2007

Predicting transition and adjustment to college: Minority biomedical and behavioral science students' first year of college

Sylvia Hurtado
June C Chang
Victor B Saenz
Lorelle L Espinosa
Nolan L Cabrera, et al.

Research in Higher Education, Vol. 48, No. 7, November 2007 (© 2007)
DOI: 10.1007/s11162-007-9051-x

PREDICTING TRANSITION AND ADJUSTMENT TO COLLEGE: BIOMEDICAL AND BEHAVIORAL SCIENCE ASPIRANTS' AND MINORITY STUDENTS' FIRST YEAR OF COLLEGE

Sylvia Hurtado,*,† June C. Han,* Victor B. Sáenz,* Lorelle L. Espinosa,* Nolan L. Cabrera,* and Oscar S. Cerna*

The purpose of this study is to explore key factors that impact the college transition of aspiring underrepresented minority students in the biomedical and behavioral sciences, in comparison with White, Asian students 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 of the integration model (Nora, Barlow, and Crisp, 2005), we find concerns about college financing, negotiating family support and responsibility, and campus racial dynamics (perceived and behavioral) affect student adjustment and sense of integration in the first year.

KEY WORDS: college adjustment; underrepresented minorities; science education; first year of college; sense of belonging; transition.

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

*University of California, 405 Hilgard Ave., 3005 Moore Hall, Los Angeles, CA, 90095-1521 USA.

†Address correspondence to: Sylvia Hurtado, University of California, 405 Hilgard Ave., 3005 Moore Hall, Los Angeles, CA, 90095-1521 USA. E-mail: shurtado@gseis.ucla.edu

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% of scientific bachelor's degrees are awarded to African American and Latina/os, compared with 31% for Asian Americans and 16% for White students (Anderson and 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 et al., 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). This indicates that there are aspiring scientists among the diverse student population, but we need to study the obstacles these students may face 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 (Nora, Barlow, and Krisp, 2005; Tinto, 1993; Upcraft and Gardner, 1989). 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 (Braxton, Sullivan, and Johnson, 1997; Tinto, 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 (Hurtado and Carter, 1997; Tierney, 1992).

Previous research has pointed to distinctions in the nature and quality of interactions that URMs may experience in differing racial dynamics within college environments (Allen, 1992; Chang, Denson, Sàenz, and Misa, 2006; Hurtado and Carter, 1997; Sàenz, Ngai, and Hurtado, 2007). URMs aspiring toward biomedical or behavioral science careers may be severely underrepresented on predominantly white campuses. We explored how their experiences differed from racial/ethnic minorities in other fields as well as compared them 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 (Chickering and Reisser, 1993; Erikson, 1968; Piaget, 1985), such as the first year of college where new expectations of faculty and new levels of competence among peers are evident. Gurin, Dey, Hurtado, and Gurin (2002) have described transitions as pivotal moments for development that present a high degree of uncertainty. 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 and 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 with 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, 1970), 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, 1994; Ruble and Flett, 1988). 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 (Braxton, Milem, and Sullivan, 2000; Tinto, 1997). 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 and 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, and 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 and Carter, 1997; Locks, Bowman, Hurtado, and 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 (Chang, 1999; Chang et al., 2006; Gurin et al. 2002; Hurtado, Milem, Clayton-Pederson, and Allen, 1998). More specifically, these dynamics can affect student transition to college for all students early in their college career (Hurtado and Carter, 1997; Locks et al., 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, and 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 (Farrell, 2002; Goodchild, 2004). Students may 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 (Steele, 1997; Thompson and Sekaquaptewa, 2002). 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 et al. (2005) have 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. They include 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, they emphasize 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, they include 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 (2007) 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

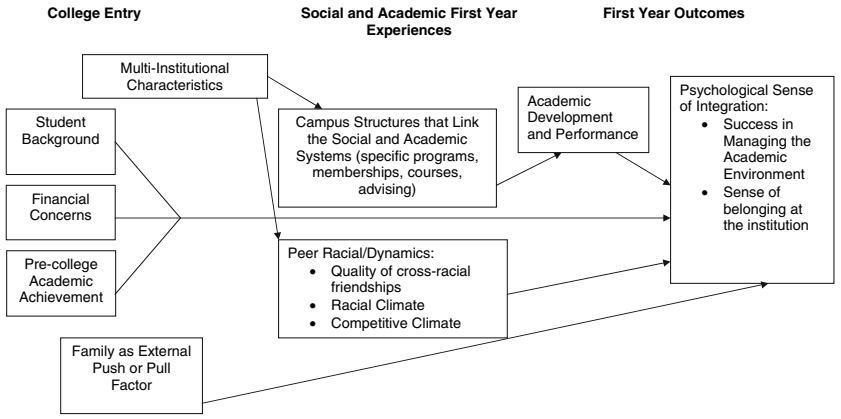

FIG. 1 Conceptual model guiding the study.

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 Fig. 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.

We adopted key constructs from the Nora et al. (2005) model to detail the link between first year college outcomes at multiple types of 4-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 and Stolzenberg, 2004, and Sax et al., 2004, for more detail of both surveys). In total, over 26,000 students from 203 4-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 representation 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), 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 subgroups 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 biomedical/behavioral 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 85 targeted institutions that met these initial criteria. This sampling technique was employed to compare (1) underrepresented (URM) with represented (White and Asian) groups in science and (2) science and non-science minority groups. White and

Asian students were treated as an aggregate "majority" group to study the effects of race and representation on science students' adjustment during the first year of college. Subsequent papers may focus on differences between individual racial groups, but the intent of this inquiry was to contrast broader distinctions between minority and majority groups and science and non-science students.

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 first selected institutions that returned surveys from more than 80% of their first-time full-time population (as determined by the ratio of total YFCY students surveyed divided by their total first-time full-time student population). We then also selected institutions that indicated they attempted to survey all of their first-year student population, all their CIRP respondents, or a random selection thereof. This process of selecting institutions was employed in order to mirror our targeted sampling strategy (detailed in the previous paragraphs). In sum, this selection process yielded additional students attending 75 institutions. The longitudinal sample yielded a total 160 institutions, and a final sample of 5049 students comprised of URM science majors (1851), White/Asian science majors (1366), and URM non-science majors (1832).

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 (Astin and Molm, 1972), and a weight adjustment technique. Researchers employ this weighting technique to adjust the sample upward to the original population (Babbie, 2001; Dey, 1997), 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. For both

samples, we had entering freshmen responses to the CIRP survey. This ensured we had full data on both respondents and non-respondents at college entry and allowed us to do several important things. It allowed us to understand well the entering characteristics of students selecting the same types of colleges and to use more than 200 variables to determine non-response bias across these campuses. Using a variety of prediction equations, we derived a final set of 45 variables that were the strongest predictors of non-response. Weight values were assigned to each respective student within the targeted and all FTFT samples through these separate regression analyses, and then these samples were combined to create a single weight variable for all students. (A detailed description of weighting analyses and variables that predict non-response are available in a technical report at http://www.gseis.ucla.edu/heri/nih).

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. These weighting procedures follow those outlined by Astin and Molm (1972). In reviewing this technique, Dey's (1997) analysis of weighting adjustments in survey data found them to be "very effective in reducing nonresponse bias...even when response rates are low", and especially in cases when many predictor variables are available as in the present study (p. 225). As a final check, analyses were conducted to confirm how well the weighted sample approximated the original freshmen population on key variables available for both respondents and nonrespondents.[3]

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

TABLE 1. Description of Variables and Measures

Variables	Scale
Dependent Variables	
Success at managing the academic environment	A composite measure of five variables that assess students' success at understanding what your professors expect of you academically, developing effective study skills, adjusting to the academic demands of college, managing your time effectively and getting to know faculty. The five variables are measured separately on a three-point scale: 1 = unsuccessful to 3 = completely successful.
Sense of belonging	A composite measure of three variables that assess students' agreement with the statements: I see myself as a part of the campus community, I feel that I am a member of this college, and I feel I have a sense of belonging to this college. The three variables are measured separately on a four-point scale: 1 = strongly disagree to 4 = strongly agree.
Independent Variables	
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:	1 = all/nearly all racial/ethnic minorities; 5 = all/nearly all White
High school you last attended	
Neighborhood where you grew up	
Concern of financing college	1 = no concern; 3 = major concern
Socioeconomic status	A composite measure of three variables that assess family income, father's education and mother's education.

TABLE 1. continued

Variables	Scale
Academic achievement: Pre-college	
Combined SAT score or converted ACT score	Range: 400–1600
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
Hours/week studying or doing homework in high school	1 = none; 8 = over 20 hours
Likelihood of communicating with professors in college	1 = no chance; 4 = very good chance
Aspire to PhD, MD, JD	1 = no, 2 = yes
Self-rated time management ability	1 = lowest 10%; 5 = highest 10%
Academic self-concept	A composite measure of four variables that assess students' self-rated academic ability, mathematics ability, intellectual self-confidence and writing ability. The four variables are measured separately on a five-point scale: 1 = lowest 10% to 5 = highest 10%
Social self-concept	A composite measure of three variables that assess students' self-rated leadership ability, social self-confidence and intellectual self-confidence. The three variables are measured separately on a five-point scale: 1 = lowest 10% to 5 = highest 10%
External push/pull factors	
Rely on family support to succeed	1 = not at all; 4 = frequently
Family responsibilities interfere 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

TABLE 1. continued

Variables	Scale
Public university	1 = no, 2 = yes
Public college	1 = no, 2 = yes
Institutional Selectivity	Range: 400–1600
Percent of degrees awarded in the bio-behavioral sciences (NCES, 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	1 = never; 6 = daily
Student/teaching assistant	1 = not at all; 4 = frequently
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

TABLE 1. continued

Variables	Scale
Received advice/academic advising from a first-year student	1 = not at all; 4 = frequently
Peer environment	
Positive cross-racial interactions	A composite measure of seven variables that assess how often students have experienced the following with students from a different racial/ethnic group than their own: socialized, dined or shared a meal, had meaningful and honest discussions about race/ethnicity, shared personal feelings and problems, had intellectual discussions outside of class, studied or prepared for class, socialized or partied. The seven variables are measured separately on a five-point scale: 1 = never to 5 = very often
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	A composite measure of three variables that assess students' agreement with the statements: I have been singled out because of my race/ethnicity, gender, or sexual orientation, I have heard faculty express stereotypes about racial/ethnic groups in class, There is a lot of racial tension on this campus. The three variables are measured separately on a four-point scale: 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

of three survey items modified from previous studies (Bollen and Hoyle, 1990; Hurtado and Carter, 1997), 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. Scales were constructed based on the original scales of the variables comprising the factor. Factor loading and alpha reliability measures are included in Appendix A.

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 precollege 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 and 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 4-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.

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 also 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, and Rubin, 1977, cited in Allison, 2002; McLachlan and 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 Appendix A).

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.

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 the outcome variables across sample 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 non-science students to gain an understanding of whether and how academic and social transition issues are different for minority 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.

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. Surprisingly, no statistically significant between-group differences across these three groups' sense of belonging is evident ($F = 0.89$). Multivariate analyses, however, indicated a difference in predictors of students' sense of belonging.

While these results offer some evidence of the existence of between-group differences for the academic adjustment measure, they do not

TABLE 2. Descriptives and 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)

Note: Data are weighted. .

offer any information on the specific differences among subgroups. Subsequently, 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 Table 4, although only results for students' success at managing the academic environment are shown, since no between group differences were observed for the sense of belonging outcome measure.

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 URM non-science peers but not their White/Asian science peers. These descriptive results demonstrate key between-group differences that served to inform the multivariate analyses.

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			

Notes: 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..

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% of the variance of the academic adjustment outcome, with students' academic competence before and during college, as well as the formal characteristics of their

TABLE 5. Success at Managing Academic Environment

	URM Science (1800)			White Asian Science (1347)			URM Non-Science (1771)		
Variable	*r*	Inputs	Final Beta	*r*	Inputs	Final Beta	*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
Years of math in HS	−0.03	−0.05 *	−0.03	0.02	0.00	−0.02	−0.02	−0.05 *	−0.06**
Years 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

TABLE 5. *Continued*

Variable	URM Science (1800)			White Asian Science (1347)			URM Non-Science (1771)		
	r	Inputs	Final Beta	*r*	Inputs	Final Beta	*r*	Inputs	Final Beta
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-year college)	−0.12***	−0.11***	−0.05	−0.20***	−0.16***	−0.09**	−0.09***	−0.09***	−0.08**
Private University (referent: Private 4-year college)	−0.01	−0.03	−0.02	0.04	0.02	−0.04	0.01	−0.03	−0.05
Public 4-year College (referent: Private 4-year college)	0.05	0.06**	−0.02	0.05	0.08**	−0.02	−0.01	0.03	−0.05 *
Selectivity	−0.11***	−0.18***	−0.16**	−0.04	−0.15***	−0.25***	−0.07**	−0.19***	−0.21***
% of degrees 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

TABLE 5. *Continued*

Variable	URM Science (1800)			White Asian Science (1347)			URM Non-Science (1771)		
	r	Inputs	Final Beta	*r*	Inputs	Final Beta	*r*	Inputs	Final Beta
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		

TABLE 5. *Continued*

Variable	URM Science (1800)			White Asian Science (1347)			URM Non-Science (1771)		
	r	Inputs	Final Beta	*r*	Inputs	Final Beta	*r*	Inputs	Final Beta
Academic development and 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..

higher education institution contributing strong predictive power to the equation.

In terms of traits and experiences that students bring with them when they enter college, 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.

On the other hand, students' self-rated ability to manage their time, sense of social self-concept, and expectation that they will communicate with professors 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 adjustment.

Results for how institutional characteristics affect URM science students' academic adjustment support this argument. For instance, controlling for ability levels, students attending public universities and highly selective institutions had lower assessments of their sense of academic success in the first year. In fact, enrollment at a selective institution ($\beta = -.16^{**}$) 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 ($\beta = .08^{**}$), the association becomes nonsignificant once selectivity is taken into account. This indicates MSIs are typically less selective institutions; thus, any influence institutional race has on the dependent variable is accounted for by institutional selectivity.

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 ($\beta = .05^{*}$) can positively affect students' sense of academic success, but obtaining advice from another first-year student ($\beta = .–07^{**}$) 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 et al., 1996). Contrary to Tinto's (1997) research at community colleges, participating in a learning community showed no direct influence on the dependent variable for this sample. Participation in an academic support program for underrepresented students or a first-year experience seminar, however, both have a significant positive influence on the dependent variable. Once students' college GPA is taken into account, these relationships become insignificant, indicating a potential indirect effect of these programs.

In terms of peer environment, students' perceptions of a hostile racial climate ($\beta = -.05$*) showed a unique predictive and negative effect on the dependent variable. Similarly, students who perceived a highly competitive environment were also less likely to feel successful at managing their academic environment ($\beta = -.08$***).

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 ($\beta = .31$***), assessing that the coursework has relevance to daily life ($\beta = .17$***) 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 ($\beta = .10$***) and hours per week spent studying or doing homework ($\beta = .11$***) 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 neither negative nor significant on the outcome variable. While these differences suggest that White and Asian students are not hindered by the same type of expectations that weigh on their underrepresented peers, attending a selective institution ($\beta = -.25$***) 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 ($\beta = -.05$*) for White and Asian science students

and receiving academic advising from peers had no effect. Table 6 depicts the unstandardized 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) when compared with URM students (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 competitive environment or a hostile racial climate. Different from the URM peers, studying with a predominantly White study group ($\beta = .08^{***}$) was a positive predictor of adjustment for White and Asian science students. The contribution of variables assessing students' sense of academic performance while in college acted similarly for majority and minority students pursuing the sciences. The relevance of coursework to life, however, more strongly influenced White and Asian science students than their underrepresented peers (Table 6).

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' experiences are more like their underrepresented peers in other academic disciplines than their White and Asian science peers. As specific examples, the influence of social self-concept upon entering college ($\beta = .08^{***}$) and experiencing a hostile racial climate ($\beta = -.05^{*}$) or competitive peer environment ($\beta = -.05^{*}$) 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 ($\beta = .06^{*}$) than other URM non-science students. Family support to succeed is another positive factor ($\beta = .04^{*}$) that is statistically and significantly distinct from URM science majors (see Table 5). Also, interacting with a graduate student or teaching assistant ($\beta = .08^{***}$) positively influences academic adjustment as does experiencing positive cross-racial interactions ($\beta = .06^{*}$) with peers. The pedagogical differences in how science and non-science classes operate

TABLE 6. Comparison of Unstandardized Beta (b) Coefficients on Both Outcomes

	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	URM Science [A]	White/Asian Science [B]	URM Non-science [C]
Background characteristics						
Gender: Female	−0.02	−0.03	−0.01	0.02	0.01C	0.10B
Latino (referent: Black)	0.02	NA	0.05	−0.08C	NA	0.05A
American Indian (referent: Black)	0.03	NA	0.04	−0.06C	NA	0.12A
Asian/Asian American (referent: White)	NA	−0.07	NA	NA	0.01	NA
Ethnic comp of pre-college environment (White)	0.01B	−0.02A	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	−0.08C	−0.09C	−0.01A,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
Years of math in HS	−0.03	−0.02	−0.04	−0.04C	0.01	0.03A
Years 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

TABLE 6. *Continued*

Variable	Academic success			Sense of belonging		
	Final unstandardized b coefficient			Final unstandardized b coefficient		
	URM Science [A]	White/Asian Science [B]	URM Non-science [C] URM Science	URM Science [A]	White/Asian Science [B]	URM Non-science [C]
Aspire to PhD, MD, JD	−0.05C	−0.02	0.01A	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	−0.01C	0.00	0.02A	0.02	0.05C	0.05B
Family responsibilities interfere	−0.03	−0.04C	−0.05B	−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-year college)	−0.05	−0.08	−0.08	0.07	0.02	0.05
Private University (referent: Private 4-year college)	−0.02	−0.04	−0.05	0.08	−0.03C	0.05B
Public 4-year College (referent: Private 4-year college)	−0.03	−0.03	−0.05	−0.03	0.00	0.09
Selectivity	−0.05	−0.10	−0.06	−0.07C	−0.01C	0.00A,B
%of degrees awarded in Bio-behavioral sciences	0.25	0.71C	0.52B	0.47	0.59	0.17

TABLE 6. *Continued*

Variable	Academic success			Sense of belonging		
	Final unstandardized b coefficient			Final unstandardized b coefficient		
	URM Science [A]	White/Asian Science [B]	URM Non-science [C] URM Science	URM Science [A]	White/Asian Science [B]	URM Non-science [C]
Formal structures linking academic and social systems—College						
Participate in health science research program	0.00	0.03	−0.03	0.01	−0.05C	0.09B
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	0.06C	0.04B
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	−0.01B,C	0.05A,C	0.03A,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	0.01B	−0.02A,C	0.02B	0.02	0.02C	0.01B
Worked with academic advisor to select courses	0.02	0.01	0.01	0.02	0.03C	0.04B
Academic advising by junior/ senior	0.02	0.01	0.02	0.07	0.06	0.05
Academic advising by a freshmen	−0.03	−0.02C	−0.02B	0.04	0.07	0.02

TABLE 6. *Continued*

Variable	Academic success			Sense of belonging		
	Final unstandardized b coefficient			Final unstandardized b coefficient		
	URM Science [A]	White/Asian Science [B]	URM Non-science [C] URM Science	URM Science [A]	White/Asian Science [B]	URM Non-science [C]
Peer environment						
Positive cross-racial interactions	0.02	0.02	0.03	0.07	0.07C	0.05B
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	0.02C	0.01C	0.03A,B
Perceptions of racial climate (hostile)	−0.04	−0.03C	−0.03B	−0.15	−0.12	−0.18
Perceptions of competitive environment	−0.04	−0.03	−0.02	0.01	0.01C	0.08B
Academic development and performance						
Relevance of coursewrk to life	0.09B	0.13A,C	0.09B	0.11	0.10	0.13
Change in ability to conduct research	0.06	0.07C	0.06B	0.07	0.05C	0.05B
Ability to manage academic environment				0.12	0.19	0.17

TABLE 6. *Continued*

Variable	Academic success			Sense of belonging		
	Final unstandardized b coefficient			Final unstandardized b coefficient		
	URM Science [A]	White/Asian Science [B]	URM Non-science [C] URM Science	URM Science [A]	White/Asian Science [B]	URM Non-science [C]
Hrs/week studying or doing homework	0.03	0.03C	0.03B	0.02	0.00	0.00
College GPA	0.10	0.10C	0.10B	−0.02	−0.03C	0.00B

$p < .05$ (two-tailed)..
Letters [A, B, C] referring to group where difference is statistically significant..

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 student's own psychological sense of social integration resulting from the intersection of academic and social realms, which are crucial to students' transition in college (Hoffman et al., 2002; Hurtado and Carter, 1997).

Underrepresented Minority Students in the Sciences

Several factors that affected URM science students' ability to manage the academic environment function similarly to influence their sense of belonging (see Table 7). For instance, financial and family concerns impede both academic and social adjustment for this group of students. Students' social self-concept ($\beta = .06$*) upon entering college also serves as a positive predictor of sense of belonging as it did academic adjustment. 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. URM students with high SAT/ACT scores and those with a higher social self-concept show a greater sense of belonging.

Among the institutional characteristics, selectivity ($\beta = -.17$**) was the only variable that showed a negative effect on students' sense of belonging. Attending an MSI or campuses with a higher percentage of science students did not seem to significantly affect students' sense of belonging. While the broader enrollment composition of an institution 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 ($\beta = .05$*), receiving advice from a junior or senior ($\beta = .12$***), receiving academic advice from a freshman ($\beta = .06$**) and interacting with peers of diverse racial backgrounds ($\beta = .11$***). 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

TABLE 7. Sense of Belonging

	URM Science (1779)			White Asian Science (1335)			URM Non-Science (1760)		
Variable	*r*	Inputs	Final Beta	*r*	Inputs	Final Beta	*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
Years of math in HS	0.00	−0.04	−0.04	0.07 *	0.02	0.01	0.08***	0.04	0.03
Years 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

TABLE 7. *Continued*

Variable	URM Science (1779)			White Asian Science (1335)			URM Non-Science (1760)		
	r	Inputs	Final Beta	*r*	Inputs	Final Beta	*r*	Inputs	Final Beta
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-year college)	−0.03	0.00	0.05	−0.05	−0.03	0.02	-0.03	−0.02	0.04
Private University (referent: Private 4-year college)	0.06**	0.02	0.05	0.10***	0.04	−0.02	0.09***	0.02	0.03
Public 4-year College (referent: Private 4-year 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 degrees 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 *

TABLE 7. *Continued*

Variable	URM Science (1779)			White Asian Science (1335)			URM Non-Science (1760)		
	r	Inputs	Final Beta	*r*	Inputs	Final Beta	*r*	Inputs	Final Beta
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 *

TABLE 7. *Continued*

Variable	URM Science (1779)			White Asian Science (1335)			URM Non-Science (1760)		
	r	Inputs	Final Beta	*r*	Inputs	Final Beta	*r*	Inputs	Final Beta
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 and 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..

one's sense of belonging; however, the validity of that information may be questionable and thus negatively affect academic success. 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 and will be the focus of future studies that utilize other statistical tests, such as path analysis, to test these connections.

Looking to the peer environment, the significant positive influence of cross-racial interactions ($\beta = .11^{***}$) 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 ($\beta = -.16^{***}$), 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.

The connection between the academic and social realms of college is clearly evinced when examining the last block of variables. Relevance of coursework to life ($\beta = .15^{***}$), self-rated change in ability to conduct research ($\beta = .09^{***}$), and ability to manage the academic environment ($\beta = .09^{***}$) 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 has similar effects for URM and White/Asian students in the sciences. As mentioned earlier, the positive and significant effect of interacting with diverse peers held true for White and Asian students ($\beta = .11^{***}$) as did the negative influence of perceiving a hostile racial climate ($\beta = -.11^{***}$). 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. The number of hours per week they spent in class or attending laboratories ($\beta = .09^{***}$) 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 ($\beta = -.08^{**}$), 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 comparison groups. For instance, women ($\beta = .07^{***}$) and American Indians ($\beta = .05^{*}$) 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 7), the functioning 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, several of these variables 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.

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 ($\beta = .08^{**}$) was a positive predictor of sense of belonging. However, the context in which these interactions took place was also important. Interacting with a predominantly White group of friends ($\beta = -.08^{**}$) negatively affected their sense of belonging, but studying with White students ($\beta = .06^{*}$) 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 6). 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 ($\beta = -.18^{***}$) 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 ($\beta = .11^{***}$) among non-science minority students.

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 and 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' 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 (Nora et al., 2005; Tinto, 1997). 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 have a consistent negative effect 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 appear to add another dimension to the tension in adjustment particularly for minorities in the sciences.

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-Hammarth, 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 and 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.

Further, our results indicate that while students are affected by broader institutional characteristics, such as selectivity, more often than not, it is their immediate environments, including informal peers groups and formal structures that link academic and social systems, which shape their adjustment experiences. Institutional researchers may glean additional useful information by assessing students' experiences in these more immediate environments in addition to tracking broader enrollment or climate trends. Partnering and coordinating program evaluation with institutional research efforts could be a step in this direction.

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.

APPENDIX

Appendix A: Construction of factors for analyses

Component	Factor loadings
Success at managing the academic environment ($\alpha = 0.78$)	
Since entering this college, how successful have you felt at:	
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 ($\alpha = 0.84$)	
Agreement with the following statements:	
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
Student Demographic Variables: Socio-economic status ($\alpha = 0.67$)	
Family income	0.73
Father's education	0.86

Appendix *Continued*

Component	Factor loadings
Mother's education	0.83
Academic self-concept (α = 0.58)	
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)	
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:	
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:	
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

NOTES

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.

3. Regression results using weighted and unweighted data showed little difference, indicating the relationships among the variables remained the same.

REFERENCES

Allen, W. R. (1992). The color of success: African American college student outcomes at predominantly White and historically Black colleges and universities. *Harvard Educational Review* 62(1): 26–44.

Allison, P. D. (2002). *Missing Data*, Sage Publications, Thousand Oaks, CA.

Anderson, E., and Kim, D. (2006). *Increasing the Success of Minority Students in Science and Technology*, American Council on Education, Washington, D.C.

Antonio, A. L. (2004). The influence of friendship groups on intellectual self-confidence and educational aspirations in college. *Journal of Higher Education* 75(4): 446–471.

Astin, A. W., and Molm, L. D. (1972). *Correcting for Nonresponse Bias in Follow-up Surveys*. Unpublished paper. Office of Research, American Council of Education, Washington, DC.

Babbie, E. (2001). *The Practice of Social Research*, Wadsworth, Belmont, CA.

Bollen, K. E., and Hoyle, R. H. (1990). Perceived cohesion: A conceptual and empirical examination. *Social Forces* 69(2): 479–504.

Bonous-Hammarth, M. (2000). Pathways to success: Affirming opportunities for science, mathematics, and engineering majors. *Journal of Negro Education* 69(1): 92–111.

Bonous-Hammarth, M. (2006). Promoting student participation in science, technology, engineering and mathematics careers. In: Allen, W. R., Bonous-Hammarth, M., and Teranishi, R. T. (eds.), *Higher Education in a Global Society: Achieving Diversity, Equity, and Excellence*, Elsevier Ltd, Oxford, pp. 269–282.

Braxton, J. M. (2000). *Reworking the Student Departure Puzzle*, Vanderbilt University Press, Nashville, TN.

Braxton, J. M., Milem, J. F., and Sullivan, A. S. (2000). The influence of active learning on the college student departure process: Toward a revision of Tinto's theory. *The Journal of Higher Education* 71(5): 569–590.

Braxton, J. M., Sullivan, A. S., and Johnson, R. M. (1997). Appraising Tinto's theory of college departure. In: Smart, J. (ed.), *Higher Education: a Handbook for Theory And Research*, Agathon Press, New York, pp. 107–164.

Chang, M. J. (1999). Does racial diversity matter? The educational impact of a racially diverse undergraduate population. *Journal of College Student Development* 40(4): 377–394.

Chang, M. J., Denson, N., Sàenz, V., and Misa, K. (2006). The educational benefits of sustaining cross-racial interaction among undergraduates. *The Journal of Higher Education* 77(3): 430–455.

Chickering, A. W., and Reisser, L. (1993). *Education and Identity*, (2nd Ed.). Jossey-Bass, San Francisco, CA.

Dempster, A. P., Laird, N. M., and Rubin, D. B. (1977). Maximum likelihood from incomplete data via the EM algorithm. *Journal of the Royal Statistical Society* 39(1): 1–38.

Dey, E. L. (1997). Working with low survey response rates: The efficacy of weighting adjustments. *Research in Higher Education* 38(2): 215–227.

Erikson, E. H. (1968). *Identity: Youth and Crisis*, Norton, New York.

Farrell, E. F. (2002). Engineering a warmer welcome for female students. *The Chronicle of Higher Education* 48(2/22): A31–A32.

Goodchild, F. M. (2004). The pipeline: Still leaking. *American Scientist* 92(2): 112–113.
Gurin, P., Dey, E. L., Hurtado, S., and Gurin, G. (2002). Diversity and higher education: Theory and impact on educational outcomes. *Harvard Educational Review* 72(3): 330–366.
Hoffman, M., Richmond, J., Morrow, J., and Salomone, K. (2002). Investigating "Sense of Belonging" in first-year college students. *Journal of College Student Retention* 4(3): 227–256.
Hurtado, S. (2007). The sociology of the study of college impact. In: Gumport, P. (ed.), *Sociology of Higher Education*, Johns Hopkins University Press, Baltimore, MD, pp. 94–112.
Hurtado, S., and Carter, D. F. (1997). Effects of college transition and perceptions of the campus racial climate on Latino college students' sense of belonging. *Sociology of Education* 70(4): 324–345.
Hurtado, S., Carter, D. F., and Spuler, A. (1996). Latino student transition to college: Assessing difficulties and factors in successful college adjustment. *Research in Higher Education* 37(2): 135–157.
Hurtado, S., Cerna, O. S., Chang, J. C., Sàenz, V. B., Lopez, L. R., Mosqueda, C., Oseguera, L., Chang, M. J., and Korn, W. S. (2006). *Aspiring Scientists: Characteristics of College Freshmen Interested in the Biomedical and Behavioral Sciences*, Higher Education Research Institute, Los Angeles.
Hurtado, S., Milem, J. F., Clayton-Pederson, A. R., and Allen, W. R. (1998). Enhancing campus climates for racial/ ethnic diversity: Educational policy and practice. *Review of Higher Education* 21(3): 279–302.
Keup, J. R., and Stolzenberg, E. B. (2004). *Your First College Year Survey: Exploring the Academic and Personal Experiences of First-Year Students*, University of South Carolina, National Resource Center for the First Year Experience and Students in Transition, Columbia, S.C.
Locks, A., Bowman, N., Hurtado, S., and Oseguera, L. (2006). *Extending Notions of Campus Climate and Diversity to the Transition to College: Experiences with Diverse Peers and College Sense of Belonging*. Paper presented at the annual meeting of the American Educational Research Association. San Francisco, CA, April, 2006.
McLachlan, G. J., and Krishnan, T. (1997). *The EM Algorithm and Extensions*, Wiley, New York.
National Science and Technology Council (2000). *Ensuring a Strong U.S. Scientific, Technical, and Engineering Workforce in the 21st century*, Office of Science and Technology Policy, Washington, DC.
National Center for Education Statistics (2001). *Digest of Education Statistics 2001 (NCES 2001–258). U.S. Department of Education*, U.S. Government Printing Office, Washington, DC.
Nora, A., Barlow, L., and Crisp, G. (2005). Student persistence and degree attainment beyond the first year in college. In: Seidman, A. (ed.), *College Student Retention: Formula for Success*, Praeger Publications, Westport, CT, pp. 129–153.
Piaget, J. (1985). *Equilibration of Cognitive Structures*, University of Chicago Press, Chicago, IL.
Ruble, D. (1994). Developmental changes in achievement evaluation: Motivational implications of self-other differences. *Child Development* 65(4): 1095–1110.
Ruble, D., and Flett, G. L. (1988). Conflicting goals in self-evaluative information seeking: Developmental and ability level analyses. *Child Development* 59(1): 97–106.
Sàenz, V. B., Ngai, H., and Hurtado, S. (2007). Factors influencing positive interactions across race for African-American, Asian-American, Latino, and White college students. *Research in Higher Education* 48(1): 1–38.
Sax, L. J., Hurtado, S., Lindholm, J., Astin, A., Korn, W., and Mahoney, K. (2004). *The American Freshman: National Norms for Fall 2004*, UCLA, Higher Education Research Institute, Los Angeles.

Seymour, E., and Hewitt, N. M. (1997). *Talking about Leaving: Why Undergraduates Leave the Sciences*, Westview Press, Boulder, CO.

Spady, W. (1970). Dropouts from higher education: An interdisciplinary review and synthesis. *Interchange* 1(1): 64–85.

Spady, W. G. (1971). Dropouts from higher education: Toward an empirical model. *Interchange* 2(3): 38–62.

Steele, C. M. (1997). A threat in the air: How stereotypes shape intellectual identity and performance. *American Psychologist* 52: 613–629.

Sullivan Commission (2004). *Missing Persons: Minorities in the Health Professions*, Sullivan Commission on Diversity in the Healthcare Workforce, Washington, DC.

Thompson, M., and Sekaquaptewa, D. (2002). When being different is detrimental: Solo status and the performance of women and racial minorities. *Analyses of Social Issues and Public Policy* 2(1): 183–203.

Tierney, W. G. (1992). An anthropological analysis of student participation in college. *Journal of Higher Education* 63(6): 603–607.

Tinto, V. (1975). Dropouts from higher education: A theoretical synthesis of the recent literature. *A Review of Educational Research* 45(1): 89–125.

Tinto, V. (1993). *Leaving College: Rethinking the Causes and Cures of Student Attrition*, (2nd Ed.). The University of Chicago Press, Chicago, IL.

Tinto, V. (1997). Classrooms as communities: Exploring the educational character of student persistence. *The Journal of Higher Education* 68(6): 599–623.

Upcraft, U. M., and Gardner, J. N. (1989). *The Freshman Year Experience: Helping Students Survive and Succeed in College*, Jossey-Bass, San Francisco, CA.

Received June 9, 2006; accepted October 2, 2006