Predicting Transition and Adjustment to College: Minority Biomedical and Behavioral Science Students' First Year of College

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Abstract

The purpose of this study is to explore key factors that impact the college transition and persistence of aspiring underrepresented minority students in the biomedical and behavioral sciences, in comparison with White, Asian science and non-science minority students. We examined successful management of the academic environment and sense of belonging during the first college year. Longitudinal data were derived from the Higher Education Research Institute's (HERI) 2004 Cooperative Institutional Research Program (CIRP) Freshman Survey and the 2005 Your First College Year (YFCY) Survey. Using a reformulation integration model, proposed by Nora (2001), we find significant effects of concerns about financing, negotiating family support and responsibility, and the racial dynamics (perceived and behavioral) affect student adjustment and sense of integration in the first year. Perceptions of a competitive environment affect groups differentially, and satisfaction with the relevance of coursework and change in ability to conduct research are key to transition for all first year students.

Introduction

Higher education institutions are chiefly responsible for developing successive generations of scientific talent that will serve individual and societal needs. However, the National Science and Technology Council (2000) reports the demand for scientists already outweighs the supply. This is compounded by the fact that fewer racial and ethnic minorities are pursuing careers that can be of service to growing minority communities in need of professional care and scientific research (Sullivan Commission, 2004). Recent national data indicate that relative to other students, comparable percentages of underrepresented minorities (URMs) indicate a strong interest in pursuing a scientific major. However, only about 13 percent of scientific bachelor's degrees are awarded to African American and Latina/os, compared with 31 percent for Asian Americans and 16 percent for White students (Anderson & Kim, 2006).

Among college freshmen nationally, there is a promising pool of first-year URMs who enter college with a strong academic interest in the biomedical and behavioral sciences (Hurtado, Cerna, Chang, J., Saenz, Lopez, Mosqueda, Oseguera, Chang, M., & Korn, 2006). Over two-thirds of URM students who indicate an early interest in science also aspire toward a post-graduate degree, and more than half indicate the importance of a personal goal to work on finding a cure to a major health problem (Hurtado et.al, 2006). These reports indicate that there are aspiring scientists among the diverse student population, but that these students face obstacles in realizing their career goals.

The transition from high school to college for students interested in pursuing scientific careers has received little study. However, it is well known that undergraduates use the first few years of college to assess their potential in a variety of fields vital to the health and well-being of our society. Moreover, the first year of college is critical to student success because it sets the

stage for the remaining undergraduate experience (Tinto, 1993; Upcraft & Gardner, 1989; Nora, 2001). The purpose of this study is to explore the key factors that may impact the transition to college for aspiring biomedical and behavioral scientists, including various dimensions of academic and social engagement.

We specifically seek to identify key facilitators and barriers of URM students' success at managing the academic community, as well as their sense of belonging within the overall college environment (also referred to as psychological or normative sense of academic and social integration) in their transition to college. Both of these areas are deemed critical to retention in college and have received much attention in previous research and reformulations of the theory of student departure (Tinto, 1997; Braxton, Sullivan, & Johnson, 1997). We draw finer distinctions among academic adjustment, formal and informal engagement, and students' own sense of integration in a multicultural environment. Clearly, much more research is needed to understand how these dimensions are distinct for students of color (Tierney, 1992; Hurtado & Carter, 1997).

Previous research has pointed to distinctions in the nature and quality of interactions that URMs may experience in differing racial dynamics within college environments (Saenz, Ngai, & Hurtado, in press; Allen, 1992; Hurtado & Carter, 1997; Chang et al., 2006). URMs aspiring toward biomedical or behavioral science careers may be severely underrepresented on predominantly-white campuses. We explored how both their experiences differed from racial/ethnic minorities in other fields as well as when compared with White and Asian students in these science majors. This approach extends the higher education research literature on college transition, further identifies various forms of academic engagement in college as antecedents of students' own psychological sense of integration, and provides a more complete understanding

of campus racial dynamics and their impact on URM students in science and non-science majors. Our goal is to identify informal and campus-facilitated practices that can advance the preparation and retention of students in science, with a specific focus on underrepresented minorities in their critical first year of college.

Research and Theoretical Models

This study adopts and tests several premises from both developmental and college impact models, with an eye toward providing further definition to aspects of the college environment most likely to affect a diverse student population in the sciences.

Academic Engagement as an Antecedent of Academic and Social Adjustment

Several scholars tie developmental change to life transitions that present significant individual challenges (Erikson, 1968; Chickering & Reisser, 1993; Piaget, 1985), such as the first year of college where new expectations of faculty and new levels of competence among peers are evident. "Transitions are significant moments for development because they present new situations about which individuals have little knowledge and in which they will experience uncertainty" (Gurin, P., Dey, Hurtado, & Gurin, G. 2002). In order to reduce this level of uncertainty, information seeking and comparison with others becomes particularly salient for individuals involved in assessment of their own competence (Ruble & Flett, 1988). Individuals seek some level of normative congruence of their own expectations, goals, and dispositions with the new academic and social environment (Spady, 1971). Thus, academic adjustment has much to do with a student's *intrinsic* assessment of his or her relative success in navigating a new academic environment. We hypothesize that these internal assessments (manifested in self-concept) are central to academic adjustment and that it is also associated external assessments of academic competence.

Understandably, college grades provide another piece of information that help students assess their success in managing the academic system in college, however, it represents an *extrinsic* academic award (Spady, 1971), or an external assessment relative to peers within the formal structure of a classroom. Although grades imply some level of conformity with academic expectations, they are separate from academic adjustment. Students may sense they have successfully managed an academic environment but, as in many science classrooms, if they are graded on a curve only a few will be judged as highly competent. Some students will feel they have successfully managed the academic environment if they simply passed a course. The more confidence students have in their own ability, the less they will rely on social comparisons, and the more likely they will achieve independent judgments about their competence (Ruble & Flett, 1988; Ruble, 1994). We have, therefore, separated the construct of academic adjustment (students' internal sense of successful management of the academic environment) from student or institutional-based assessments of individual competence in developing the model for this study.

In his early model of college student departure, Spady (1971) posited a variety of academic constructs in relation to student social integration, commitment to the institution, and decisions to drop out of college. Of central interest is Spady's notion that students' assessment of their intellectual development (measured as self-reports of stimulation in classes, expansion of perspectives, and perceived excellence of one's academic work) has a direct effect on social integration in college, and ultimately, retention. He also hypothesized academic potential (SAT scores, high school quality, and class rank) as directly influencing grade performance and intellectual development in college. It is important to note, however, that grades and academic potential did not have a direct influence on institutional commitment in the first year of college.

Friendship support, in contrast, was a key feature of his model that influenced grade performance, intellectual development, social integration, and decisions to drop out of college. In empirical tests of the Tinto model (1975; 1993), many studies have included various measures of engagement in the formal and informal academic systems of a college (Braxton, 2000). However, these measures have not been established as conceptually distinct from students' own psychological sense of academic integration as posited in the original model (Tinto, 1993). The antecedents of academic integration have received more attention in reformulations of Tinto's model of institutional departure, with a new focus on formal academic structures that result in both academic and social integration (Tinto, 1997; Braxton, Milem, & Sullivan, 2000). Specifically, Braxton, et al. (2000) found that an active learning pedagogy (a structure within classrooms) creates greater student engagement with the academic environment, which in turn results in students' social and academic integration, thereby increasing the likelihood of returning for the second year at the same college.

Tinto (1997) studied the effects on student persistence of a learning community; a formal structure that links both the academic and social environments. He found community college students in a learning community felt they were able to successfully manage the academic environment and were statistically more likely to continue to the second year of college than non-participants. He further concluded that such classroom structures provide a small community of supportive peers "that helps bond students to the broader social communities of the college, while also engaging them more fully in the academic life of the institution" (p. 613). Tinto reformulated his model to include classrooms (classes, labs, and studios) as they combine the academic and social system of a college, further linking learning with persistence. He also included external commitments that can diminish engagement in college. Given the amount of

time that science majors invest in their studies, these reformulations of the theory appear ideally suited for understanding students' successful management of the academic environment and overall sense of belonging with a college. The current study explores other formal structures and informal interactions that result in a high psychological sense of adjustment.

We employ a construct of social cohesion, called sense of belonging, as an indicator of the extent to which students feel part of the overall campus community (Bollen & Hoyle, 1990). Studies of sense of belonging in college indicate that it is associated with persistence in the first year of college (Hoffman, Richmond, Morrow & Salomone, 2002), and is influenced by successful management of the college transition as well as student perceptions of campus racial climate and peer interactions (Hurtado & Carter, 1997; Locks, Bowman, Hurtado, & Oseguera, 2006). It is important to determine whether students experience differential levels of sense of belonging and whether it is as tied with academic engagement, as we believe it may be for science students who regard classrooms as social communities. Moreover, a sense of belonging construct is useful in assessing whether minority students may experience more social isolation in fields where they are severely underrepresented.

Racial dynamics, Peer Interactions, and Adjustment in College

Previous models have neglected to identify how the racial dynamics of college affect peer interactions and integration. An emerging body of literature has begun to establish that distinct campus racial dynamics, including levels of structural diversity (numerical representation), interactions across race, and perceptions of the racial climate can lead to a host of educational outcomes (Hurtado, Milem, Clayton-Pederson, & Allen, 1998; Chang, 1999; Gurin, P., Dey, Hurtado, & Gurin, G. 2002; Chang, Denson, Saenz, & Misa, 2006). More specifically, these dynamics can affect student transition to college for all students early in their college career

(Hurtado & Carter, 1997; Locks, Bowman, Hurtado & Oseguera, 2006). Perceptions of a negative racial climate, for example, had a negative impact on adjustment to college that included academic, social, and personal-emotional domains, as well as sense of attachment to the institution (Hurtado, Carter, & Spuler, 1996). Antonio (2004) found that a racially diverse friendship group and a high level of intellectual self-confidence in the immediate peer group are associated with increases in the intellectual self-concept of URM students.

Several studies have provided more specific insights as to how the racial and intergroup dynamics in college are relevant to persistence and performance of URMs in the sciences. Seymour and Hewitt (1997) found that minority students switch out of science, mathematics, and engineering majors if they encounter ethnic isolation, perceptions of racism, and perceived differences in ethnic and cultural values and socialization. Additionally, Bonous-Hammarth (2006) found that a highly selective environment is negatively associated with URM persistence in science, technology, engineering, and mathematics (STEM) majors. She argues that the lack of institutional diversity and the competitive academic environment has a strong (generally negative) influence on URM persistence in these disciplines. In addition, researchers report that STEM fields have failed to highlight the social value and relevance of scientific subject matter (Goodchild, 2004; Farrell, 2002). Meaning, students encounter a disconnect between what they learn in their classes and laboratories and the potential for scientific discovery in real life. This is especially relevant for URM students who frequently leave the sciences because of a perceived lack of relevance to improving conditions for their communities (Bonous-Hammarth, 2000).

Theory and research on the situational factor of "solo status" for women and minorities indicates that such underrepresentation creates more scrutiny of their performance, results in underperformance in the context where others are believed to be of higher status, and increases

the possibility of confirming the stereotype of one's group (Thompson & Sekaquapewa, 2002; Steele, 1997). These studies imply several organizational responses, including changing the situation of severe underrepresentation, affirming domain-specific belonging, providing role models, creating safe teacher-student relationships to build domain efficacy, and building overall self-efficacy or self-confidence (Steele, 1997). The current study examines these principles, as well as differences in interaction patterns with diverse peers in predominantly White environments, and whether environments where students of color are not severely under-represented determine levels of social and academic adjustment in the first year of college.

Conceptual Model

Nora (2001) has provided a reformulation that brings more clarity to the academic dimensions of the college environment while building upon modifications of the departure model where social and academic integration is a central tenet. He includes factors that may influence minority, low-income, and non-traditional student populations such as aspects of pre-college socialization environments (school and home environment), financial assistance/need, family support, environmental pull factors (family and work responsibilities), and commuting to college. In reference to the academic and social experiences in college, he emphasizes formal and informal academic interactions with faculty, involvement in learning communities, social experiences, campus climates (perceptions), validating experiences (from faculty and peers), and mentoring relationships (faculty, peer, and advising staff). As stated earlier, he includes academic performance, academic/intellectual development, and non-cognitive gains (in psychosocial domains) as intermediate outcomes, which determine subsequent goals, institutional commitment, and persistence in college.

Hurtado (in press) suggests that sociological models of college impact should include four measurable domains of institutional, normative constructs: *characterizations* of the environment focusing on student perceptions of their experiences within the social and academic systems of the collegiate environment; social *interactions* that capture both the frequency and quality of informal academic and social engagement in college; formal *memberships* based on both individual interest and how the group determines entry and confers privileges on its members; and, *perceived social cohesion* or the students' own psychological sense of integration in the college community. In multi-institutional studies, it is important to include relevant structural characteristics that define distinctions between colleges such as minority enrollment and selectivity, which further shape the social and academic environment. In this study, we employ these constructs in relation to academic adjustment and perceived cohesion: successful management of the academic environment and students' sense of belonging to the college community. We have ordered our measures to reflect a model that further delineates aspects of the college environment in accordance with this literature (see Figure 1.), giving more order to an array of academic measures that may have distinct effects on academic adjustment and overall sense of belonging to the college community.

--Insert Figure 1 here--

We adopted key constructs from the Nora (2001) model to detail the link between first year college outcomes at multiple types of four-year colleges. Specifically, we posit that a students' psychological sense of integration is not only a result of characteristics they bring at college entry, but is also impacted by participation in formal structures, the racial dynamics of a

college, the continuing influence of family, financial concerns, and assessments of their own development and competence at the end of the first year.

Methods

Data Source and Sample

Data were derived from the Higher Education Research Institute's (HERI) 2004 Cooperative Institutional Research Program (CIRP) Freshman Survey and 2005 Your First College Year (YFCY) Survey. The Freshman Survey is administered during the summer before or fall orientation of the freshman year; YFCY is administered at the end of the freshman year (see Keup & Stolzenberg, 2004 and Sax, Hurtado, Lindholm, Astin, Korn, & Mahoney, 2004, for more detail of both surveys). In total, over 26,000 students from 203 four-year institutions participated in both surveys to constitute a longitudinal assessment over the first year of college. However, not all of these institutions or students were included as part of the present study, as we utilized a selection process to ensure representatives of the first year population and the population of URM science students for this study.

Specific to this year's administration was an intentional recruitment of a variety of minority-serving institutions (MSI) as well as schools with National Institutes of Health-funded programs, as well as campuses with a reputation of graduating large numbers of baccalaureates in the sciences. These institutions were recruited to help examine issues involving the preparation of underrepresented minority students in the biomedical and behavioral sciences. HERI was able to supplement the overall longitudinal sample of YFCY respondents—that are typically gathered through the more traditional institution-based administration—with a special sampling strategy aimed at a subset of institutions whose CIRP and YFCY survey participation was based on successful attainment of minority graduates in the sciences. Moreover, within these

targeted institutions, three sub-groups of students were chosen for YFCY survey administration, representing the key student groups under investigation in this study.

The YFCY survey sample at each of these targeted institutions was composed by first selecting all URM students who indicated (on their CIRP freshman survey) an intention to major in a biomedical or behavioral science field. Second, using the sample size of this first group as the baseline at each institution, we randomly selected an equal number of White and Asian students[1] intending to major in these same science fields as well as an equal number of URM students who were non-science majors at these same institutions. For example, within a targeted institution that had a total of 100 URM science majors among their CIRP freshman survey respondents, all of these 100 students were first chosen as part of the YFCY survey sample, followed by a random selection of 100 White and/or Asian students and a random selection of 100 URM non-science students, for a total of 300 students[2]. This process was repeated for 78 targeted institutions that met these initial criteria.

To draw further from students at institutions without NIH programs but who pursue biomedical careers, another group of students were selected from the set of institutions that administered the 2005 YFCY on their campus. To control for as much variability in administration method as possible, we only selected institutions that yielded a response rate above 80 percent (as determined by the ratio of total YFCY respondents divided by their total first-time full-time (FTFT) student population), and we also selected institutions that either attempted to survey all their first-year student population, all their CIRP respondents, or a random sample representative of the first year population. This process of selecting institutions

[1] White and Asian students in this study are treated as one group, meaning that they have been combined to form one group of students rather than being treated as two separate groups. This decision was made in order to maintain a more appropriate sample size of highly represented students in comparison to URM students.
[2] In a few of institutions where there were not enough students within the two comparison groups (relative to URM science majors) to randomly choose from, all available students were selected.

was employed in order to mirror our targeted sampling strategy (detailed in the previous paragraphs). In sum, this selection process yielded additional students attending 95 institutions. The longitudinal sample yielded a total 173 institutions, and a final sample of 5,047 students comprised of 1,850 URM science majors, 1,365 White/Asian science majors, and 1,832 URM non-science majors.

Weighting

Statistical weighting techniques were used to correct for low survey response rates (averaging 22.5%) for both the targeted sample of institutions as well as for the set of institutions that administered the 2005 YFCY (which we are also referring to as All FTFT institutions). As such, the final weighting scheme was arrived at through two steps: both logistic and multivariate regression analyses were used to obtain predicted probabilities of responding to the 2005 YFCY based on responses to the CIRP freshman survey, and a weight adjustment technique. Researchers employ this weighting technique to adjust the sample upward to the original population (Babbie, 2001), thereby correcting for response bias based on information obtained from representatives of low responding groups (e.g., URMs) in the original population.

Data weights were constructed separately for the target institutions and for the fully participating (i.e., all FTFT) YFCY institutions, although the same procedures were employed for each group. First, YFCY respondents within the set of targeted institutions were analyzed to construct response weights based on the selected sample taken from their CIRP respondents. Next, respondents attending only institutions that attempted to survey all FTFT students were used to predict response based on their representation of their entire FTFT population at these institutions. Weight values were assigned to each respective student in the targeted and All FTFT

samples. These two samples were then combined, assigning their respective weight scores, for analysis.

The general formula used to develop the weight variable is: Total weight = (1/predicted probability of response). The weight variable used for this study accounted for the probability of students responding to both the 2004 and 2005 surveys. In order to ensure that the weighted sample did not produce incorrect standard errors and inflated t-statistics due to a larger weighted sample size, an adjusted weight variable was also created (adjusted weight= total weight variable/mean of the total weight variable). The adjusted weight was applied for statistical analyses in this paper.

Key Variables

Table 1 shows the measures and scales used in this study. We examined two outcomes based on factor-derived scales, success in managing the academic environment and sense of belonging, at the end of the first year of college. The factor "success in managing the academic environment" was constructed using the following five self-evaluation variables from the YFCY: understanding professor expectations, developing effective study skills, adjusting to academic demands, getting to know faculty, and managing time. The construct "sense of belonging" consisted of three survey items modified from previous studies (Hurtado & Carter, 1997; Bollen & Hoyle, 1990), measuring the extent to which the student felt part of the campus community, saw him/herself as a member of the college, and had a strong sense of belonging at his or her respective institution. The dependent variables were constructed using principal components factor analysis with varimax rotation. Factor loading and alpha reliability measures are included in Table 1.

Independent variables were organized into blocked hierarchical linear regression models

to reflect the conceptual framework guiding this study. Background characteristics included gender, race, socioeconomic status, concern for financing college, and ethnic composition of the pre-college environment. Academic achievement included students' high school grades, test scores, and years of high school mathematics and biological science, as well as academic behaviors and self-concept prior to starting college. Students' external commitments included family support needed to succeed in college (sense of validation) and family responsibilities that interfere (a pull factor). Managing family relationships was deemed important to particular ethnic groups in the transition to college. Indeed, complete separation is not as important as negotiating interdependent relationships with family (Hurtado & Carter, 1997).

We included multiple measures of the college environment with specific distinctions between formal characteristics, perceptions, interactions, and memberships. Formal characteristics of the institution include type (university or four-year college), control (public/private), selectivity, and whether or not the college/university is a minority serving institution (HBCU or HSI). We also included the percent of total bachelors degrees awarded in the biomedical and behavioral sciences at each institution to capture the peer norm to pursue a science discipline.

Insert Table 1 here

The next block of variables reflect the reformulation of the integration model by capturing the formal institutional structures that link academic and social systems. These structures include hours per week in classes/labs and participation in academic support programs, learning communities, first-year seminars, and/or health science research programs. Interaction

with key individuals in the college environment also works to link the academic and social realms. To this end, measures were included to capture students' interaction with teaching assistants and academic advisors (distinguishing between professionals, junior/senior peers, and other freshmen). Participation in a pre-professional or department club (group membership) as well as participation in a professor's research project in the first year was also examined.

Racial dynamics of the peer environment were assessed through measures of the quality of students' cross-racial interactions and the ethnic composition of friends and college study groups. In addition, perceptions of the racial climate and competitiveness of the college environment were assessed (see Table 1 for exact measures).

A key piece of this study examines how academic/intellectual development, competence, and performance also affect sense of belonging. Thus, we included these intermediate outcomes in the last block of the regression model. These variables included students' satisfaction with the relevance of coursework to everyday life and self-reported change in their ability to conduct research. The independent variables were identical for analyses of both outcomes; however, in the equation for "sense of belonging", we included students' success in managing the academic environment to further test the link between academic adjustment with sense of belonging in the first year.

Analysis

In order to maintain statistical power, missing values for all continuous variables were replaced using the EM algorithm. The EM algorithm represents a general method for obtaining maximum likelihood (ML) estimates when a small proportion of the data is missing (Dempster, Laird & Rubin, 1977, cited in Allison, 2002; McLachlan & Krishnan, 1997). We conducted factor analysis, as a data reduction technique, to create both dependent variables and also several

of the independent variables that measured a common construct (see Table 1 for items that construct each factor).

We then employed descriptive statistical analysis to examine students' academic and social adjustment. Means were calculated for each sample group (URM science students, White/Asian science students, and URM non-science students) and compared using ANOVAs and Scheffe post-hoc tests. One-way analyses of variance (ANOVAs) were used to establish significant mean differences between the subgroups on each outcome measure. Investigations of more specific between-group differences among the subgroups of interest were performed using Scheffe's post-hoc test of mean difference. This test is useful for comparing mean differences across independent samples when the sample sizes are not equal. These within- and between-group difference tests were employed as descriptive tools with which to establish significant differences among key groups of students on the outcomes of interest. Linear regression analysis was then performed on each of the outcome measures for the three sample groups. Independent variables were force entered in each equation to predict the variance on students' "success in managing the academic environment" and "sense of belonging". The contribution of each independent variable was compared through statistical tests on the final unstandardized beta coefficients across the equations for each group. In considering the potential for indirect effects within in the equations, partial correlations controlling for pre-college variables were examined.

Results

In the following section, we present key findings for first-year students' self-rated ability to manage the academic environment and sense of belonging, respectively. Our discussion begins by examining our outcome variables across sample and racial/ethnic groups. We then focus on the experiences of underrepresented minority students intending to major in a

biomedical or behavior science field and compare them to their White and Asian peers in the same academic disciplines. We conclude by presenting results for URM students not intending to major in the sciences on both outcome variables to gain an understanding of whether and how academic and social transition issues are different for students in the sciences.

To explore possible between-group differences on the two outcome measures of academic success habits and sense of belonging, we first examined a set of mean comparisons across gender and racial groups as well as across the three primary comparison groups for this study. Table 2 displays a summary of mean scores for both outcome measures by gender, racial status, and comparison group status. We utilized ANOVAs and post-hoc tests to investigate significant differences across the key groups in our study. Tables 3 and 4 display the results of these analyses.

Insert Table 2 here

In examining the ANOVA results by racial group, there is clear evidence of significant between-group mean differences across race for academic adjustment ($F=8.60$, $p<.001$) and sense of belonging ($F=2.62$, $p<.03$). These results validate the importance of disaggregating analyses across key student background characteristics. For "success at managing the academic environment", the ANOVA results also establish the existence of a significant ($F=3.65$, $p<.05$) between-group difference among the three comparison groups of interest in this study, thus, confirming the utility of isolating students into distinct groupings.

Surprisingly, no significant between-group differences across these three groups' sense of belonging as evidenced by the low F-statistic ($F=0.89$). While these results offer some evidence of the existence of between-group differences for the academic adjustment measure, they do not

offer any useful information on the specific differences among subgroups. Further exploration of these between-group differences across race and across the three comparison groups is warranted in order to gain a more specific portrait of how outcomes vary from one group to another.

Insert Table 3 here

Investigation of specific between-group differences among subgroups of students was performed using Scheffe's post-hoc test of mean difference. Post-hoc tests were run on both outcome measures, allowing for more specific interpretations of subgroup differences. The results of these post-hoc analyses are listed in the following table (Table 4), although only results for the outcome measure of success at managing the academic environment are shown, since no between group differences were observed for the sense of belonging outcome.

Insert Table 4 here

The post-hoc tests display only those between-group differences that resulted in statistically significant mean differences across the groups of interest. Within the racial groups examined, Asian/Pacific Islanders have significantly lower ($p<.05$) mean scores on academic adjustment relative to their peer groups. White students have significantly higher ($p<.05$) mean scores than their Latino counterparts on this outcome. For the comparison groups of interest, URM science majors were shown to have significantly lower ($p<.05$) mean scores relative to their URM non-science peers and their White/Asian science peers. These descriptive results demonstrate key between-group differences that served to inform the multivariate analyses.

Academic Success: Managing the Academic Environment

Underrepresented minority science students. Table 5 displays the regression results for student "success in managing the academic environment" by each of the three sample groups. For URM science students, the model accounts for 34 percent of the variance of the academic adjustment outcome, with students' academic competence before and during college as well as the formal characteristics of their higher education institution contributing strong predictive power to the equation. In terms of background characteristics and external commitments, minority science students who had concerns about financing college and family responsibilities that interfere with their education, were less likely to feel successful at managing their academic environment during the first year of college. Understandably, these students' time and attention are divided between school and out-of-school commitments, which can contribute to difficulties in academic adjustment.

Students' self-rated ability to manage their time and sense of social self-concept upon entering college were significant positive predictors of academic adjustment. Social self-concept included measures of self-confidence and public speaking ability, which can influence aspects of managing the college academic environment, such as communicating with and getting to know faculty members. Interestingly, URM science students with higher secondary school grade point averages (GPA) and degree aspirations tended to be less assured of their success in academic adjustment. It could be that these students have heightened expectations of themselves and perceptions of their peers' abilities and thus feel less satisfied with their own academic performance. Results for how the institutional environment affects URM science students supports this argument. For instance, controlling for ability levels, students attending public universities and highly selective institutions had lower levels of their sense of academic success

in the first year. In fact, enrollment at a selective institution (β=-.16**) is the strongest negative predictor of any of the variables in the regression equation. Institutional selectivity also affects the influence of matriculating at a Minority Serving Institution (MSI): while attending an MSI has an initial positive relationship with the dependent variable even after controlling for all the pre-college factors (β=.08**), the association becomes negative once selectivity is taken into account. This indicates a suppressor effect on academic adjustment. For students, comparison with an academically strong and competitive peer group can be a daunting experience. The variable that assesses students' perceptions of the level of competition at their campus (β=-.08***) confirms this trend, also showing a negative influence on URM science students' sense of academic success at the end of the first year.

Insert Table 5 here

Several of the formal structures that span the academic and social realms of college influence URM science students. In particular, receiving academic advising from an upper-classman (β =.05*) can positively affect students' sense of academic success, but obtaining advice from another first-year student (β =.-07**), results in a lower sense of academic success. Information-sharing among first-year students may be a case of "the blind leading the blind" and actually hinder academic success. This finding was also found among highly talented Latino students (Hurtado, Carter & Spuler, 1996). Contrary to Tinto's research at community colleges, however, participating in a learning community showed no direct influence on the dependent variable for this sample in the first year. Participation in an academic support program for underrepresented students or a first-year experience seminar both have a significant positive

influence on the dependent variable; however, once students' college GPA is taken into account, these relationships become insignificant. In addition to experiencing a high level of competition, students' perceptions of a hostile racial climate (β=-.05*) showed unique predictive and negative effect on the dependent variable. While the racial climate affected academic adjustment, positive cross-racial interactions and the ethnic composition of friends and study groups did not show direct effects on academic adjustment but do have an impact on the next outcome we examined (see Table 6).

As would be expected, URM science students' academic development while in college strongly affected their feelings of success at managing the academic environment. Besides college GPA (β=.31***), assessing that the coursework has relevance to daily life (β=.17***) was important to URM science students, thus confirming previous research about the implication of this factor (Bonous-Hammarth, 2000). Similarly, URM students' self-rated change in ability to conduct research (β=.10***) and hours per week spent studying or doing homework (β=.11***) also positively affected academic adjustment in college.

Comparison to White/Asian science students. More similarities than distinctions appeared in the regression equations comparing URM science students to their White and Asian peers. Nonetheless, some differences surfaced in terms of students' pre-college academic potential and self-concept. Unlike their underrepresented peers, the influence of high school GPA and aspiring toward a doctorate or professional degree was not negative or significant on the outcome variable. It also appears that White and Asian students' success at managing the academic environment is not affected by their perceptions of the level of competition among peers. While these differences suggest that White and Asian students are not hindered by the same type of

expectations and perceptions that weigh on their underrepresented peers, attending a selective institution (β= -.25***) still had a negative and significant influence on academic adjustment.

Other points of difference appeared in the block of variables assessing the impact of formal structures that link the academic and social systems in college. Surprisingly, interaction with teaching assistants was a negative predictor (β=-.05*) for White and Asian science students and receiving academic advising from peers had no effect. Table 7 depicts the undstandardized beta coefficients for each sample group and compares the magnitude of each coefficient through statistical tests. An effect that is significantly different is denoted by a bracketed letter corresponding to that group held in comparison. In this case, the impact of interacting with teaching assistants was statistically significantly different for White and Asian science students (group B) than for URMs (groups A, C). The peer environment differentially affected science students based on their racial backgrounds as well. White and Asian students were not hindered by a hostile racial climate, while studying with a predominantly White study group (β=.08***) was a positive predictor of adjustment. The contribution of variables assessing students' sense of academic development and performance while in college acted similarly for majority and minority students pursuing the sciences. The relevance of coursework to life on the dependent variable, however, was statistically and significantly greater for White and Asian science students than for the other two underrepresented student samples (Table 7).

Insert Table 7 here

(Tests from Table 7 will be incorporated in Table 5 & 6 for the published manuscript)

Comparison to non-science URM students. When contrasting the three sample groups' success at managing the academic environment, it seems that the influence of students' racial/ethnic background is stronger than choice of major. In other words, URM science students respond more like their underrepresented peers in other academic disciplines than they do their White and Asian science peers. This trend can be seen when comparing the statistically significant points of difference in the unstandardized beta coefficients among the sample groups (see Table 5). As specific examples, the influence of social self-concept upon entering college (β=.08***) and experiencing a hostile racial climate (β=-.05*) or competitive peer environment (β=-.05*) on the dependent variable are similar for URM students regardless of choice of major (see Table 5).

However, there are also some ways in which URM students intending on a non-science major differ from science students. For one, Latino non-science students tend to report greater success at managing the academic environment (β=.06*). Family support to succeed is another positive factor (β=.04*) that is statistically and significantly distinct from URM science majors (see Table 5). Also, interacting with a graduate student or teaching assistant (β=.08***) positively influences academic adjustment as does experiencing positive cross-racial interactions (β=.06*) with peers. The pedagogical differences in how science versus non-science classes operate may offer some explanation for these differences. Non-science classes tend to rely more heavily on class discussion and interaction with peers. Thus, these relationships in the academic environment can play a larger role in helping students feel more academically adjusted.

Social Adjustment: Sense of Belonging

Sense of belonging is a theoretical concept resulting from the intersection of academic and social realms, which are crucial to students' transition in college (Hurtado & Carter, 1997; Hoffman, Richmond, Morrow & Salomone, 2002).

Insert Table 6 here

Underrepresented minority students in the sciences. Table 6 presents regression results, in the form of standardized beta coefficients, for students' sense of belonging after the first-year of college. Several factors that affected URM science students' ability to manage the academic environment function similarly to influence their sense of belonging. For instance, financial and family concerns impede both academic and social adjustment for this group of students. Students' social self-concept (β=.06*) upon entering college serves as a positive predictor of sense of belonging. Interestingly, its influence on the social aspect of adjustment is not as strong or significant as it was for academic adjustment (β=.09***). Results also reveal some factors that affect sense of belonging but not academic success. For instance, Latinas/os tend to have a slightly lower sense of belonging than other first year URM students in the sciences, while students with high SAT/ACT scores show a greater sense of belonging.

Among the institutional characteristics, selectivity (β=-.17**) was the only variable that showed lasting significance in the equation. Attending campuses with more students of color (i.e., MSIs) or a higher percentage of science students did not seem to significantly affect students' sense of belonging. While the enrollment composition may not influence the dependent variables, several of the structures and diverse student interactions within the academic system in

college were key. The following types of interactions all positively shaped URM science students' sense of belonging: interacting with a graduate student or teaching assistant (β=.05*), receiving advice from a junior or senior (β=.12***), receiving academic advice from a freshmen (β=.06**) and interacting with peers of diverse racial backgrounds (β=.11***). While receiving academic advice from another first-year negatively affected students' academic adjustment, it resulted in positive effects for sense of belonging for science students. Sharing information with others in the same academic year can help develop camaraderie and community among peers that could improve one's sense of belonging; however, the validity of that information may be questionable and thus negatively affect academic success. The significant positive influence of cross-racial interactions (β=.11***) on students' sense of belonging reaffirms the benefits of diversity on college campuses. The corollary to this, that is, the negative impact of experiencing a hostile racial climate (β=-.16***), furthers this argument. Moreover, these two racial dynamic measures work similarly for White and Asian science students as well as URM students not in the sciences.

Several of the other formal structures included in the regression were significant positive predictors, but their independent contributions over and above other independent variables were not significant in the final equation. This indicates possible indirect effects. Formal program experiences that fall into this category include: participating in a pre-professional or departmental club, participating in an academic support program for underrepresented minorities, and enrolling in a learning community course. While these experiences showed a statistically significant positive influence on the dependent variable even after controlling for all the pre-college factors, their predictive powers become insignificant once all the variables are considered. These results were subject to further tests by examining their partial correlation on

certain intermediate outcomes after controlling for pre-college characteristics, including background, academic achievement and external push/pull factors (see Table 8). College GPA and self-rated change in conducting research serve as intermediate outcomes that contribute to both dependent variables. Table 8 shows that in addition to those variables already mentioned, participating in a health science research program (r=.08**) was positively related to self-rated change in conducting research, as was enrolling in a first-year seminar (r=.07**) to college GPA. Moreover, interacting with graduate students or teaching assistants and receiving academic advice from other students or an advisor showed positive and significant correlations with intermediate outcomes.

Insert Table 8 here

The connection between the academic and social realms of college is clearly evinced when examining the last block of variables. Returning to Table 6, relevance of coursework to life (β=.15***), self-rated change in ability to conduct research (β=.09***), and ability to manage the academic environment (β=.09***) were all statistically significant positive predictors of students' sense of belonging. The first two of these show the importance of curriculum that supports active and experiential learning on both academic and social adjustment during college. Of note, college GPA does not show a significant direct effect on sense of belonging, much like early work reported by Spady (1971). Thus, self-assessment of academic ability seems to be more important to students' sense of belonging than external evaluation through grade assignment.

Comparison to other sample groups' sense of belonging. In general, the influence of many of the variables in the regression equation have similar effects for URM and White/Asian

students in the sciences. As mentioned earlier, the positive and significant effect of interacting with diverse peers (β =.11***) held true for White and Asian students as did the negative influence of perceiving a hostile racial climate (β=-.11***). The college academic development variables also showed similar relationships with sense of belonging for science students regardless of race. However, unlike underrepresented students in the sciences, White and Asian students' sense of belonging was not affected by the selectivity of the institution. Their numbers of hours per week spent in class or attending laboratories (β=.09***) positively shaped their sense of belonging. This variable's influence on the dependent variable is statistically and significantly distinct for this sample group (see Table 6). Working on a professor's research project negatively affected White and Asian students' sense of belonging (β=-.08**), a result of a suppressor effect, indicating that other elements of support and self-assessment must be in place if first year students are to participate in such activities in the first year of college.

For underrepresented students in the non-sciences, sense of belonging seemed to depend on other factors in addition to those that were significant for the other sub-samples. For instance, women (β=.07***) and American Indians (β=.05*) had a higher sense of belonging than other students. Women college students may feel a greater sense of belonging in academic disciplines that enroll greater numbers of women than men, such as several of the humanities and social science majors. While the significance of these background characteristics was distinct for URM non-science students (see Table 6), the influence of many of the formal structures that bridge the academic and social systems was similar to that of their underrepresented peers in the sciences. That is, participating in academic programs, support programs for URM students, or first-year experience seminars were initially significant contributors to URM non-science students' sense of belonging, however, the direct effects were not significant once all other variables were

controlled. Table 8 shows the relationship of these variables with academic intermediate outcomes after controlling for pre-college characteristics. While more of these formal structures are statistically significant, positive correlates with both college GPA and self-rated change in conducting research for URM science students, seven of these variables were positively related to college GPA for White and Asian science students, and eight correlated with self-rated change in conducting research for URM non-science students.

Of particular relevance to this study's focus on racial dynamics and their effect on students' academic and social adjustment is the functioning of the college peer environment. For URM non-science students, experiencing positive cross-racial interactions (β =.08**) was a positive predictor of the dependent variable. However, the context in which these interactions took place was also important. Interacting with a predominantly White group of friends (β=-.08**) negatively affected their sense of belonging, but studying with White students (β=.06*) was a positive predictor of sense of belonging. The finding on the ethnic composition of URM non-science students' study groups is statistically distinct from the other two sample groups (see Table 5). It appears that the racial composition of these students' academic versus social peer group works differently on their sense of belonging. Similar to the other two sample groups, perceiving a negative racial climate (β=-.18***) was the greatest detriment to students' sense of belonging among the variables assessed. However, experiencing a competitive peer environment actually worked as a positive predictor (β=.11***).

Discussion and Conclusion

We relied on recent advancements in research and practice that hold promise to study the early college experiences of aspiring scientists and racial/ethnic minorities. The first year of college is filled with challenges for students and, inevitably, students seek connections and

information that will help them manage the adjustment to a new academic environment, as well as find their place within it. Several findings create a greater awareness of the challenges students face in the first year, and begin to highlight important areas where campus resources may make a difference in easing the transition to college.

Managing interdependent relationships with family is a key developmental task for college students (Chickering & Reisser, 1993), though previous theories suggested that separation or achieving autonomy was the preferred adaptation (Tinto, 1993). In a direct test of this relationship, we found family support is important for minority non-science and White and Asian science students for students' sense of belonging in the new environment. However, family responsibilities that interfere with college (according to the student) have a consistent negative affect for both academic adjustment and sense of belonging among all students. Colleges may do best to monitor unusual family responsibilities of particular students in order to assist them financially and emotionally renegotiate relationships.

URM science students seemed to be particularly affected by concerns about their ability to finance college, compared with other students. Science students of all racial groups were also more likely to be affected by financial concerns when it came to feeling a part of campus life. It may well be that these students feel the pressure to work, keep up with the latest technology, and the costs of key texts—it is an area that merits further investigation since it has implications for institutional investment in scientific talent.

Students who were sure of themselves, their ability to communicate with faculty, and had a good handle on managing their time were more likely to have successively managed the academic environment in the first year. This subsequently translated into seeking and taking advantage of access to resources, programs and people that could help them navigate the

academic and social systems of college. Specifically, non-science students were more likely to manage the academic environment when they had frequent interaction with teaching assistants and sought academic advisors for course selection. Seeking academic advice from a junior or senior was particularly important for all students, but seeking advice from another freshman student was negatively associated with academic adjustment for URM science students. Students seek support and information from a variety of sources and understanding this relationship suggests that peer advising can be helpful depending on how these programs are structured.

Recent reformulations of the departure/integration model promise greater inclusiveness of diverse college student experiences (Tinto, 1997; Nora, 2001). Our study was an empirical test of these concepts drawn from earlier work and now confirmed on a multi-institutional sample of first year students. Perhaps more importantly, we have begun to probe the racial dynamics of institutions by examining the effect of students' perceptions and behaviors on academic adjustment and sense of belonging. Perceptions of a hostile climate has a consistent negative affect on sense of belonging for all students, and a persistent negative affect on academic adjustment for underrepresented minorities (both science and non-science). In contrast, the development of positive cross-racial interactions tended to assist all students in achieving a higher sense of belonging on campus. Improving campus intergroup relations merits additional attention if we expect our campuses to achieve both diversity and excellence. Moreover, perceptions of a highly competitive environment appears to add another dimension to the tension in adjustment for minorities in the science.

Intermediate outcomes in the conceptual model for this study had the strongest impact on both academic adjustment and sense of belonging. Specifically, student satisfaction with the relevance of coursework to everyday life is a key factor in both managing the new academic

environment and sense of belonging. This suggests that students' understanding of the application of their knowledge promotes a psychological sense of adjustment. It confirms previous work in this area with racial/ethnic minorities (Bonous-Harmouth, 2000), and extends it to include all students. Changes in students' ability to conduct research (since entering college) is an area of development critical to all students in their management of the academic environment, and plays an important role in URM students' sense of belonging on campus. College grades, however, only had a role in students' assessment of successfully managing the academic environment in the first year. This further suggests the need to separate the use of grades in studies of adjustment from other measures that capture academic adjustment and participation in the academic systems of a college. It is important to note in the evaluation and assessment of programs devised for improving academic transition and acquisition of resources and skills, that they be evaluated using multiple dimensions of academic engagement, adjustment, and integration. Many of these specific programs have an effect on these intermediate outcomes, for example, and facilitate interactions that eventually lead to integration in college. As such, these indirect relationships merit further study.

Finally, our study confirms that academic adjustment and sense of belonging are strongly linked for all students in the first year of college. While previous researchers have assumed that the two can be independent of one another, and they may well be in the later years of college, we show that managing the academic environment is essential to feeling a part of campus life in the first year for all students. Studying how the social and academic systems are linked in college is essential if we hope to increase the talent pools that will lead to graduate and professional school enrollments, and eventual entry into fields of research and practice advancing the health of diverse communities.

Implications for Institutional Research

At the outset of this study, we suggested that the promising pool of URM students who enter college with a strong interest in the biomedical and behavioral sciences could portend an important opportunity for higher education institutions in producing more baccalaureates within these fields (Hurtado et al., 2006). However, we also acknowledged that URM science students face many obstacles along the path toward realizing their career goals as evidenced by the lack of matriculation witnessed in educational attainment data (Anderson & Kim, 2006). The main purpose of this study was to identify the key facilitators and barriers of URM science students' success at managing the academic and social environments of their institutions. The lessons learned through our research might serve as a guide for institutions and institutional researchers seeking to investigate the ways to best support their URM science majors in achieving their educational and career goals.

Some key perspectives for institutional researchers seeking to examine this student population include continued monitoring of the transition experiences of students through the use of CIRP and YFCY data. Together these surveys represent a powerful tool for assessing change within the first year of college as well as tapping into key psychosocial elements of the transition process. It is also of central importance to consider the role that intergroup relations play in URM science student experiences. Several campuses have engaged in climate studies, and our research suggests that institutional climate is a central factor affecting student success. In terms of facilitating success, it is also important to understand the sources of student information and subsequent use of peers in academic advising.

Finally, institutional researchers can do more to investigate how the burden of financial concerns may derail the dream of even the most promising science student. Each of the

institutions participating in CIRP and YFCY in 2004-2005 have these data available to further investigate such effects on their campuses. These are just a few areas within the grasp of knowledge produced by institutional researchers that can lead to programs and planning that enhances the success rate of URM students in the biomedical and behavioral science fields.

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Figure 1:

Conceptual Model Guiding the Study

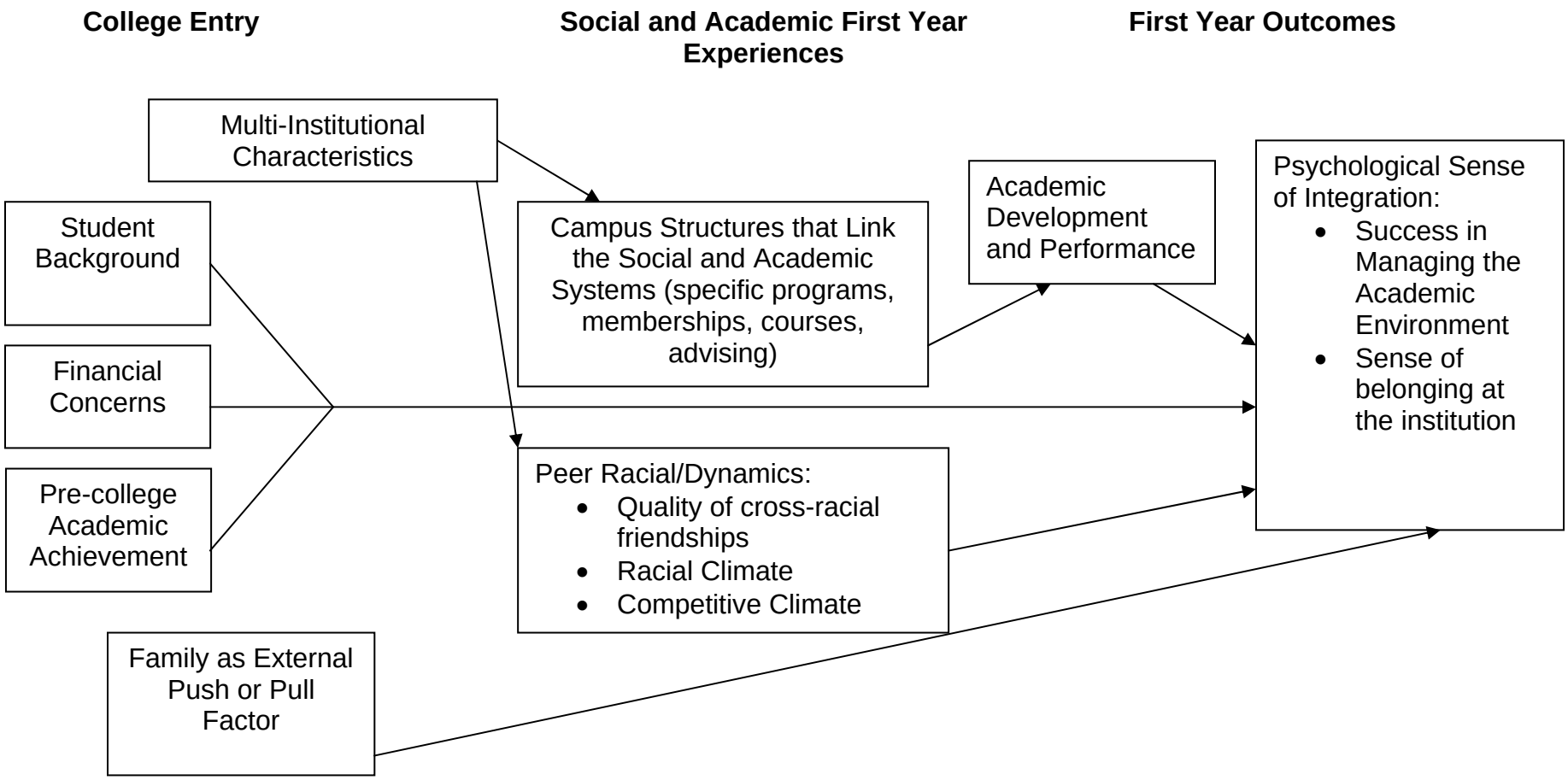

Table 1

Description of Variables and Measures

Dependent Variables

Component	Factor Loadings & Reliability
Success at managing the academic environment	α=0.78
Since entering this college, how successful have you felt at (1=unsuccessful; 3=completely successful):	
Understanding what your professors expect of you academically	0.66
Develop effective study skills	0.82
Adjusting to the academic demands of college	0.81
Managing your time effectively	0.78
Getting to know faculty	0.55
Sense of belonging	α=0.84
Agreement with the following statements (1=strongly disagree; 4=strongly agree):	
I see myself as part of the campus community	0.84
I feel that I am a member of this college	0.89
I feel I have a sense of belonging to this college	0.89

Independent Variables (Factors)

Component	Factor Loadings & Reliability
Student Demographic Variables: Socio-economic status	α=0.67
Family income	0.73
Father's education	0.86
Mother's education	0.83
Academic self-concept	α=0.58
Self-rated academic ability (1=lowest 10%; 5=highest 10%):	
Academic ability	0.84
Mathematics ability	0.61
Self-rated intellectual self-confidence	0.72
Self-rated writing ability	0.54
Social self-concept	α=0.71
Self-rated social ability (1=lowest 10%; 5=highest 10%):	
Leadership ability	0.83
Self-rated social self-confidence	0.76
Self-rated intellectual self-confidence	0.81
Positive racial interactions	α=0.90
To what extent have you experienced the following with students from a racial/ethnic group other than your own (1=never; 5=very often):	
Socialized with someone of a different race	0.61
Dined or shared a meal	0.82
Had a meaningful and honest discussion about race/ethnicity	0.78
Shared personal feelings and problems	0.85
Had intellectual discussions outside of class	0.85
Studied or prepared for class	0.77
Socialized or partied	0.79

Attended events sponsored by other racial/ethnic group	0.63
Perceptions of racial climate	α=0.64
Agreement with the following statements (1=strongly disagree to 4=strongly agree):	
I have been singled out because of my race/ethnicity, gender, or sexual orientation	0.78
I have heard faculty express stereotypes about racial/ethnic groups in class	0.76
There is a lot of racial tension on this campus	0.76

Independent Variables

Variables	Scale
Student background characteristics	
Gender: female	1=no, 2=yes
Ethnic background: Latino, African American/Black, American Indian, Asian/Asian American, White	1=no, 2=yes
Ethnic composition of pre-college environment: High school you last attended Neighborhood where you grew up	1= all/nearly all racial/ethnic minorities; 5= all/nearly all White
Socioeconomic status	scaled index (see above)
Concern of financing college	1=no concern; 3=major concern
Pre-college academic potential	
Combined math and verbal SAT score or converted ACT score	Range: 400 to 1600
High school grade point average	1=D; 8=A or A+
Years of math in high school	1=none; 7=five or more
Years of science in high school	1=none; 7=five or more
Pre-college academic competence	
Hours/week studying or doing homework in high school	1=none; 8=over twenty hours
Likelihood (chances) of communicating with professors in college	1=no chance; 4=very good chance
Highest intended degree (PhD, MD, JD)	1=no, 2=yes
Self-rated time management ability	1=lowest 10%; 5=highest 10%
Academic self-concept	Scaled index (see above)
Social self-concept	Scaled index (see above)
External Commitments	
Rely on family support to succeed	1=not at all; 4=frequently
Interference of family responsibilities with school work	1=not at all; 4=frequently
Institutional Characteristics	
Minority-serving institutions (MSI)	1=no, 2=yes
Private university	1=no, 2=yes
Public university	1=no, 2=yes
Public college	1=no, 2=yes
Institutional Selectivity	Range: 400 to 1600
Percent of degrees awarded in the bio-behavioral sciences (IPEDS, 2001)	Range: 0-100%
Formal structures that link academic/social systems (college)	
Participated in a health science research program	1=no, 2=yes
Joined a pre-professional or department club	1=no, 2=yes
Participated in an academic enrichment/support program for underrepresented minority students	1=no, 2=yes
Enrolled in a first-year experience seminar	1=no, 2=yes
Enrolled in a learning community/cluster program	1=no, 2=yes

Hours spent per week in class/lab	1=none; 9=over 30 hours
Worked on a professor's research project	1=no, 2=yes
Frequency of interaction with graduate student/teaching assistant	1=never; 6=daily
Worked with an academic advisor to select courses	1=not at all; 4=frequently
Received advice/academic advising from a junior/senior	1=not at all; 4=frequently
Received advice/academic advising from a first-year student	1=not at all; 4=frequently
Peer Environment	
Positive cross-racial interactions	Scaled index (see above)
Ethnic composition of college friends: White	1= all/nearly all racial/ethnic minorities; 5= all/nearly all White
Ethnic composition of study groups: White	1= all/nearly all racial/ethnic minorities; 5= all/nearly all White
Perceptions of racial climate: Hostile	1=strongly disagree; 4=strongly agree
Perceptions of a competitive environment	1=strongly disagree; 4=strongly agree
Academic Competence (College)	
Relevance of coursework to everyday life	1=very dissatisfied; 5=very satisfied
Change in ability to conduct research	1=much weaker; 5=much stronger
Ability to manage academic environment	1=unsuccessful; 3=completely successful
Hours per week studying or doing homework	1=none; 9=over 30 hours
College GPA	1=C- or less; 6=A

Table 2

Descriptives & Means Across Key Groups

		DV: Success at Managing Academic Environment (scale: 1-3)		DV: Sense of Belonging (scale: 1-4)	
	N	Mean	SD	Mean	SD
Male	1645	2.14	(.44)	3.01	(.61)
Female	3385	2.12	(.44)	3.04	(.60)
White	995	2.17	(.45)	3.05	(.61)
Black	1989	2.13	(.43)	3.05	(.60)
American Indian	237	2.11	(.43)	3.00	(.67)
Asian/Pacific Islander	324	2.01	(.48)	2.95	(.56)
Latino	1447	2.11	(.44)	3.01	(.60)
URM Science majors	1749	2.10	(.43)	3.04	(.58)
White/Asian Science Majors	1247	2.13	(.46)	3.02	(.60)
URM non-Science majors	2035	2.14	(.44)	3.02	(.63)
Total	5030	2.12	(.44)	3.03	(.60)

Notes: Data are weighted.

Table 3

ANOVAs Across Key Groups on Two Outcome Measures

		Sum of Squares	df	Mean Square	F	Sig. (p-value)
DV: Academic success	Between Groups	6.68	4	1.67	8.60	0.00
By Racial Groups	Within Groups	962.14	4956	0.19		
	Total	968.82	4960			
DV: Sense of belonging	Between Groups	3.82	4	0.95	2.62	0.03
By Racial Groups	Within Groups	1778.67	4881	0.36		
	Total	1782.48	4885			
DV: Academic success	Between Groups	1.43	2	0.71	3.65	0.03
By Three Groups	Within Groups	974.99	4990	0.20		
	Total	976.41	4992			
DV: Sense of belonging	Between Groups	0.65	2	0.32	0.89	0.41
By Three Groups	Within Groups	1790.62	4915	0.36		
	Total	1791.27	4917			

Note: Data are weighted. By Racial Groups refers to the five racial groups represented in the data. By Three Groups refers to URM Science, URM non-Science, and White/Asian Science majors.

Table 4

Scheffe Post-Hoc Tests for Success at Managing Academic Environment by Key Groups

1st Group	2nd Group	Mean Diff. (1st - 2nd)	p<.05
Asian/Pacific Islander	White	-0.16	*
	Black	-0.12	*
	American Indian	-0.11	*
	Latino	-0.11	*
White	Latino	0.02	*
URM Science majors	URM non-Science majors	-0.04	*
	White/Asian Science Majors	-0.03	not sig.

Note: Data are weighted. Only significant between-group differences are displayed in this table.

Table 5

Success at Managing Academic Environment

VARIABLE	URM Science (1,800) r	Inputs	Final Beta	White Asian Science (1,347) r	Inputs	Final Beta	URM Non-Science (1,771) r	Inputs	Final Beta
Background characteristics									
Gender: Female	-0.03	-0.04	-0.02	0.00	-0.02	-0.03	0.00	0.00	-0.01
Latino (referent: Black)	-0.05	0.00	0.02	NA	NA	NA	0.02	0.03	0.06 *
American Indian (referent: Black)	0.03	0.02	0.02	NA	NA	NA	-0.04	0.00	0.02
Asian/Asian American (referent: White)	NA	NA	NA	-0.19 ***	-0.17 ***	-0.06 *	NA	NA	NA
Ethnic comp of pre-college environment (White)	0.10 ***	0.09 ***	0.03	0.10 ***	-0.01	-0.05	0.03	0.01	-0.01
SES	0.08 ***	0.02	0.01	0.05	-0.03	-0.03	0.04	0.01	-0.05 *
Concern of financing college	-0.13 ***	-0.08 ***	-0.07 ***	-0.15 ***	-0.10 ***	-0.06 *	-0.06 **	-0.04	-0.05 *
			Adj. R^2=.02			Adj. R^2=.05			Adj. R^2=.00
Academic Achievement-Pre College									
SAT/ACT	-0.01	-0.09 **	-0.06	0.02	-0.06	0.03	0.00	-0.06	-0.01
HSGPA	0.05 *	0.01	-0.05 *	0.14 ***	0.06	0.00	0.09 ***	0.03	0.01
Yrs. Of math in HS	-0.03	-0.05 *	-0.03	0.02	0.00	-0.02	-0.02	-0.05 *	-0.06 **
Yrs. Of Bio Sci in HS	0.03	0.01	0.00	0.01	0.00	0.02	0.02	0.02	0.03
Hrs/week studying or doing homework in HS	0.11 ***	0.07 **	0.03	0.11 ***	0.08 **	0.05	0.10 ***	0.04	0.01
Best guess to communicate w/professors	0.14 ***	0.09 ***	0.07 **	0.18 ***	0.09 ***	0.08 **	0.18 ***	0.13 ***	0.06 **
Aspire to PhD, MD, JD	-0.05 *	-0.07 **	-0.05 *	0.02	-0.04	-0.02	0.04	0.00	0.01
Self-rated ability to time manage	0.26 ***	0.19 ***	0.14 ***	0.30 ***	0.22 ***	0.15 ***	0.26 ***	0.20 ***	0.16 ***
Academic self-concept	0.17 ***	0.08 **	0.03	0.19 ***	0.05	0.01	0.17 ***	0.03	-0.02
Social self-concept	0.18 ***	0.07 *	0.09 ***	0.16 ***	0.03	0.04	0.20 ***	0.09 **	0.08 ***
			Adj. R^2=.12			Adj. R^2=.14			Adj. R^2=.10
External Push/Pull Factors									
Family support to succeed	0.02	0.00	-0.03	0.10 ***	0.06 *	0.01	0.07 **	0.06 *	0.04 *
Family responsibilities interfere	-0.09 ***	-0.08 ***	-0.07 ***	-0.14 ***	-0.09 ***	-0.08 ***	-0.13 ***	-0.13 ***	-0.10 ***
			Adj. R^2=.12			Adj. R^2=.15			Adj. R^2=.12
Institutional Characteristics									
MSI	0.10 ***	0.08 **	-0.05	0.05 *	0.06 *	-0.01	0.07 **	0.10 ***	-0.01
Public University (referent: Private 4-yr college)	-0.12 ***	-0.11 ***	-0.05	-0.20 ***	-0.16 ***	-0.09 **	-0.09 ***	-0.09 ***	-0.08 **
Private University (referent: Private 4-yr college)	-0.01	-0.03	-0.02	0.04	0.02	-0.04	0.01	-0.03	-0.05
Public 4-yr College (referent: Private 4-yr college)	0.05	0.06 **	-0.02	0.05	0.08 **	-0.02	-0.01	0.03	-0.05 *
Selectivitiy	-0.11 ***	-0.18 ***	-0.16 **	-0.04	-0.15 ***	-0.25 ***	-0.07 **	-0.19 ***	-0.21 ***
%of degreses awarded in Bio-behavioral sciences	0.01	0.06 **	0.06	0.07 *	0.09 **	0.17 **	0.05 *	0.09 ***	0.13 ***
			Adj. R^2=.17			Adj. R^2=.23			Adj. R^2=.18
Institutional structures linking academic and social systems									
Participate in health science research program	0.03	0.02	0.00	0.04	0.02	0.02	0.01	-0.01	-0.02
Participate in pre-prof or dept. club	0.09 ***	0.08 ***	0.01	0.08 **	0.06 *	-0.04	0.07 **	0.04	-0.02
Participate in academic support program for URMs	0.03	0.02	0.02	-0.02	0.02	0.00	0.00	-0.03	-0.02
Enroll in first-year experience seminar	0.09 ***	0.08 ***	0.03	0.05 *	0.04	0.01	0.06 *	0.04	0.02
Enroll in learning community	0.02	0.04	0.01	0.04	0.02	0.00	0.02	0.02	0.00
Hrs/week in class or lab	0.06 *	0.04	-0.03	0.08 **	0.04	-0.04	0.08 ***	0.05 *	-0.03
Worked on prof.'s research	0.06 **	0.05 *	-0.02	0.05	0.05	-0.05	0.09 ***	0.09 ***	-0.02
Frequency of interacting with grad student/TA	0.05 *	0.04	0.04	-0.01	-0.05 *	-0.05 *	0.10 ***	0.07 **	0.08 ***
Worked with academic advisor to select courses	0.17 ***	0.15 ***	0.04	0.18 ***	0.13 ***	0.02	0.15 ***	0.13 ***	0.02
Academic advising by junior/senior	0.12 ***	0.10 ***	0.05 *	0.09 **	0.06 *	0.03	0.14 ***	0.09 ***	0.04
Academic advising by a freshmen	0.00	0.00	-0.07 **	0.03	0.02	-0.03	0.05 *	0.03	-0.05 *
			Adj. R^2=.20			Adj. R^2=.24			Adj. R^2=.20
Peer Environment									
Positive cross-racial interactions	0.04	0.04	0.05	0.05	0.04	0.05	0.07 **	0.05	0.06 *
Ethnic composition college friends (White)	0.01	0.03	0.02	0.17 ***	0.10 **	0.02	0.04	0.02	-0.01
Ethnic composition study groups (White)	0.07 **	0.05 *	0.03	0.17 ***	0.11 ***	0.08 ***	0.10 ***	0.07 **	0.04
Perceptions of racial climate (hostile)	-0.12 ***	-0.10 ***	-0.05 *	-0.11 ***	-0.08 **	-0.03	-0.12 ***	-0.12 ***	-0.05 *
Perceptions of competitive environment	-0.11 ***	-0.13 ***	-0.08 ***	-0.10 ***	-0.10 ***	-0.05	-0.05 *	-0.08 ***	-0.05 *
			Adj. R^2=.22			Adj. R^2=.25			Adj. R^2=.21
Academic development & performance									
Relevance of coursewrk to life	0.31 ***	0.28 ***	0.17 ***	0.39 ***	0.32 ***	0.24 ***	0.33 ***	0.28 ***	0.18 ***
Change in ability to conduct research	0.23 ***	0.20 ***	0.10 ***	0.26 ***	0.21 ***	0.10 ***	0.25 ***	0.20 ***	0.11 ***
Hrs/week studying or doing homework	0.19 ***	0.16 ***	0.11 ***	0.24 ***	0.17 ***	0.10 ***	0.19 ***	0.14 ***	0.10 ***
College GPA	0.39 ***	0.40 ***	0.31 ***	0.41 ***	0.38 ***	0.27 ***	0.37 ***	0.38 ***	0.29 ***
			Adj. R^2=.34			Adj. R^2=.39			Adj. R^2=.33

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

Includes: Success at understanding professors' expectations, developing effective study skills, adjusting academically, managing time, getting to know faculty

Table 6

Sense of Belonging

VARIABLE	URM Science (1,779) r	Inputs	Final Beta	White Asian Science (1,335) r	Inputs	Final Beta	URM Non-Science (1,760) r	Inputs	Final Beta
Background characteristics									
Gender: Female	-0.01	0.00	0.01	0.00	0.02	0.00	0.03	0.06 *	0.07 ***
Latino (referent: Black)	-0.05 *	-0.04	-0.06 *	NA	NA	NA	0.01	0.02	0.04
American Indian (referent: Black)	0.01	-0.02	-0.03	NA	NA	NA	0.00	0.02	0.05 *
Asian/Asian American (referent: White)	NA	NA	NA	-0.11 ***	-0.06 *	0.01	NA	NA	NA
Ethnic comp of pre-college environment (White)	0.09 ***	0.07 *	0.02	0.10 ***	0.02	-0.02	0.08 ***	0.02	0.02
SES	0.08 ***	-0.02	-0.03	0.15 ***	0.04	0.02	0.11 ***	0.05	0.03
Concern about financing college	-0.12 ***	-0.08 ***	-0.09 ***	-0.19 ***	-0.12 ***	-0.09 ***	-0.07 **	-0.02	-0.01
			Adj. R^2=.02			Adj. R^2=.05			Adj. R^2=.01
Academic Achievement-Pre College									
SAT/ACT	0.09 ***	0.06 *	0.08 *	0.17 ***	0.05	0.01	0.13 ***	0.06	0.08 *
HSGPA	0.05 *	-0.01	0.00	0.17 ***	0.07 *	0.04	0.09 ***	-0.02	-0.03
Yrs. Of math in HS	0.00	-0.04	-0.04	0.07 *	0.02	0.01	0.08 ***	0.04	0.03
Yrs. Of Bio Sci in HS	0.04	0.01	0.00	0.03	-0.01	-0.01	0.04	0.02	0.02
Hrs/week studying or doing homework in HS	0.07 **	0.03	0.00	0.14 ***	0.08 **	0.05	0.11 ***	0.03	-0.01
Best guess to communicate w/professors	0.13 ***	0.08 ***	0.04	0.15 ***	0.05	0.00	0.22 ***	0.15 ***	0.06 **
Aspire to PhD, MD, JD	0.03	0.00	0.00	0.08 **	0.01	0.01	0.06 **	-0.01	-0.01
Self-rated ability to time manage	0.10 ***	0.05	0.03	0.15 ***	0.04	-0.01	0.13 ***	0.05 *	0.02
Academic self-concept	0.14 ***	0.04	0.01	0.21 ***	0.03	0.03	0.20 ***	0.05	0.01
Social self-concept	0.15 ***	0.09 ***	0.06 *	0.20 ***	0.12 ***	0.10 ***	0.22 ***	0.14 ***	0.10 ***
			Adj. R^2=.05			Adj. R^2=.10			Adj. R^2=.09
External Push/Pull Factors									
Family support to succeed	0.10 ***	0.07 **	0.04	0.16 ***	0.12 ***	0.07 **	0.13 ***	0.10 ***	0.07 ***
Family responsibilities interfere	-0.11 ***	-0.10 ***	-0.09 ***	-0.17 ***	-0.12 ***	-0.09 ***	-0.13 ***	-0.12 ***	-0.09 ***
			Adj. R^2=.06			Adj. R^2=.13			Adj. R^2=.12
Institutional Characteristics									
MSI	0.01	0.00	-0.06	-0.09 ***	-0.07 *	-0.04	0.01	0.06 *	0.03
Public University (referent: Private 4-yr college)	-0.03	0.00	0.05	-0.05	-0.03	0.02	-0.03	-0.02	0.04
Private University (referent: Private 4-yr college)	0.06 **	0.02	0.05	0.10 ***	0.04	-0.02	0.09 ***	0.02	0.03
Public 4-yr College (referent: Private 4-yr college)	-0.06 **	-0.03	-0.02	-0.12 ***	-0.06 *	0.00	-0.06 *	0.02	0.06 *
Selectivity	0.03	-0.01	-0.17 **	0.19 ***	0.13 ***	-0.02	0.08 ***	-0.02	-0.01
%of degreses awarded in Bio-behavioral sciences	0.05	0.08 **	0.09	0.13 ***	0.15 ***	0.11	0.08 ***	0.09 ***	0.03
			Adj. R^2=.07			Adj. R^2=.15			Adj. R^2=.13
Institutional structures linking academic and social systems									
Participate in health science research program	0.06 *	0.04	0.01	0.03	0.01	-0.03	0.08 ***	0.06 **	0.05 *
Participate in pre-prof or dept. club	0.13 ***	0.10 ***	0.04	0.09 ***	0.05	-0.03	0.13 ***	0.09 ***	0.03
Participate in academic support program for URMs	0.09 ***	0.08 ***	0.04	0.03	0.06 *	0.04	0.09 ***	0.06 **	0.03
Enroll in first-year experience seminar	0.05 *	0.04	0.03	0.09 ***	0.08 **	0.05	0.08 ***	0.07 **	0.03
Enroll in learning community	0.05 *	0.07 **	0.03	0.04	0.03	0.01	0.03	0.03	0.01
Hrs/week in class or lab	0.05 *	0.01	-0.03	0.15 ***	0.10 ***	0.09 ***	0.14 ***	0.10 ***	0.06 **
Worked on prof.'s research	0.01	0.02	-0.05	-0.03	0.00	-0.08 **	-0.01	0.01	-0.04
Frequency of interacting with grad student/TA	0.14 ***	0.13 ***	0.05 *	0.16 ***	0.10 ***	0.04	0.14 ***	0.10 ***	0.02
Worked with academic advisor to select courses	0.15 ***	0.13 ***	0.03	0.19 ***	0.16 ***	0.05	0.18 ***	0.17 ***	0.06 **
Academic advising by junior/senior	0.24 ***	0.21 ***	0.12 ***	0.25 ***	0.20 ***	0.10 ***	0.24 ***	0.18 ***	0.08 ***
Academic advising by a freshmen	0.17 ***	0.16 ***	0.06 **	0.24 ***	0.22 ***	0.11 ***	0.17 ***	0.13 ***	0.04
			Adj. R^2=.14			Adj. R^2=.21			Adj. R^2=.18
Peer Environment									
Positive cross-racial interactions	0.16 ***	0.15 ***	0.11 ***	0.19 ***	0.15 ***	0.11 ***	0.16 ***	0.11 ***	0.08 **
Ethnic composition college friends (White)	0.04	0.04	-0.01	0.13 ***	0.06	0.04	0.02	-0.04	-0.08 **
Ethnic composition study groups (White)	0.12 ***	0.10 ***	0.04	0.14 ***	0.09 ***	0.02	0.15 ***	0.09 ***	0.06 *
Perceptions of racial climate (hostile)	-0.16 ***	-0.16 ***	-0.16 ***	-0.14 ***	-0.13 ***	-0.11 ***	-0.19 ***	-0.21 ***	-0.18 ***
Perceptions of competitive environment	0.02	0.01	0.01	0.06 *	0.04	0.02	0.12 ***	0.09 ***	0.11 ***
			Adj. R^2=.18			Adj. R^2=.24			Adj. R^2=.24
Academic development & performance									
Relevance of coursewrk to life	0.27 ***	0.25 ***	0.15 ***	0.30 ***	0.26 ***	0.14 ***	0.34 ***	0.30 ***	0.18 ***
Change in ability to conduct research	0.19 ***	0.19 ***	0.09 ***	0.19 ***	0.16 ***	0.05 *	0.20 ***	0.18 ***	0.07 **
Ability to manage academic environment	0.25 ***	0.21 ***	0.09 ***	0.30 ***	0.24 ***	0.15 ***	0.30 ***	0.24 ***	0.11 ***
Hrs/week studying or doing homework	0.12 ***	0.10 ***	0.05	0.21 ***	0.13 ***	0.01	0.17 ***	0.10 ***	0.00
College GPA	0.11 ***	0.07 **	-0.04	0.14 ***	0.04	-0.06 *	0.15 ***	0.089 ***	0.004
			Adj. R^2=.22			Adj. R^2=.29			Adj. R^2=.29

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

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

Table 7

Comparison of Unstandardized Beta (b) Coefficients

	Academic success			Sense of belonging		
	Final Unstandardized b Coefficient			Final Unstandardized b Coefficient		
VARIABLE	URM Science [A]	White/ Asian Science [B]	URM Non-science [C]	URM Science [A]	White/ Asian Science [B]	URM Non-science [C]
Background characteristics						
Gender: Female	-0.02	-0.03	-0.01	0.02	0.01 C	0.10 B
Latino (referent: Black)	0.02	NA	0.05	-0.08 C	NA	0.05 A
American Indian (referent: Black)	0.03	NA	0.04	-0.06 C	NA	0.12 A
Asian/Asian American (referent: White)	NA	-0.07	NA	NA	0.01	NA
Ethnic comp of pre-college environment (White)	0.01 B	-0.02 A	0.00	0.01	-0.01	0.01
SES	0.00	-0.02	-0.02	-0.02	0.01	0.02
Concern of financing college	-0.05	-0.04	-0.03	-0.08 C	-0.09 C	-0.01 A,B
Academic Achievement-Pre College						
SAT/ACT	-0.02	0.01	0.00	0.03	0.00	0.03
HSGPA	-0.02	0.00	0.00	0.00	0.02	-0.01
Yrs. Of math in HS	-0.03	-0.02	-0.04	-0.04 C	0.01	0.03 A
Yrs. Of Bio Sci in HS	0.00	0.01	0.01	0.00	-0.01	0.02
Hrs/week studying or doing homework in HS	0.01	0.02	0.00	0.00	0.02	0.00
Best guess to communicate w/professors	0.04	0.05	0.04	0.04	0.00	0.06
Aspire to PhD, MD, JD	-0.05 C	-0.02	0.01 A	0.00	0.01	-0.02
Self-rated ability to time manage	0.07	0.08	0.08	0.02	-0.01	0.01
Academic self-concept	0.02	0.01	-0.01	0.01	0.04	0.01
Social self-concept	0.05	0.03	0.05	0.04	0.08	0.08
External Push/Pull Factors						
Family support to succeed	-0.01 C	0.00	0.02 A	0.02	0.05 C	0.05 B
Family responsibilities interfere	-0.03	-0.04 C	-0.05 B	-0.06	-0.06	-0.06
Institutional Characteristics						
MSI	-0.05	-0.02	-0.01	-0.07	-0.09	0.04
Public University (referent: Private 4-yr college)	-0.05	-0.08	-0.08	0.07	0.02	0.05
Private University (referent: Private 4-yr college)	-0.02	-0.04	-0.05	0.08	-0.03 C	0.05 B
Public 4-yr College (referent: Private 4-yr college)	-0.03	-0.03	-0.05	-0.03	0.00	0.09
Selectivitiy	-0.05	-0.10	-0.06	-0.07 C	-0.01 C	0.00 A,B
%of degreses awarded in Bio-behavioral sciences	0.25	0.71 C	0.52 B	0.47	0.59	0.17
Formal structures linking academic and social systems - College						
Participate in health science research program	0.00	0.03	-0.03	0.01	-0.05 C	0.09 B
Participate in pre-prof or dept. club	0.01	-0.04	-0.02	0.05	-0.05	0.06
Participate in academic support program for URMs	0.02	0.00	-0.02	0.05	0.09	0.05
Enroll in first-year experience seminar	0.03	0.01	0.01	0.04	0.06 C	0.04 B
Enroll in learning community	0.02	0.00	0.00	0.06	0.02	0.02
Hrs/week in class or lab	-0.01	-0.02	-0.01	-0.01 B,C	0.05 A,C	0.03 A,B
Worked on prof.'s research	-0.01	-0.03	-0.01	-0.03	-0.06	-0.03
Frequency of interacting with grad student/TA	0.01 B	-0.02 A,C	0.02 B	0.02	0.02 C	0.01 B
Worked with academic advisor to select courses	0.02	0.01	0.01	0.02	0.03 C	0.04 B
Academic advising by junior/senior	0.02	0.01	0.02	0.07	0.06	0.05
Academic advising by a freshmen	-0.03	-0.02 C	-0.02 B	0.04	0.07	0.02
Peer Environment						
Positive cross-racial interactions	0.02	0.02	0.03	0.07	0.07 C	0.05 B
Ethnic composition college friends (White)	0.01	0.01	0.00	-0.01	0.02	-0.04
Ethnic composition study groups (White)	0.01	0.02	0.01	0.02 C	0.01 C	0.03 A,B
Perceptions of racial climate (hostile)	-0.04	-0.03 C	-0.03 B	-0.15	-0.12	-0.18
Perceptions of competitive environment	-0.04	-0.03	-0.02	0.01	0.01 C	0.08 B
Academic development & performance						
Relevance of coursewrk to life	0.09 B	0.13 A,C	0.09 B	0.11	0.10	0.13
Change in ability to conduct research	0.06	0.07 C	0.06 B	0.07	0.05 C	0.05 B
Ability to manage academic environment				0.12	0.19	0.17
Hrs/week studying or doing homework	0.03	0.03 C	0.03 B	0.02	0.00	0.00
College GPA	0.10	0.10 C	0.10 B	-0.02	-0.03 C	0.00 B

p<.05 (two-tailed)

Letter [A, B, C] referring to group where difference is statistically signficant

Table 8

Partial correlations of formal structures with intermediate outcomes (controlling for input variables)

	URM Science		White Asian Science		URM Non-science	
Correlations	College GPA	Change in conducting research	College GPA	Change in conducting research	College GPA	Change in conducting research
Participate in health science research program	-0.01	0.08 **	0.02	0.05	0.00	0.06 *
Participate in pre-prof or dept. club	0.08 **	0.05 *	0.02	0.04	0.04	0.03
Participate in academic support program for URMs	-0.01	0.02	-0.04	0.04	0.01	0.03
Enroll in first-year experience seminar	0.07 **	0.00	0.08 **	0.03	0.03	0.06 **
Enroll in learning community	0.04	0.04	0.06 *	-0.01	0.06 *	-0.01
Hrs/week in class or lab	0.07 **	0.04	0.09 ***	-0.01	0.10 ***	0.05 *
Worked on prof.'s research	0.05 *	0.22 ***	0.07 **	0.16 ***	-0.01	0.20 ***
Frequency of interacting with grad student/TA	-0.04	0.10 ***	-0.05 *	0.09 ***	-0.03	0.06 *
Worked with academic advisor to select courses	0.09 ***	0.13 ***	0.12 ***	0.02	0.04	0.11 ***
Academic advising by junior/senior	0.06 *	0.12 ***	0.09 ***	0.04	0.02	0.10 ***
Academic advising by a freshmen	0.03	0.08 **	0.06 *	0.04	-0.04	0.07 *

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

Correlations controlling for background, academic achievement, external push/pull factors.