sig.**
Level 1 (n=4046)												
Model 1												
English native language	-.11	.03	**	-.10	.04	**	-.10	.04	**	-.09	.03	**
Gender (Female)	.04	.02		.03	.03		.02	.02		.02	.02	
Native American (reference is White)	-.06	.16		-.06	.15		-.14	.11		-.15	.12	
Asian American	-.04	.04		-.05	.04		-.01	.03		-.01	.04	
Black	.02	.04		.04	.04		.01	.04		.03	.04	
Latino	-.05	.04		-.06	.04		-.06	.04		-.06	.04	
Other	-.09	.14		-.09	.14		-.17	.12		-.17	.12	
Multiracial	.01	.03		.00	.03		-.01	.03		-.01	.03	
Socioeconomic Status (SES)	.05	.01	**	.03	.01	*	.02	.01		.02	.01	
Model 2												
High School GPA				.02	.01		.00	.01		.00	.01	
Years of Mathematics in H.S.				.01	.02		.00	.02		.00	.02	
Years of Physical Science in H.S.				.00	.01		-.01	.01		-.01	.01	
Years of Biological Science in H.S.				-.01	.01		-.01	.01		-.01	.01	
Participated in a summer research program				.07	.03	*	.06	.03	*	.06	.03	*
Participated in a health science research program sponsored by a university				-.04	.05		-.07	.04		-.07	.04	
Enrolled in college to prepare for graduate/professional school				.03	.02		-.01	.02		-.01	.02	
Hours per week: Talking with high school teachers outside class				.04	.01	**	.00	.01		.00	.01	
Concerns about ability to finance college education				-.01	.02		.00	.02		.00	.02	

Parent Occupation In STEM	.03	.03	.03	.03		.03	.03	
SAT composite score (100)	.02	.01	.01	.01		.00	.01	
2004 Degree aspiration: Less than bachellors degree (reference is bachellors degree)	-.23	.19	-.06	.18		-.07	.18	
2004 Degree aspiration: Masters	-.05	.04	-.04	.04		-.04	.04	
2004 Degree aspiration: Ph.D. or Ed.D.	.02	.05	.01	.05		.00	.05	
2004 Degree aspiration: MD	.01	.05	-.01	.05		-.01	.05	
2004 Degree aspiration: Other professional degree (law, divinity, other)	-.01	.08	-.01	.08		-.02	.08	
Model 3								
Worked on independent study projects			.08	.02	**	.08	.02	**
Discussed course content with students outside of class			.02	.02		.02	.02	
Studied with other students			.08	.02	**	.08	.02	**
Tutored another college student			.05	.02	**	.05	.02	**
Met with an advisor/counselor about your career plans			.03	.02		.02	.02	
Asked a professor for advice outside of class			.07	.02	**	.07	.02	**
Felt intimidated by your professors			.03	.02		.03	.02	
Felt isolated from campus life			.02	.02		.02	.02	
Failed one or more courses			.01	.03		.00	.03	
Worked full-time while attending school			.00	.03		.00	.03	
Enrolled in honors or advanced courses			.02	.02		.02	.02	
Participated in an internship program			.00	.02		.00	.02	
Participated in an undergraduate research program (e.g. MARC, MBRS, REU)			.02	.03		.02	.03	
Participated in a program to prepare for graduate school			-.02	.03		-.03	.03	
Participated in an academic program for racial/ethnic minorities			.07	.03	*	.06	.03	
Joined a club or organization related to major			.06	.02	*	.06	.02	**
Presented research at a conference			-.04	.03		-.03	.03	
Hours per Week: Socializing with friends			.01	.01	*	.02	.01	*
Hours per Week: Talking with faculty outside of class or office hours			.02	.01		.02	.01	

Hours per Week: Working for pay off campus							.00	.00		.00	.00	
Hours per Week: Commuting							.00	.01		-.01	.01	
Hours per Week: Career planning (job searches, internships, etc.)							.00	.01		.00	.01	
Faculty here are interested in students' personal problems							.00	.02		-.01	.02	
There is strong competition among most students for high grades							.01	.01		.01	.01	
Faculty here are interested in students' academic problems							.04	.02	*	.05	.02	**
Satisfaction: Courses in your major field							.03	.02	*	.03	.02	
Satisfaction: Racial/ethnic diversity of the student body							.01	.01		.01	.01	
Career Concern: Discovery/enhancement of knowledge							.00	.01		.00	.01	
Overall College GPA							.01	.01		.00	.01	
Academic Disengagement (factor) (10)							.03	.01	*	.03	.01	*
Academic Self-Concept (factor) (10)							.02	.01		.02	.01	
Negative Cross-Racial Interactions (factor) (10)							-.01	.02		-.01	.02	
Positive Cross-Racial Interactions (factor) (10)							.05	.02	**	.05	.02	**
Sense of Belonging (factor) (10)							.05	.02	**	.05	.02	**
Social Self-Concept (factor) (10)							-.01	.01		-.01	.01	
Faculty Mentorship (factor) (10)							.07	.02	**	.07	.02	**
Biological Sciences Major (reference is students who switched to non-STEM majors)							-.02	.03		-.02	.03	
Engineering Major							-.04	.04		-.04	.04	
Professional Health Major							.00	.05		.01	.05	
Math Major							-.17	.10		-.16	.10	
Physcial Science Major							.05	.05		.05	.05	
Other Stem Major							.04	.04		.04	.04	
Model 4												
Level 2 (n=212)												
Intercept	2.22	.04	**	2.22	.06	**	2.19	.06	**	2.06	.11	**
HBCU (vs. non-HBCU)										.01	.07	
Institution offers a medical degree (vs not)										.02	.03	

Proportion of STEM undergraduate majors				.02	.10
Proportion of undergraduate White students				.04	.07
Undergraduate full-time enrollment (1000)				.00	.00
Private (vs. public)				.01	.04
Masters comprehensive institution (vs. liberal arts)				.03	.05
Research university (vs. liberal arts)				.06	.05
Selectivity (100-point increments)				-.01	.02
Student peer mean: Faculty here are interested in students' personal problems				-.03	.05
% Level-1 variance explained	0.68%	1.80%	16.11%	5.74%	
% Level-2 variance explained	n/a	n/a	n/a	51.93%	

*indicates p-value less than .05; **indicates p-value less than .01

Table 3. *Results of hierarchical models predicting faculty mentorship score*

	Model 1			Model 2			Model 3			Model 4		
Variables	**β**	**SE**	**Sig.**	**β**	**SE**	**Sig.**	**β**	**SE**	**Sig.**	**β**	**SE**	**Sig.**
Level 1 (n=4046)												
Model 1												
English native language	-.58	.57		-.40	.58		.26	.40		.09	.40	
Gender (Female)	1.28	.39	**	.76	.41		.52	.29		.52	.28	
Native American (reference is White)	1.42	2.32		.75	2.37		1.20	1.58		1.17	1.58	
Asian American	-1.27	.62	*	-1.35	.61	*	-.37	.45		-.25	.44	
Black	-.61	.57		-.76	.60		-.27	.43		-.76	.48	
Latino	-.58	.64		-1.15	.64		-.47	.39		-.49	.39	
Other	.15	2.17		.14	2.33		-1.28	1.93		-1.13	1.89	
Multiracial	-1.51	.51	**	-1.59	.49	**	-.97	.34	**	-1.04	.33	**
Socioeconomic Status (SES)	.47	.15	**	.39	.16	*	.23	.13		.22	.13	
Model 2												
High School GPA				.47	.17	*	-.11	.12		-.07	.12	
Years of Mathematics in H.S.				.13	.33		.11	.23		.14	.23	
Years of Physical Science in H.S.				.06	.13		-.09	.09		-.07	.09	
Years of Biological Science in H.S.				.03	.16		.03	.11		.03	.11	
Participated in a summer research program				-.24	.49		-.34	.38		-.34	.38	
Participated in a health science research program sponsored by a university				.96	.59		-.30	.53		-.43	.54	
Enrolled in college to prepare for graduate/professional school				1.21	.37	**	.29	.23		.34	.23	
Hours per week: Talking with high school teachers outside class				1.24	.16	**	.29	.12	*	.28	.12	*
Concerns about ability to finance college education				-.79	.27	**	-.49	.20	**	-.46	.20	*
Parent Occupation In STEM				-.46	.37		-.37	.25		-.29	.25	

SAT composite score (100)	-.21	.13		-.36	.11	**	-.27	.12	*
2004 Degree aspiration: Less than bachelors degree (reference is a bachelors degree)	-6.59	1.16	**	-2.52	1.27	*	-2.57	1.16	*
2004 Degree aspiration: Masters	.28	.60		.80	.42		.83	.42	*
2004 Degree aspiration: Ph.D. or Ed.D.	.11	.67		.03	.45		.03	.45	
2004 Degree aspiration: MD	.30	.77		.18	.56		.12	.56	
2004 Degree aspiration: Other professional degree (law, divinity, other)	.99	1.38		.53	1.39		.45	1.32	
Model 3									
Worked on independent study projects				.86	.16	**	.85	.15	**
Discussed course content with students outside of class				.43	.28		.44	.27	
Studied with other students				.36	.24		.32	.23	
Tutored another college student				.14	.20		.11	.20	
Met with an advisor/counselor about your career plans				1.55	.21	**	1.59	.21	**
Asked a professor for advice outside of class				2.18	.22	**	2.08	.22	**
Felt intimidated by your professors				-.58	.22	**	-.58	.21	**
Felt isolated from campus life				-.55	.21	**	-.56	.21	**
Had instruction that supplemented course work				.88	.21	**	.90	.21	**
Failed one or more courses				-.49	.34		-.48	.34	
Worked full-time while attending school				-.40	.32		-.48	.31	
Enrolled in honors or advanced courses				.60	.30	*	.57	.29	*
Participated in an internship program				.33	.25		.39	.24	
Participated in an undergraduate research program (e.g. MARC, MBRS, REU)				.52	.36		.67	.35	
Participated in a program to prepare for graduate school				1.39	.32	**	1.30	.32	**
Participated in an academic program for racial/ethnic minorities				.06	.32		.13	.32	
Joined a club or organization related to major				.40	.26		.30	.25	
Presented research at a conference				1.28	.39	**	1.16	.38	**
Hours per Week: Socializing with friends				-.07	.10		-.09	.10	

Hours per Week: Talking with faculty outside of class or office hours							1.43	.13	**	1.40	.13	**
Hours per Week: Working for pay off campus							.05	.05		.04	.05	
Hours per Week: Commuting							.02	.09		.01	.09	
Hours per Week: Career planning (job searches, internships, etc.)							-.04	.11		-.03	.11	
Faculty here are interested in students' personal problems							1.83	.18	**	1.99	.18	**
There is strong competition among most students for high grades							.02	.17		.15	.16	
Faculty here are interested in students' academic problems							2.31	.21	**	2.09	.21	**
Satisfaction: Courses in your major field							1.12	.17	**	1.14	.16	**
Satisfaction: Racial/ethnic diversity of the student body							.58	.14	**	.57	.14	**
Career Concern: Discovery/enhancement of knowledge							.92	.16	**	.91	.15	**
Overall College GPA							.35	.11	**	.31	.11	**
Academic Disengagement (factor) (10)							-.47	.15	**	-.42	.15	**
Academic Self-Concept (factor) (10)							.11	.18		.12	.18	
Negative Cross-Racial Interactions (factor) (10)							.29	.18		.28	.18	
Positive Cross-Racial Interactions (factor) (10)							.13	.16		.22	.16	
Sense of Belonging (factor) (10)							.34	.19		.28	.19	
Social Self-Concept (factor) (10)							-.07	.16		-.04	.15	
Biological Sciences Major (reference is students who switched to non-STEM majors)							-.46	.32		-.62	.32	
Engineering Major							-1.54	.38	**	-1.35	.38	**
Professional Health Major							.53	.52		.47	.53	
Math Major							-2.11	1.01	*	-2.09	.99	*
Physical Science Major							.44	.54		.39	.54	
Other Stem Major							-.67	.50		-.72	.49	
Model 4												
Level 2 (n=212)												
Intercept	49.65	.70	**	49.99	.91	**	47.83	.63	**	44.40	1.58	**
HBCU (vs. non-HBCU)										2.54	.78	**

Institution offers a medical degree (vs. not)				.27	.41	
Proportion of STEM undergraduate majors				-1.89	.86	*
Proportion of undergraduate White students				2.23	.69	**
Undergraduate full-time enrollment (1000)				-.06	.02	**
Private (vs. public)				.13	.43	
Masters comprehensive institution (vs. liberal arts)				1.03	.49	*
Research university (vs. liberal arts)				.95	.51	
Selectivity (100-point increments)				-.31	.19	
Student peer mean: Faculty here are interested in students' personal problems				2.87	.61	**
% Level-1 variance explained	0.57%	3.72%	50.00%	43.90%		
% Level-2 variance explained	n/a	n/a	n/a	93.67%		

*indicates p-value less than .05; **indicates p-value less than .01

Table 4. *Results of hierarchical models predicting student participation in an internship program, an undergraduate research program, and a club or organization related to major*

	Participated in an internship program				Participated in an undergraduate research program				Joined a club or organization related to major			
Variables	**b**	**SE**	**Sig.**	**Delta-P**	**b**	**SE**	**Sig.**	**Delta-P**	**b**	**SE**	**Sig.**	**Delta-P**
Level 1 (n=4046)												
Model 1												
English native language	-.01	.14	.95		.10	.16	.52		-.18	.13	.15	
Gender (Female)	.19	.10	.05		-.24	.12	.05		.17	.09	.08	
Native American (reference: White)	-.35	.40	.39		-1.91	1.20	.11		-.06	.46	.90	
Asian American	.05	.14	.70		.31	.21	.13		.01	.14	.95	
Black	.06	.14	.65		.89	.23	.00	16.27%	-.27	.14	.06	
Latino	.19	.14	.15		.17	.20	.39		-.05	.15	.74	
Other	-.35	.48	.47		.15	.64	.82		.57	.46	.21	
Multiracial	.08	.12	.50		.13	.16	.43		.00	.16	.99	
Socioeconomic Status (SES)	.13	.05	.00	3.29%	.00	.07	.94		.03	.05	.55	
Model 2												
High School GPA	-.02	.04	.66		-.02	.06	.76		.17	.04	.00	3.98%
Years of Mathematics in H.S.	-.03	.08	.72		.05	.10	.66		.16	.09	.06	
Years of Physical Science in H.S.	.00	.03	.91		-.10	.04	.01	-1.54%	-.01	.03	.86	
Years of Biological Science in H.S.	.05	.04	.23		.01	.05	.88		-.01	.05	.78	
Participated in a summer research program?	.08	.12	.53		.13	.17	.46		-.13	.16	.41	
Participated in a health science research program sponsored by a university	.03	.18	.88		.05	.24	.85		.66	.19	.00	14.47%
Enrolled in college to prepare for graduate/professional school	-.21	.08	.01	-5.21%	-.05	.12	.69		-.08	.09	.35	
Hours per week: Talking with high school teachers outside class	-.01	.04	.85		-.04	.05	.49		.06	.05	.23	

Concerns about ability to finance college education	-.08	.07	.23		.07	.09	.45		-.06	.08	.41	
Parent Occupation In STEM	.06	.11	.58		-.29	.12	.02	-4.60%	.00	.10	.98	
SAT composite score (100)	-.10	.04	.01	-2.53%	.16	.06	.01	2.58%	-.01	.04	.76	
2004 Degree aspiration: Less than bachelors degree (reference is bachelors degree)	-.70	.69	.30		1.35	.86	.12		-1.21	.69	.08	
2004 Degree aspiration: Masters	.05	.16	.77		.46	.25	.07		.04	.15	.82	
2004 Degree aspiration: Ph.D. or Ed.D.	.16	.16	.30		.64	.25	.01	9.51%	.11	.17	.51	
2004 Degree aspiration: MD	-.12	.17	.50		.45	.27	.09		.18	.20	.34	
2004 Degree aspiration: Other professional degree (law, divinity, other)	.18	.36	.63		.10	.54	.85		.01	.40	.99	
Model 3												
Worked on independent study projects	.01	.05	.87		.34	.08	.00	6.12%	-.09	.05	.09	
Discussed course content with students outside of class	.01	.10	.91		-.05	.13	.70		.30	.09	.00	6.87%
Studied with other students	.12	.08	.14		-.13	.10	.22		.09	.08	.28	
Tutored another college student	.09	.08	.25		.09	.08	.25		.20	.07	.01	4.69%
Met with an advisor/counselor about your career plans	.14	.07	.06		.20	.11	.08		-.11	.07	.13	
Asked a professor for advice outside of class	.13	.08	.10		.04	.10	.67		.23	.07	.00	5.32%
Felt intimidated by your professors	.06	.07	.41		.17	.11	.12		.00	.08	.97	
Felt isolated from campus life	.06	.07	.38		.12	.11	.26		.05	.08	.52	
Had instruction that supplemented course work	.01	.07	.90		.06	.10	.54		.17	.07	.02	4.07%
Failed one or more courses	-.42	.10	.00	-10.42%	-.02	.19	.90		.11	.11	.32	
Worked full-time while attending school	-.27	.12	.03	-6.56%	-.55	.18	.00	-7.98%	-.26	.12	.03	-6.36%
Enrolled in honors or advanced courses	.29	.09	.00	7.18%	.12	.13	.37		.24	.11	.03	5.66%
Participated in an internship program	-	-	-		.18	.13	.14		.45	.09	.00	10.77%
Participated in an undergraduate research program (e.g. MARC, MBRS, REU)	.23	.13	.07		-	-	-		.15	.14	.28	
Participated in a program to prepare for graduate school	.19	.12	.14		1.07	.13	.00	20.61%	.33	.13	.01	7.77%

Participated in an academic program for racial/ethnic minorities	.40	.14	.00	10.05%	.23	.13	.08		.37	.14	.01	8.63%
Joined a club or organization related to major	.44	.09	.00	10.90%	.23	.14	.09		-	-	-	
Presented research at a conference	.41	.12	.00	10.11%	1.71	.13	.00	35.02%	.36	.12	.00	8.33%
Hours per Week: Socializing with friends	.03	.03	.27		-.02	.04	.67		.00	.03	.94	
Hours per Week: Talking with faculty outside of class or office hours	-.05	.04	.22		.04	.05	.48		.16	.06	.01	3.69%
Hours per Week: Working for pay off campus	.04	.02	.01	1.03%	-.01	.03	.64		.00	.02	.81	
Hours per Week: Commuting	.00	.03	.89		-.05	.04	.24		-.10	.03	.00	-2.37%
Hours per Week: Career planning (job searches, internships, etc.)	.29	.03	.00	7.25%	-.05	.04	.25		.09	.03	.01	2.13%
Faculty here are interested in students' personal problems	.07	.07	.35		-.05	.10	.64		-.12	.07	.08	
There is strong competition among most students for high grades	-.10	.06	.08		-.17	.08	.04	-2.60%	.20	.06	.00	4.64%
Faculty here are interested in students' academic problems	-.18	.07	.01	-4.46%	.29	.09	.00	5.06%	.10	.08	.21	
Satisfaction: Courses in your major field	-.01	.05	.80		-.14	.07	.06		.05	.06	.38	
Satisfaction: Racial/ethnic diversity of the student body	-.12	.04	.01	-2.87%	.06	.06	.32		-.05	.05	.26	
Career Concern: Discovery/enhancement of knowledge	-.04	.05	.38		.18	.08	.03	3.08%	-.07	.06	.24	
Overall College GPA	.11	.04	.01	2.81%	.18	.05	.00	3.02%	.04	.03	.22	
Academic Disengagement (factor) (10)	-.08	.06	.19		-.05	.08	.50		.01	.05	.80	
Academic Self-Concept (factor) (10)	-.11	.06	.08		-.01	.09	.94		.03	.06	.59	
Negative Cross-Racial Interactions (factor) (10)	.10	.06	.09		.01	.09	.90		-.04	.07	.58	
Positive Cross-Racial Interactions (factor) (10)	-.07	.06	.20		.05	.08	.52		-.04	.07	.51	
Sense of Belonging (factor) (10)	.08	.07	.26		-.07	.09	.43		.15	.07	.03	3.58%
Social Self-Concept (factor) (10)	.18	.07	.01	4.48%	.01	.08	.86		.01	.06	.92	
Faculty Mentoring (factor) (10)	.09	.06	.12		.15	.09	.08		.06	.06	.33	

Biological Sciences Major (reference is students who switched to non-STEM majors)	-.21	.12	.09		.78	.17	.00	13.89%	-.02	.12	.87	
Engineering Major	1.12	.13	.00	26.57%	.16	.19	.41		.85	.14	.00	19.02%
Professional Health Major	-.52	.21	.01	-12.05%	-1.01	.35	.01	-9.93%	.60	.20	.00	14.03%
Math Major	-.42	.31	.18		-.10	.42	.82		-.50	.30	.09	
Physical Science Major	-.21	.22	.34		1.21	.25	.00	23.54%	.20	.19	.29	
Other Stem Major	.31	.14	.03	7.71%	.21	.26	.43		.16	.16	.34	
Model 4												
Level 2 (n=212)												
Intercept	-1.68	.54	.00		-3.63	.72	.00		-1.23	.55	.03	
HBCU (vs. non-HBCU)	-.09	.38	.81		.39	.50	.44		.69	.35	.05	
Institution offers a medical degree (vs. not)	-.02	.12	.88		.21	.19	.26		.15	.13	.26	
Proportion of STEM undergraduate majors	.60	.48	.21		.89	.53	.09		.39	.37	.30	
Proportion of undergraduate White students	-.18	.34	.61		-.42	.55	.44		.51	.36	.16	
Undergraduate full-time enrollment (1000)	.02	.01	.09		.00	.01	.76		.01	.01	.53	
Private (vs. public)	.57	.18	.00	13.89%	-.52	.25	.04	-8.65%	.17	.18	.34	
Masters comprehensive institution (vs. liberal arts)	.04	.24	.86		-.07	.27	.80		-.01	.19	.95	
Research university (vs. liberal arts)	-.24	.25	.33		-.09	.29	.76		.09	.20	.67	
Selectivity (100-point increments)	.18	.07	.02	4.51%	.28	.10	.01	4.55%	-.32	.07	.00	-7.98%
Student peer mean: Faculty here are interested in students' personal problems	-.28	.27	.29		-.31	.34	.37		.31	.29	.28	

*indicates p-value less than .05; **indicates p-value less than .01

Appendix A
Variables and coding

Variable	Coding Scheme
Dependent Variables	
Participated in an internship program	0=no; 1=yes
Participated in an undergraduate research program (e.g. MARC, MBRS, REU)	0=no; 1=yes
Joined a club or organization related to major	0=no; 1=yes
Had instruction that supplemented course work	1= not at all; 2=occasionally; 3= frequently
Faculty mentorship	Continuous; Nine-item factor (see Appendix B)
Demographic Characteristics	
English native language	0=no; 1=yes
Gender (Female)	0=male, 1=female
Native American	0=no; 1=yes
Asian American	0=no; 1=yes
Black	0=no; 1=yes
Latino	0=no; 1=yes
Other	0=no; 1=yes
Multiracial	0=no; 1=yes
Socioeconomic Status (SES)	Continuous; Factor of mother's education, father's education, and parental income (see Appendix B)
Pre-college preparation, achievement and experiences (Responses taken from TFS)	
High School GPA	1=D to 8=A or A+
Years of Mathematics in H.S.	1=none to 7=5+ years
Years of Physical Science in H.S.	1=none to 7=5+ years
Years of Biological Science in H.S.	1=none to 7=5+ years
Participated in a summer research program	0=no; 1=yes
Participated in a health science research program sponsored by a university	0=no; 1=yes
Enrolled in college to prepare for graduate/professional school	0=no; 1=yes
Hours per week: Talking with high school teachers outside class	1=none to 8=Over 20 hours

Concerns about ability to finance college education	1=none; 2=some; 3=major
Parent Occupation In STEM	0=no; 1=yes
SAT composite score	Continuous
2004 Degree aspiration: Less than bachelors degree (reference is a bachelors degree)	0=no; 1=yes
2004 Degree aspiration: Masters	0=no; 1=yes
2004 Degree aspiration: Ph.D. or Ed.D.	0=no; 1=yes
2004 Degree aspiration: MD	0=no; 1=yes
2004 Degree aspiration: Other professional degree (law, divinity, other)	0=no; 1=yes
College Experiences (Responses taken from the CSS)	
Worked on independent study projects	1= not at all; 2=occasionally; 3= frequently
Discussed course content with students outside of class	1= not at all; 2=occasionally; 3= frequently
Studied with other students	1= not at all; 2=occasionally; 3= frequently
Tutored another college student	1= not at all; 2=occasionally; 3= frequently
Met with an advisor/counselor about your career plans	1= not at all; 2=occasionally; 3= frequently
Asked a professor for advice outside of class	1= not at all; 2=occasionally; 3= frequently
Felt intimidated by your professors	1= not at all; 2=occasionally; 3= frequently
Felt isolated from campus life	1= not at all; 2=occasionally; 3= frequently
Failed one or more courses	0=no; 1=yes
Worked full-time while attending school	0=no; 1=yes
Enrolled in honors or advanced courses	0=no; 1=yes
Participated in a program to prepare for graduate school	0=no; 1=yes
Participated in an academic program for racial/ethnic minorities	0=no; 1=yes
Presented research at a conference	0=no; 1=yes
Hours per Week: Socializing with friends	1=none to 8=Over 20 hours
Hours per Week: Talking with faculty outside of class or office hours	1=none to 8=Over 20 hours

Hours per Week: Working for pay off campus	1=none to 8=Over 20 hours
Hours per Week: Commuting	1=none to 8=Over 20 hours
Hours per Week: Career planning (job searches, internships, etc.)	1=none to 8=Over 20 hours
Faculty here are interested in students' personal problems	1= strongly disagree; 2= disagree; 3=agree; 4= Strongly disagree
There is strong competition among most students for high grades	1= strongly disagree; 2= disagree; 3=agree; 4= Strongly disagree
Faculty here are interested in students' academic problems	1= strongly disagree; 2= disagree; 3=agree; 4= Strongly disagree
Satisfaction: Courses in your major field	1=Very dissatisfied; 2=dissatisfied; 3=neutral; 4=satisfied; 5=Very satisfied
Satisfaction: Racial/ethnic diversity of the student body	1=Very dissatisfied; 2=dissatisfied; 3=neutral; 4=satisfied; 5=Very satisfied
Career Concern: Discovery/enhancement of knowledge	1= Not Important; 2= Somewhat important; 3= Very important Essential
Overall College GPA	1=D to 8=A or A+
Academic Disengagement	Continuous; Four-item factor (see Appendix B)
Academic Self-Concept	Continuous; Five-item factor (see Appendix B)
Negative Cross-Racial Interactions	Continuous; Three-item factor (see Appendix B)
Positive Cross-Racial Interactions	Continuous; Six-item factor (see Appendix B)
Sense of Belonging	Continuous; Four-item factor (see Appendix B)
Social Self-Concept	Continuous; Three-item factor (see Appendix B)
Biological Sciences Major	0=no; 1=yes
Engineering Major	0=no; 1=yes
Professional Health Major	0=no; 1=yes
Math Major	0=no; 1=yes
Physical Science Major	0=no; 1=yes
Other Stem Major	0=no; 1=yes
Institutional Variables	
Intercept	Institutional control: Public (vs. private)
Historically Black College/University (vs. non-HBCU)	0=non-HBCU, 1=HBCU

Institution offers a medical degree (vs. not)	0=no; 1=yes
Percentage of STEM undergraduates	Continuous
Percent White undergraduates	Continuous
Undergraduate full-time enrollment (proxy for institutional size)	Continuous
Institutional control: Public (vs. private)	0=Public 1=Private
Masters granting institution (vs. liberal arts)	0=no; 1=yes
Doctoral granting institution (vs. liberal arts)	0=no; 1=yes
Selectivity (100-point increments)	Continuous
Student peer mean: Faculty here are interested in students' personal problems	Continuous

Appendix B
Factor and Construct Items

Factor	Item	Cronbach's Alpha	Factor Loading
Socioeconomic Status (TFS)		0.731	
	Father's education		0.826
	Mother's education		0.765
	Parental income		0.595

Constructs (see CIRP, 2011)

Faculty Mentorship (CSS) - Measures the extent to which students and faculty interact in relationships that foster mentorship, support, and guidance, with respect to both academic and personal domains.

- Help in achieving professional goals
- Advice and guidance about educational program
- Encouragement to pursue graduate/professional study
- A letter of recommendation
- Feedback about academic work outside of grades
- An opportunity to work on a research project

Academic Disengagement (CSS) - Measures the extent to which students engage in behaviors that are inconsistent with academic success.

- Come late to class
- Fell asleep in class
- Failed to complete homework on time
- Missed class for other reasons

Academic Self-Concept (CSS)- A unified measure of students' beliefs about their abilities and confidence in academic environments.

- Academic ability
- Self-confidence (intellectual)
- Mathematical Ability
- Writing ability

Negative Cross-Racial Interaction - A unified measure of students' level of negative interactions with diverse peers.

- Had guarded, cautious interactions
- Had tense, somewhat hostile interactions
- Felt insulted or threatened because of race/ethnicity

Positive Cross-Racial Interaction - A unified measure of students' level of positive interactions with diverse peers.

Dined or shared a meal
Had meaningful and honest discussions about race/ethnic relations outside of class
Shared personal feelings and problems
Had intellectual discussions outside of class
Studied or prepared for class
Socialized or partied

Sense of Belonging (CSS) - Measures the extent to which students feel a sense of academic and social integration on campus.

I feel I have a sense of belonging to this campus
I feel I am a member of this college
I see myself as part of the campus community

Social Self-Concept (CSS)- A unified measure of students' beliefs about their abilities and confidence in social situations.

Self-Confidence (social)
Leadership ability
Understanding of others

Appendix C

List of Majors Defined as STEM

1. General Biology
2. Biochemistry/Biophysics
3. Botany
4. Environmental Science
5. Marine (Life) Science
6. Microbiology/Bacterial Biology
7. Zoology
8. Other Biological Science
9. Aeronautical/Astronautical Engineering
10. Civil Engineering
11. Chemical Engineering
12. Computer Engineering
13. Electrical Engineering
14. Industrial Engineering
15. Mechanical Engineering
16. Other Engineering
17. Astronomy
18. Atmospheric Science
19. Chemistry
20. Earth Science
21. Marine Science
22. Mathematics
23. Physics
24. Statistics
25. Other Physical Science
26. Health Technology
27. Medicine/Dentistry/Veterinary Medicine
28. Nursing
29. Pharmacy
30. Agriculture
31. Computer Science