ABSTRACT

Title of Dissertation: SENSE OF BELONGING AMONG WOMEN OF COLOR IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH MAJORS: INVESTIGATING THE CONTRIBUTIONS OF CAMPUS RACIAL CLIMATE PERCEPTIONS AND OTHER COLLEGE ENVIRONMENTS

Dawn Rene Johnson, Doctor of Philosophy, 2007

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This study examined the relationship between campus racial climate perceptions and other college environments to sense of belonging among undergraduate women of color in science, technology, engineering, and mathematics (STEM) majors. The conceptual framework combined two college impact models, Weidman's (1989) model of undergraduate socialization and Astin's (1991) input-environment-outcome model, with a transformative perspective (Mertens, 2005) to examine sense of belonging among women of color in STEM majors.

Data came from the 2004 National Study of Living-Learning Programs, and included 1,722 women in undergraduate STEM majors from 29 institutions in the U.S. identifying as Black/African American, Asian Pacific American, Latina, American Indian, Multiracial/Multiethnic, and White/Caucasian. Results from two-way ANOVAs

revealed that women of color reported a less strong sense of belonging than White/Caucasian women and had more interactions with diverse peers than White/Caucasian women. In addition, Black/African American women perceived a less positive campus racial climate than women from other racial/ethnic groups. Significant predictors in a hierarchical multiple regression analysis for sense of belonging (29% variance explained) included race/ethnicity, perceptions of academically and socially supportive climates in the residence hall, perceptions of a positive campus racial climate, academic self-confidence, academic class year, socializing with friends from home, and participation in a STEM-related living-learning program. Partial correlation analyses indicated that perceptions of a positive campus racial climate were significantly correlated to sense of belonging for Black/African American, Multiracial/Multiethnic, and Asian Pacific American women.

Findings supported the application of college impact theories with a transformative perspective to the experiences of women of color in STEM. The regression model supported the salience of campus racial climate perceptions to sense of belonging for women in STEM; however the relationship between STEM living-learning programs and sense of belonging requires further study. Results identified the salience of the campus racial climate and sense of belonging for women of color in STEM, the significance of the residence hall climate to sense of belonging, and the need for racial/ethnic diversity among STEM living-learning program participants. Results are important given the growing enrollments of women of color in higher education and the need to expand access to STEM careers.

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Dedication

I dedicate this dissertation to the women of color who participated in the Excellence in Math, Science and Engineering Program at WPI from 1997-2002. Your individual and collective experiences inspired this dissertation and I stand in awe of all that you endure as scientists and engineers.

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They say “it takes a village to raise a child.” I would add that it also takes a village to get a Ph.D. On this page I wish to acknowledge the village who provided me with support, encouragement, and love as I completed my doctoral studies and this dissertation. I am certain that I had the best dissertation committee ever of the most phenomenal women and scholars. I will always be grateful to my advisor and chair Karen Kurotsuchi Inkelas, for all that you have taught me about the joys and challenges of faculty life. Thank you for pushing me in my writing and research and for being committed to our relationship. I continue to be inspired by Marylu McEwen for your endless generosity, wisdom, and ability to listen. I could not imagine going through this process without you to smooth over the rough edges. And finally, Lynn Bolles, Ruth Fassinger, and Susan Jones, trusted mentors from whom I have learned so much through our conversations about teaching, research, and life. Thanks to my entire committee for treating me as a colleague in this process.

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Table of Contents

List of Tables

Chapter 1: Introduction

For the past 30 years, researchers and educators have struggled to understand the under-representation of women in STEM (science, technology, engineering, and mathematics) fields (Blickenstaff, 2005; Clewell & Campbell, 2002). This body of research has identified a variety of educational and social factors affecting women's participation in these fields. These factors include inadequate academic preparation, curricula and teaching practices that are not female-friendly, few positive experiences with science, lack of role models and mentors, societal stereotypes about who can be scientists, and the chilly climate in STEM environments (Blickenstaff; Clewell & Campbell; Ehrhart & Sandler, 1987). However, this body of research has often failed to acknowledge or account for racial/ethnic group differences among women's experiences in these fields (Hanson, 2004).

In addition, a small number of studies among the body of research on women in STEM have explored non-cognitive or affective dimensions of their experiences (see A. Johnson, 2001; Ong, 2005; Seymour & Hewitt, 1997; Sosnowski, 2002), all of which used qualitative research methods. Although it is important to understand academic preparation and achievement, persistence, and other cognitive factors associated with women's under-representation in STEM fields, such foci prohibit understanding the quality of women's experiences in these fields, especially as it relates to racial and ethnic group membership. The quality of women's experiences in these male dominated arenas should not be overlooked, especially because women often receive messages from faculty and peers that they do not belong in science (see Erhrart & Sandler, 1987; Ong, 2005; Seymour & Hewitt, 1997). Focusing on the affective dimensions of the college

experiences of women in STEM may provide insight into the lack of growth of women's STEM degree attainment in recent years (National Science Foundation [NSF], 2004a). Thus, the purpose of this study was to examine an affective outcome, overall sense of belonging, among women from different racial/ethnic groups in undergraduate STEM majors.

Importance of Examining Racial/Ethnic Group Differences

Consideration of differences among racial/ethnic groups is important because not all women participate in STEM fields at comparable and equitable rates. For example, looking at gender alone, data indicated that in 2000 women comprised 50.0% of the United States population and accounted for 20.0% of the science and engineering workforce in 1999 (NSF, 2003). Among those in the science and engineering workforce, in 1999, 4.6 % were women of color and 15.5% were White (NSF, 2003). This example illustrates that considering race and ethnicity highlights important differences of women's participation in STEM fields, and that doing so enhances "our understanding of the unique talents, interests, and experiences of subgroups of women" (Hanson, 2004, p. 96).

The press for research practices accounting for the experiences of women of color in STEM fields began in 1975 with a historic meeting of 30 women of color scientists sponsored by the American Association for the Advancement of Science and the National Science Foundation (Malcom, Hall, & Brown, 1976). The purpose was to persuade researchers and policy-makers to take notice of women of color in science fields to understand their "unique position as the most underrepresented and probably overselected group in the scientific disciplines" (Malcom et al., p. ix). This unique position was characterized as the "double bind" in which women of color find themselves the target of

both racism and sexism in academic and career fields that are dominated by White people and men (Malcom et al.).

Since this meeting, the need for research and policy geared toward women of color in science was again identified in 1991 in a literature review published by the Center for Women Policy Studies (see Clewell & Anderson, 1991). Researchers continued to address the question of women's under-representation in STEM without examining differences among women from various racial/ethnic groups (Clewell & Campbell, 2002) because they were simply not included in research samples or their numbers were too small for quantitative analysis (Clewell & Ginorio, 1996).

Within the past ten years, the scholarship focused on women of color in science has grown with the works of S.V. Brown (1995), A. Johnson (2001), Ong (2005), and Sosnowski (2002) on women from under-represented racial/ethnic groups; Chinn (2002) and K. E. Vogt (2005) on Asian Pacific American/Islander women; and Hanson (2004) and Jordan (2006) on African American women. Other researchers have used samples of women and men from various racial/ethnic backgrounds to differentiate the experiences of women of color in STEM, including Bonous-Hammath (2000), Grandy (1998), Huang, Taddese, Walter, and Peng (2000), Leslie, McClure, and Oaxaca (1998), and Smyth and McArdle (2004). Although gains have been made in this area of research, it is important to continue developing knowledge and understanding of women of color in STEM fields as their enrollment in post-secondary institutions continues to grow (Harvey & Anderson, 2005) in the face of stagnant degree attainment in STEM fields (Harvey & Anderson, 2005; NSF, 2004a). These changing demographics demand that research practices continue to include the experiences of women of color because "it is no longer feasible,

or appropriate, or just to conduct research solely on White subjects and use the findings of this research to make policy decisions for the entire populace" (Clewell & Ginorio, 1996, p. 216).

The exclusion of women of color from the research literature is not unique to the scholarship on women in science and engineering. This practice was identified by feminist scholars of color who noted the lack of attention to issues faced by women of color given by White feminist scholars (Anzaldúa, 1990; Anzaldúa & Moraga, 1983). The attempts to universalize women's experiences without considering the impacts of race/ethnicity, class, and other social identities resulted in "scholarship that…cannot reveal the magnitude, complexity, or interdependence of systems of oppression" (Zinn, Cannon, Higginbotham, & Dill, 1990, p. 36). Subsequently, feminist scholars (primarily of color) began considering race, gender, and class as a means for theorizing, analyzing, and understanding women's experiences (see Amott & Matthaei, 1996; Andersen & Collins, 2001; Chow, Wilkinson, & Zinn, 1996; Zinn & Dill, 1996). Such a framework not only applies to women of color, but also to White women, who also experience race and gender, although this often goes un-named and un-analyzed in research (Uttal, 1990). Accounting for racial/ethnic group differences recognizes that "there is no generic gender oppression which is experienced by all women regardless of their race-ethnicity" (Amott & Matthaei, p. 13).

Sense of Belonging and the STEM Experience

In the 1949 statement *The Student Personnel Point of View*, the American Council on Education (1949/1987) noted that establishing a sense of belonging to their campus was an important need for students and thus, an objective of the work of student affairs

professionals. Sense of belonging was defined as relating to a student's social adjustment to college and involved "finding a role in relation to others which will make him [or her] feel valued, will contribute to his [or her] feeling of self-worth, and will contribute to a feeling of kinship with an increasing number of persons" (American Council on Education, 1949/1987, pp. 22-23). Students' sense of belonging could be achieved through involvement in campus activities and social programs, participation in small groups, and interactions with faculty outside the classroom (American Council on Education, 1949/1987). At the time this statement was issued, students enrolled in institutions of higher education in the United States were mostly White men (as evidenced by the use of male gendered pronouns), while women and people of color were largely educated in gender and racially segregated institutions (Thelin, 2003). Thus the concept of sense of belonging most likely referred to students from dominant groups fitting in among each other, rather than students from minority groups finding a sense of belonging among students from majority groups.

Contemporary scholarship, however, has been concerned with how students from racial and ethnic minority groups achieve a sense of belonging within predominantly White institutions. With a focus on Latino students' experiences, Hurtado and Carter (1997) used sense of belonging to understand how academic and social experiences contribute to students' ability to identify and affiliate with their institution. For under-represented students who have been historically marginalized in higher education, sense of belonging can assess the extent to which they feel isolated from or part of the mainstream campus community, which may offer little support or affirmation of their cultural identities (Hurtado & Carter). Sense of belonging as a subjective measure

(Hoffman, Richmond, Morrow, & Salamone, 2003) operates on both cognitive and affective levels; individuals assess their role in relation to their peer group, and the result of this assessment produces an affective response (Hurtado & Carter).

Several qualitative studies have unearthed themes related to sense of belonging among undergraduate women in STEM majors in general (see Seymour & Hewitt, 1997) and women of color in particular (see A. Johnson, 2001; Ong, 2005; Sosnowski, 2002). The nature of STEM environments that are centered on Whiteness and maleness contributed to the difficulty women of color had in feeling a sense of belonging. Negative interactions with male peers and faculty, isolation from racial/ethnic group peers, negative racial climate perceptions, encounters with negative racial and gender stereotypes, and lost confidence all contributed to a lack of belonging experienced by women of color in STEM (A. Johnson; Ong; Seymour & Hewitt; Sosnowski).

As a direction of future research, Hurtado and Carter (1997) suggested investigating sense of belonging among students from certain majors. The current study adds to the research literature by applying the concept of sense of belonging to a different under-represented group, women of color in STEM undergraduate majors, using a quantitatively derived measure of sense of belonging. It is worthwhile to examine the experiences of women of color in STEM fields through the lens of sense of belonging because of their historic under-representation, their status as racial/ethnic and gender minorities, and their participation in environments that may not welcome or affirm them.

Pre-College Patterns of Under-Representation

The under-representation of women of color in STEM fields originates in their pre-college educational experiences. Beginning in middle school and through high

school, gender and racial/ethnic group differences are evident in interest, achievement, and course completion in math and science areas (Betz, 1997; Clewell & Braddock, 2000). Because much of the pre-college information gathered does not specify these patterns for girls of color, it is necessary to discuss data for all girls and racial/ethnic minority children.

Math and science interests and self-concepts. Data reported by the National Science Foundation (2003) indicated gender differences in students' interests in math and science and self-perceptions of their abilities among children in the 4th, 8th, and 12th grades. At each of the aforementioned grade levels, girls were less likely than boys to say they liked math and science and fewer girls thought they were good at math and science. Among children of color in these same grades, African American and Asian Pacific Islander students were more likely than White students to indicate they enjoyed math. Compared to Asian Pacific Islander and White children, African American, Hispanic, and American Indian children had lower math and science self-concepts (NSF, 2003). For most children across racial/ethnic groups, interests and self-concepts in math and science were lower in high school compared to children in lower grade levels. The exception was for Asian Pacific Islander and American Indian children, more of whom liked science in high school than their counterparts in elementary and middle school (NSF, 2003).

Math and science achievement. Small, but statistically significant gaps exist between girls and boys in math achievement (NSF, 2003). Results from the National Assessment of Educational Progress (NAEP) 2000 indicated that 67.0% of boys and 65.0% of girls in the 8th grade performed at basic levels in math; among those in the 12th grade, 64.0% of girls and 65.0% of boys were at the basic level in math (NSF, 2003). In

science areas, the NAEP 1999 science scale scores indicated no statistically significant differences at the elementary, middle, and high school grades among girls and boys (NSF, 2003).

There is evidence of achievement gaps when comparing children from under-represented minority groups with White and Asian Pacific Islander children. Data from the NAEP 2000 revealed that across all grade levels, most African American, Hispanic, and American Indian children performed below the basic level in math, while most White and Asian Pacific Islander children performed at the basic level (NSF, 2003). Few under-represented minority children were at the proficient level, and almost none were at the advanced level of math performance (NSF, 2003). In the area of science achievement, data from the 1999 NAEP indicated that African American and Hispanic students had lower average science scale scores than White children (data on Asian Pacific Islander and American Indian children were not included). This held true across all grade levels over a nine-year period (NSF, 2003).

Math and science course enrollment patterns. In addition to having interests in math and science, positive self-concepts, and achievement in these areas, academic preparation is another important factor in whether students will select an undergraduate major in a STEM field (NSF, 2003). Data reported by the NSF showed that girls and boys completed math courses such as algebra II, trigonometry, pre-calculus, and calculus at the same rates. However, there were differences in the completion rates of various science courses. More girls than boys took biology, honors/AP biology, and chemistry courses, but fewer of them completed high school physics (NSF, 2003).

There were differences among racial/ethnic groups in math and science courses completed in high school. Across all groups, roughly 90.0% of students completed biology. Asian Pacific Islander students had the highest completion rates of math, chemistry, and physics, and White students had the next highest completion rate for these courses. Although the data revealed an upward trend in the course completion rates of under-represented students of color, they were still further behind their Asian Pacific Islander and White peers in taking courses such as pre-calculus, calculus, chemistry, and physics (NSF, 2003).

Students may have the opportunity to complete Advanced Placement (AP) courses in high school. The benefits of taking AP courses include exposure to college-level content, and the potential of earning college credit by taking the AP exam (College Board, n.d.). The data on AP test-takers were reported by gender within each racial/ethnic group, thus offering a glimpse into the math and science course-taking patterns of girls of color. In 2000, girls were 46.0% of AP test takers in math areas, and 44.0% in science areas. White women completed AP tests in math and science at similar rates (30.0% and 34.0% respectively), and Asian Pacific Islander women had similar AP test-completion rates in math (8.0%) and science (9.0%). Black and Hispanic women had comparable rates of taking AP exams in math (2.0%) and science (3.0%), while American Indian women had the lowest rates of AP test taking (less than 1.0% for both areas) (NSF, 2003).

Scholars point to a variety of social factors that influence the interest, self-concept, achievement, and preparation of girls and children of color in math and science. First, parents, teachers, and counselors have discouraged students from these courses by

communicating low expectations, and gender and racial biases about who can do math and science (Betz, 1997; Clewell, Anderson, & Thorpe, 1992; Clewell & Braddock, 2000). Girls may think that being good in math and science will make them less feminine (Clewell et al.), and both girls and children of color may be told they are better suited for service and people oriented careers rather than those requiring quantitative skills (Betz; Clewell et al.; Clewell & Braddock). Many under-represented students of color attend schools that have fewer resources, offer less advanced math and science courses, and have teachers with less experience (Clewell et al.; Ginorio & Grignon, 2000). In addition, these students often have parents with lower educational levels and have fewer educational resources available at home (Clewell & Braddock). Practices of ability-grouping or tracking serve to steer under-represented students of color away from college-preparatory courses, moving them toward remedial, general, or vocational courses (Ginorio & Grignon, 2000). Both girls and children of color lack involvement in science and math related extra-curricular activities, have fewer role models of scientists with whom they can identify, and receive less information on math and science careers (Clewell et al.; Clewell & Braddock). These factors taken together would imply that the number of girls of color, particularly those from under-represented groups, who would show interest in and be prepared for an undergraduate major in a STEM field would be quite a small and exceptional group.

Undergraduate Enrollment and Degree Attainment

In 2004, women made up 55.9% of undergraduate students at four-year institutions; among these women, 7.0% were African American, 5.6% were Latina, 3.0% were Asian Pacific Islander, .05% were American Indian, and 35.0% were White (NSF,

2007). Among students earning bachelor's degrees in STEM fields, women earned 38.4% of these degrees in 2004, with 44.5% of STEM degrees earned in biological sciences. A breakdown by race and ethnicity shows that White women earned 23.6% of STEM degrees, followed by 4.5% of Asian Pacific Islander women, 3.7% African American women, 2.7% Latinas, and .02% American Indian women (NSF, 2007).

Although under-represented women of color earned fewer STEM degrees than White women, they expressed greater intentions to major in a STEM field at the beginning of their college careers. In 1999, 20.2% Black, 14.9% Chicana/Puerto Rican, and 17.3% of American Indian women, compared to 14.5% of White women, expressed intentions of majoring in a STEM field. Asian Pacific Islander women had the greatest intention of majoring in a STEM field in their first year of college at 27.1% (NSF, 2004b). Though not a longitudinal comparison, and assuming that students take at least five years to earn a bachelor's degree (Wirt et al., 2004), these data suggest that somewhere between starting college and actual graduation, large portions of White and Asian Pacific Islander women pursued their intentions to major in a STEM field and earned degrees, while large portions of under-represented women of color were somehow dissuaded from their STEM major intentions and earned fewer degrees in these areas. Some of the potential sources of discouragement among women from different racial/ethnic groups were the subject of investigation in the current study.

Conceptual Framework

Prior research and literature describes challenging college environments and climates for women of color in STEM majors. The climate in STEM is often a "chilly" one (Ehrhart & Sandler, 1987) in which women of color encounter gender and racial bias

and stereotypes, are discouraged from pursuing these majors by advisors and faculty, have few racial/ethnic peers and mentors, and are excluded from informal social activities and interactions by both faculty and peers (Ehrhart & Sandler; A. Johnson, 2001; Ong, 2005; Sosnowski, 2001). Women from all racial/ethnic backgrounds may struggle with the competitive nature of STEM, including the practices of weeding out students early in their course work, grading on the curve, and impersonal relationships with faculty (Seymour & Hewitt, 1997). These experiences undermine many women of color, in which they feel isolated and lonely, and question whether they belong in science (A. Johnson; Ong; Sosnowski).

College impact theory. Given that many collegiate environmental factors contribute to the experiences of women of color in STEM, I used two college impact models as part of this study's conceptual framework. According to Pascarella and Terenzini (2005), college impact theories and models focus on the sociological rather than the psychological or individual influences on student learning and development by situating the "environment as an active force that not only affords opportunities for change-inducing encounters, but also can induce particular kinds of responses" (Pascarella & Terenzini, p. 60) among students in college. Assessment of the impact of college requires accounting for relevant student background and personal characteristics, identifying pertinent experiences students have in college, and comparing the effects of these experiences on different students for the outcomes of interest (Astin, 1993).

The college impact models I used in this study are Astin's (1991) input-environment-outcome (I-E-O) model, and Weidman's (1989) model of undergraduate socialization. The I-E-O model (Astin, 1991) assumes that outcomes related to college

attendance are influenced by students' background characteristics (inputs) and the people, programs, policies, services, curriculum and events that characterize the collegiate environment. By accounting for the characteristics students have at the time they enter college, the I-E-O model can better assess the extent to which aspects of the college environment relate to students' growth and development (Astin, 1993). The I-E-O framework draws attention to the campus environment rather than individual student characteristics as a contributing source of the challenges and supports experienced by students.

Weidman's (1989) model of undergraduate socialization considers the extent to which the non-cognitive or affective outcomes of college attendance are related to students' demographic backgrounds, institutional characteristics, and interactions with both college and non-college reference groups. Peers, faculty, parents, and others not directly part of the college experience function as agents of socialization in two ways. First, they communicate the norms and expectations of students' membership in the college community. Second, they reinforce or undermine students' educational goals and experiences through three dimensions of the socialization process identified by Weidman as interpersonal interactions, intrapersonal processes, and integration. Interpersonal interactions with faculty and peers are said to have a socializing influence on students when occurring in greater frequency and intensity. Intrapersonal processes are defined as students' subjective assessments of the college experiences. Integration is defined as the sense of cohesion students experience with their peers and faculty. The outcome of these socialization processes is the extent to which they influence students' career aspirations, values, and lifestyle choices (Weidman).

Weidman's (1989) socialization framework is appropriate for use in a study examining overall sense of belonging because of the focus on non-cognitive outcomes related to undergraduate socialization processes. In addition, Weidman accounted for the influence of people outside of the campus environment (non-college reference groups) on students' experiences. Research demonstrates the significance of parents, teachers and other pre-college affiliations to undergraduate women in STEM (Huang et al., 2000; A. Johnson, 2001; Seymour & Hewitt, 1997), students of color (Rendón, Jalomo, & Nora, 2000; Tierney, 1992), and under-represented students of color in STEM (S. W. Brown, 2002; Russell & Atwater, 2005).

A transformative perspective. Although typically associated with qualitative research, I choose to discuss the philosophical and experiential perspective that informed my thinking about this study. I openly acknowledge that my research interests and the meaning I derive from the results of my work are influenced by my values and experiences within the specific context of being an African American woman in the United States. As a researcher and educator interested in social justice issues, I decided to incorporate a transformative perspective (Mertens, 1999, 2005) into the conceptual framework of this study. Mertens defined the transformative approach to research as one that focuses on the experiences of marginalized groups and the ways they are oppressed by dominant groups, analyzes how and why social inequities are manifested in the unequal power relationships between dominant and marginalized groups, links the results of the research process to social and political action, and situates the results of the research within the context of unequal power structures rather than characterize the participants as somehow deficient or at fault. I incorporated a transformative approach

into this study by (a) making race/ethnicity a primary identity of interest among women in STEM majors, (b) considering the power dynamics of the interactions between women of color and the dominant groups in STEM, (c) recognizing the influence of my social identities and experiences with working with undergraduate women of color in STEM on the research process, and (d) considering how the results of this study can help transform the dominant cultures within STEM environments and predominantly White institutions into arenas where all talents are valued and developed.

My interest in studying women of color in STEM emerged from my work in minority student affairs at a predominantly White and male engineering and science university. While I worked there, the institution enrolled about 23.0% women and 5.0% under-represented students of color; in any given year there were approximately 15 undergraduate women from under-represented minority groups. I was responsible for developing and coordinating recruitment and retention activities for African American, Latina/o and American Indian students. I worked closely with these students and learned a great deal about their experiences at the university, both inside and outside of the classroom. In particular, I became sensitive to the experiences of some of the women of color, who were in the smallest minority on campus and expressed feelings of being a "double minority," especially in the classroom. During my time at the university, there were many concerns among the students of color about the racial climate and the extent to which the institution was committed to racial diversity on campus. Students often shared with me their negative encounters with peers and some faculty around racial issues, and the stereotypes they faced from members of the campus community about their abilities to do science. My work as a student affairs practitioner and multicultural

educator serves as the inspiration for my interest in examining the contribution of the campus racial climate to undergraduate women's experiences in STEM.

My purpose in describing my perspectives and experiences is to not let these go un-named in this research process, and to debunk the myth of objectivity commonly associated with quantitative research methods (Mertens, 2005). While I can take a step back from the findings of my research to see a broader meaning as well as accept findings that did not support my hypotheses, my subjective experiences allow me an up-close view that elicited deeper meaning from the data. Both perspectives help to advance knowledge about the experiences of women of color in STEM fields.

Tanaka (2002) asserted that a limitation of college impact theories is that they do not account for aspects of dominant institutional cultures of campus environments and the effect these cultures have on the experiences of students from non-dominant social groups. He suggested that higher education researchers reflect upon and acknowledge how their social identities influence the development of theory, and consider how power dynamics operate in college environments. To overcome this limitation, the current study incorporates a transformative perspective with college impact theory. Thus, while college impact theories and models were not developed explicitly to consider the experiences of students of color and other under-represented groups, when used in light of Tanaka's recommendations, these theories can enhance understanding of how under-represented students experience campus environments in ways similar to and different from students from dominant social groups. In addition, when combined with a transformative approach, college impact theories can potentially identify aspects of privilege, power, and

oppression that are embedded within institutional climates and cultures, and provide a foundation for transforming campus environments to meet the needs of diverse students.

Sense of Belonging and the Peer Group

Astin (1993) noted the importance of the influence of the peer group on students' learning and development in college. This influence has individual (psychological) and group (sociological) components. On an individual level, students seek affiliation, identification, and membership with a peer group. In turn, the peer group confers acceptance and dictates the norms and expectations of its members (Astin, 1993). In their meta-analysis of the influence of the peer group, Pascarella and Terenzini (2005) documented the research supporting the idea that belonging to a peer group is related to persistence, degree attainment, and pursuit of graduate education. Students are also influenced by their relationships with faculty, and these interactions influence students' institutional commitment, satisfaction with college, and degree attainment (Astin, 1993).

The extent to which students are connected to peers and faculty has been conceptualized as social and academic integration, which is said to influence students' decisions to remain in college (Tinto, 1993). Successful integration with some aspect of the campus community is associated with students' decisions to remain in college. Thus, students unable to integrate in some manner are at risk for withdrawal from the institution (Tinto, 1993). The growing racial/ethnic diversity of college campuses has caused many scholars (e.g., Hurtado & Carter, 1997; Rendón et al., 2000; Tierney, 1992) to question the applicability of the academic and social integration concepts to marginalized students, because integration implies that students must give up aspects of their cultural identities and adopt new values in order to persist in college. Such a task may be quite difficult for

students of color in institutions that are centered on the cultural values, practices, and identities of dominant social groups to which they do not belong (Hurtado & Carter; Rendón et al.; Tierney). In place of integration, Hurtado and Carter offered sense of belonging as a way of conceptualizing and understanding how the academic and social experiences contribute to students' of color ability to identify and affiliate with their institution.

Research indicates that students of color were more likely to report a less strong sense of belonging to their campuses than White students (Gilliard, 1996; D. R. Johnson, Solder, Leonard, Alvarez, Inkelas, Rowan-Kenyon et al., 2007; Mandell, Mulvey, & Bond, 1992; Reid & Radhakrishnan, 2003). A key factor in the sense of belonging among students of color was the climate for racial/ethnic diversity on the campus. Institutional diversity and perceptions of the campus racial climate are said to relate to the psychological dimensions of students' college experiences, including feelings of isolation, loneliness, or belonging (Hurtado, Milem, Clayton-Pedersen, & Allen, 1999). This relationship has been empirically tested by several scholars, including Hurtado and Carter (1997), Gilliard (1996), D. R. Johnson et al. (2007), Nora and Cabrera (1996), and Reid and Radhakrishnan (2003). Sense of belonging among students of color was also linked with faculty interactions (Hurtado & Carter; D. R. Johnson et al.; Nora & Cabrera; Reid & Radhakrishnan) and interactions with peers (Gilliard, ; Hurtado & Carter, 1997; D. R. Johnson et al., 2007; Velásquez, 1999). Factors associated with sense of belonging for students in general were academic major (Mandell et al., 1992) and participation in learning communities (Hoffman et al., 2003) or living-learning programs (Inkelas & Associates, 2004).

The Campus Climate for Racial and Ethnic Diversity

As women of color pursue STEM degrees, they are very likely interacting with a faculty body and peer group that is predominantly White and male. According to data published by the National Science Foundation (NSF, 2004b), among the STEM faculty at four-year institutions in 2001, 79.9% were men, 20.1% were women. Among racial/ethnic groups, 81.0% of the STEM faculty were White, 6.0% were from under-represented racial/ethnic groups, and 12.0% were Asian Pacific Islander. Nelson (2005) found that among the "top 50" STEM departments in the United States, 75 women from under-represented racial/ethnic groups were on the faculty. In 2001, of the students earning STEM bachelor's degree, 66.6% were White, and 61% were male (NSF, 2004b).

Given the importance of peer and faculty interactions on the college experience (Astin, 1993; Pascarella & Terenzini, 2005), the lack of racial and gender diversity in STEM has potentially negative impacts on women of color. Hurtado et al. (1999) described the educational disadvantages to students who are in college communities that lack racial/ethnic and gender diversity. Such disadvantages seem to fall squarely on the shoulders of students of color and in some cases women, who are more likely to be seen as representatives of their group, and to lack a peer group with whom they can identify and affiliate. The lack of diversity leaves students of color and women without faculty role models, mentors, and advisors with backgrounds similar to their own, deprives all students of different viewpoints and perspectives both in and out of the classroom, and contributes to students' perceptions of the campus racial climate (Hurtado et al.).

There is a long line of research illustrating that students of color generally perceive a more negative campus racial climate than their White peers (Ancis, Sedlacek,

& Mohr, 2000; Hurtado, 1992; Nettles, Thoeny, & Gosman, 1986; Nora & Cabrera, 1996; Reid & Radhakrishnan, 2003). These perceptions of the campus racial climate negatively affected interactions with faculty and peers (Cabrera, Nora, Terenzini, Pascarella, & Hagedorn, 1999; Nora & Cabrera, 1996; Suarez-Balcazar, Orellana-Damacela, Portillo, Rowan, & Andrews-Guillen, 2003); college grade point average (Nettles et al.; Nora & Cabrera); and social integration and academic development (Cabrera et al.; Nora & Cabrera). Among racial/ethnic minority groups, African Americans were the most likely to have negative experiences with the racial climate (Ancis et al.; Hurtado; Reid & Radhakrishnan; Suarez-Balcazar et al.). In addition, African American and Asian Pacific American students were more likely to experience racism in their interactions with faculty (Ancis et al.; Cabrera et al.; Hurtado, Dey, & Treviño, 1994). These results suggest that when it comes to differences in perceptions of the campus racial climate, not only does it matter that students are members of racial/ethnic minority groups, but also to which particular racial/ethnic minority groups they belong.

Among the suggestions of future research on the under-representation of women and students of color in STEM, scholars called for an examination of the institutional environment (Hollenshead et al., 1996; Tinto, 2000), including factors such as the campus climate and commitment to diversity (Denes, 2000). Such research can provide insight on how to "transform current institutions into those that provide an equitable environment for everyone interested in science and engineering" (Hollenshead et al., p. 326). Studying the relationship between the campus racial climate and experiences in STEM majors is relevant to women of color, who often experience race as the more

salient aspect of their identities in predominantly White institutions (Jackson, 1998; Martínez Alemán, 2000), and may be negotiating multiple aspects of their identities (Jones & McEwen, 2000).

Faculty and Peers as Agents of the "Chilly" Climate

The literature has documented the STEM environment as "chilly" for women, particularly in their interactions with faculty and peers (Ehrhart & Sandler, 1987; Ginorio, 1995; Seymour & Hewitt, 1997). The climate is competitive and impersonal, characterized by the practice of weeding students out of majors and grading on the curve, and requires an intense focus on schoolwork (Hyde & Gess-Newsome, 2000; Rosser & Lane, 2002; Seymour & Hewitt). Women in STEM environments experienced gender bias and discrimination (Mandell et al., 1992; Seymour & Hewitt, 1997; C. Vogt, 2003), and encountered faculty who behaved rudely or intentionally made women uncomfortable in class, and displayed subtle forms of sexism (Seymour & Hewitt). The STEM climate can also facilitate difficult peer interactions, particularly with men (Ehrhart & Sandler). Women experienced their male peers as focusing too much on women's appearance, dominating and controlling work groups, and having little interest in socializing with them (Seymour & Hewitt).

As undergraduate women in STEM fields interact with faculty and male peers, they may encounter a phenomenon described by Betz (2006) as the null environment. This kind of environment is said to exist when women in male dominated arenas are ignored rather than overtly discriminated against and when they are neither discouraged nor encouraged in their career aspirations. The lack of active encouragement and engagement of women in STEM majors by faculty serves as yet another signal that

women do not belong in these fields, and inhibits their retention and success (Betz). Over time, the lack of faculty interactions eventually accrue into what Fassinger and Asay (2006) described as micro-inequities – small biases that appear to be minor, isolated infractions, but ultimately accumulate to disadvantage women (relative to men) in their career development and mobility.

The impact of the STEM environment leaves women with few opportunities to develop and maintain close relationships with peers and faculty, culminating in feelings of isolation and loneliness (Ginorio, 1995). The climate appears to be especially burdensome for women of color because they are often isolated from their racial/ethnic peer group *and* White students (A. Johnson, 2001; Sosnowski, 2002), experience difficult and tense relationships with STEM faculty (A. Johnson; Sosnowski), encounter racial stereotypes related to their academic abilities, and feel overlooked by their faculty and peers (A. Johnson; Ong, 2005). As a result, women of color may feel lonely and out of place in STEM environments (A. Johnson; Ong; Sosnowski).

Residence Hall Climate and Living-Learning Programs

Research indicates that students living on campus are more likely to persist and graduate from college, even after controlling for background characteristics (Pascarella & Terenzini, 2005). Combining the benefits of living on campus with students' academic experiences, living-learning programs were developed to integrate the academic and social dimensions of college (Inkelas, Johnson et al., 2006). These residence hall based learning communities provide opportunities for students with shared academic interests to live together, with access to specially dedicated resources and academic-related co-curricular activities (Inkelas, Johnson et al.). Living-learning program participation was

positively associated with a variety of outcomes, including the transition to college (Inkelas & Weisman, 2003), retention of first-year students (Pike, Schroeder, & Berry, 1997; Stassen, 2003), greater involvement with peers (Inkelas, Vogt, Longerbeam, Owen, & Johnson, 2006; Pike, 1999), and interactions with faculty (Pike), including mentoring activities (Inkelas, Vogt et al., 2006).

Institutions developed living-learning programs to provide supportive environments for women majoring in STEM fields (see Inkelas & Associates, 2004); however, the significance of these programs has been examined in only a few studies (Inkelas, Johnson, Alvarez, & Lee, 2005). From this small body of research, there is evidence suggesting that STEM-related living-learning programs had a positive relationship to women's persistence in STEM (Gandhi, 1999; Hathaway, Sharp, & Davis, 2001), adjustment to college (Gandhi), and experiences in the residence hall and with faculty (Inkelas et al., 2005). However, under-represented women of color did not reap the benefits of participation in STEM related living-learning programs, as they had lower retention rates in STEM than White and Asian women (Hathaway et al.). STEM-related living-learning programs targeted at women only (e.g., Women in Science and Engineering) were dominated by White women (see Hathaway et al.; Inkelas et al.), while under-represented women of color participated largely in co-educational STEM-related living-learning programs, and Asian Pacific American women mostly participated in non-science related programs (see Inkelas et al.).

The climate found in the residence halls can be an important dimension to students' campus residential experiences. Berger (1997) found that first-year students who felt a sense of community within their residence halls had higher first-to-second year

retention rates, greater intentions to graduate from their institution, and more interactions with faculty and peers. Students in living-learning programs perceived the residence hall environment to be supportive, compared to students who lived in traditional residence halls (Inkelas, Vogt et al., 2006; Inkelas & Weisman, 2003). Women in STEM living-learning programs, compared to those in traditional residence halls, also reported residence hall environments that were more supportive (Gandhi, 1999; Inkelas et al., 2005).

The findings from prior research demonstrated that participants in learning communities or living-learning programs reported greater sense of belonging (see Hoffman et al., 2003; Inkelas & Associates, 2004). In addition, the residence hall environment had a strong positive relationship to the sense of belonging among first-year students from all racial/ethnic groups (D. R. Johnson et al., 2007). The current study provided an opportunity to examine the relationship between participation in STEM-living-learning programs and perceptions of the residence hall climate to the overall sense of belonging of women of color in STEM majors. Such a focus can help to understand if students pursuing similar academic interests have different experiences in these types of educational programs.

Academic and Math Self-Confidence

Women, girls, and people of color of all ages encounter stereotypes about their abilities to do math and science, and these messages are communicated through low teacher expectations, parental discouragement, poorly resourced schools, academic tracking and ability grouping, societal images of scientists, and gender role expectations (Betz, 1997; Chinn, 2002; Clewell & Braddock, 2000). In turn, these stereotypes can

influence students' math and science self-concepts and shape the extent to which students identify as people capable of doing science and math (Betz; Clewell & Braddock).

Perhaps the most prominent recent example of gender stereotypes in math and science came from comments by former Harvard president Lawrence Summers. In a speech to the National Bureau of Economic Research in January 2005, Summers indicated that the shortage of women in STEM was due to their "intrinsic aptitude," and minimized the impact of socialization and discrimination (Summers, 2005a) on women's career development in these fields. Days later, Summers acknowledged that his comments sent "an unintended signal of discouragement to talented girls and women" (Summers, 2005b), and pledged his commitment to creating environments that nurture the scientific talent of all students.

However, the damage was done. Comments like those made by Summers contribute to a phenomenon described by psychologist Claude Steele (1997) as "stereotype threat." In studying the academic performance of African American students and the math performance of women, a "stereotype threat" is likely to exist among students performing an academic task about which there are negative stereotypes associated with their abilities. The fear of living up to the stereotype, characterized as "a threat in the air" (p. 614), impeded students' academic performance, and negatively affected their academic achievement and ability to identify with an academic domain. When the "threat" was removed, students' performance in these areas improved significantly (Steele).

The women who make it to college with their interests in STEM still intact continue to bear the brunt of societal stereotypes and expectations of who can do science

(Ehrhart & Sandler, 1987). The women and students of color from Seymour and Hewitt's (1997) study reported experiencing stereotypes about their academic abilities, and for some, this contributed to their decisions to leave their STEM majors. The competitive nature of STEM, particularly weeding students out of majors in early courses and grading on the curve, negatively affected students' academic self-concepts, which in turn affected their desire to persist in the major. Although this kind of academic climate can be detrimental to all students, many women are at a disadvantage because they are socialized to be cooperative rather than competitive in their learning environments (Seymour & Hewitt). When women do exhibit competitive qualities, they run the risk of alienation from male peers and faculty because they have disrupted gender socialization norms that dictate acceptable behaviors of women (Fassinger & Assay, 2006; Seymour & Hewitt).

The research on women and under-represented students of color in STEM established the relationship between academic self-concept and a variety of outcomes, including initial choice of STEM major (Astin & Astin, 1992; Hackett, Betz, Cases, & Rocha-Singh, 1992; Huang et al., 2000; Leslie et al., 1998), grade point average (C. Vogt,2003; K. E. Vogt, 2005), and persistence in a STEM major (Huang et al., 2000; Seymour & Hewitt, 1997; Strenta, Elliot, Adair, Matier, & Scott, 1994). Given that academic self-concept has been established as a key variable in understanding the experiences and outcomes of women in STEM majors, a related construct, academic self-confidence, was included in this study.

Purpose of Study

The purpose of this study is to examine the overall sense of belonging of undergraduate women of color in STEM fields. This study uses a conceptual framework

to study the college environments, both physical and psychological, that may serve as predictors of overall sense of belonging for women of color in STEM. College environments in this study include interactions with faculty and peers, living-learning program participation, perceptions of the climate in the residence hall, and perceptions of the campus racial climate. Using two college impact models to construct the conceptual framework, this study addresses the following research questions:

1. Are there differences in overall sense of belonging among undergraduate women in STEM majors from different racial/ethnic groups, and among those participating in different types of living-learning programs?
2. Are there differences in the perceptions of the campus racial climate among undergraduate women in STEM majors from different racial/ethnic groups, and among those participating in different types of living-learning programs?
3. How well does the conceptual framework, developed from the empirical and theoretical literature, help to understand overall sense of belonging for women of color in STEM majors, and what amount of variance in sense of belonging is explained by the conceptual framework?
4. What is the relationship between perceptions of the campus racial climate and overall sense of belonging among undergraduate women STEM majors from different racial/ethnic groups, after controlling for significant predictors from the conceptual framework, including background characteristics, confidence in academic and math abilities, faculty and peer interactions, type of living-learning program, and perceptions of the residence hall climate?

The data for this study are taken from the 2004 National Study of Living-Learning Programs (NSLLP). The 2004 NSLLP examined the relationship of participation in living-learning programs to a variety college environment and outcome measures (Inkelas & Associates, 2004). The 2004 NSLLP dataset is a multi-institutional sample drawn from 34 four-year universities from 24 states and the District of Columbia.

Definition of Terms

Science, Technology, Engineering, and Mathematics (STEM). STEM is the shorthand reference to academic majors and career fields that encompass *science, technology, engineering, and mathematics*. Specifically, these fields include agricultural science, biological science, chemistry, computer science, earth science, engineering, mathematics, and physical science. These academic areas are grouped together because they are laboratory-based disciplines with sequential courses with many prerequisites, including math courses, and are demanding in terms of the amount and frequency of work required of students (Elliot, Strenta, Adair, Matier, & Scott, 1996). The 2004 NSLLP did not directly ask respondents to indicate their academic major, but rather asked them to identify the school/college in which they were enrolled. Thus, schools/colleges related to STEM fields (e.g., School of Technology; School of Engineering; College of Agriculture and Life Sciences; College of Physical and Mathematical Sciences) were used in this definition (Inkelas et al., 2005). This method of identifying women in STEM majors could not account for other schools/colleges (e.g., College of Arts & Sciences) that may have also included STEM disciplines; therefore the actual number of women in STEM majors available in the 2004 NSLLP dataset cannot be accurately determined.

Women of color. This study defined *women of color* as those who identify as Black/African American, Latina, American Indian, Asian Pacific American, and Multiracial/Multiethnic. Use of this term does not presume that all women who are not White have the same experience, or that women of color have no European ancestry (Amott & Matthaei, 1996). Instead the term is used to draw attention to the shared experience of those women who are the targets of racial oppression in the United States (Tatum, 1997).

The term Black/African American is used to be inclusive of those who identify as being of African descent. Latina refers to women who identify themselves as being of Mexican American, Puerto Rican, Cuban, South American, or Central American descent (Nieves-Squires, 1991). The term Latina is used rather than Hispanic to acknowledge the increased preference for this pan-ethnic identity (Ferdman & Gallegos, 2001). American Indian is used to refer to those women who identify as Native American or Alaskan Native. Asian Pacific American includes those women who have ancestry from China, Japan, Korea, India, Southeast Asia, the Philippines, native Hawaii, American Samoa, and Guam (Hune, 2002).

The inclusion of women identified as Multiracial/Multiethnic was a complex decision because the extent to which these women identify as being "of color" varies across individuals. However, scholars of multiracial identity noted that many multiracial people experience racial discrimination and oppression, in part because of their racial ambiguity (Hall, 1996; Root, 1996). Given my use of the term "of color" as a way of representing a common experience of racism in the United States, I chose to define Multiracial/Multiethnic women as women of color.

Much of the literature on women and minorities in STEM fields uses the term "under-represented" to refer to Black/African American, Latino/a, and American Indian people, to indicate that their participation in STEM fields is below their representation in the general population of the United States (NSF, 1999). Thus, when necessary, the term "under-represented women of color" is used to distinguish these women from Asian Pacific American and Multiracial/Multiethnic women. The original terms are used when discussing the research of other scholars.

The above definition of women of color is imperfect and in some cases may seem inadequate or inaccurate to an individual reader. This is my attempt to work within the limitations of language and follow a path charted by other scholars who thoughtfully and intentionally considered this issue (see Amott & Matthaei, 1996; Andersen & Collins, 2001; Tatum, 1997).

Sense of belonging. There are few studies examining sense of belonging among college students (Hoffman et al., 2003); thus, this study represents an opportunity to add to this small body of literature. Based on the 2004 NSLLP, *overall sense of belonging* measured of the extent to which students felt membership in, comfort with, and supported by their campus community (Inkelas & Associates, 2004).

Academic self-confidence and math ability. The 2004 NSLLP measure of *academic self-confidence* included students' ratings of their confidence in their research, problem solving, library, and computer skills, and their ability to work independently (Inkelas, Vogt et al., 2006). *Math ability* was measured as students' level of confidence in mathematics (Inkelas & Associates, 2004).

Peer and faculty interactions. Research documents the significant influence of peer and faculty interactions on the college experiences of undergraduate students (Astin 1993; Pascarella & Terenzini, 2005); thus, measures of these concepts are included in this study. The 2004 NSLLP defined *peer interactions* as the extent to which students spent time discussing academic/career and social/cultural issues with each other (Inkelas, Vogt et al., 2006). *Interactions with faculty* were measured in terms of the amount of course-related contacts and mentoring experiences students had with faculty (Inkelas, Vogt et al.).

Living-learning programs. Living-learning (LL) programs are learning communities that link the academic and social dimensions of students' college experiences within the residence hall (Inkelas, Johnson, Lee et al., 2006). Participants in these programs share academic interests, live together on campus, have access to specially designated resources, and participate in academically related co-curricular activities (Inkelas, Johnson, Lee, et al.). The current study examines three types of living-learning programs, as identified by the 2004 NSLLP (Inkelas & Associates, 2004), in which women in STEM majors may participate. First are women-only programs, available to women pursuing science, math, and engineering majors; these are commonly known as women in science and engineering or WISE programs. The second are co-educational programs for students majoring in STEM fields, and focused on general science areas or specific STEM disciplines. Third, there are all the other types of living-learning programs not related to STEM fields, (e.g., Honors, New Student Transition, and Multicultural/Diversity programs) (Inkelas et al., 2005). The comparison group consists of women in STEM schools/colleges who were not participants in any type of living-

learning program at the time the 2004 NSLLP was administered, but rather lived in traditional residence hall arrangements.

Residence hall climate. In defining the *residence hall climate*, this study uses two measures. The first is a measure of the degree to which students find the residence hall academically supportive, including ease of forming study groups, availability of study space, and the perception that academic achievement and success was valued among the residents. The other dimension of the residence hall climate measures the extent to which students found the residence hall to be socially supportive, including the appreciation of differences related to race/ethnicity, religion, and sexual orientation; an intellectually stimulating environment; interactions between different students; and availability of academic support from peers.

Campus racial climate. This study uses two measures to define the *campus racial climate*. The first measures the extent to which students interacted with peers from racial/ethnic groups other than their own. These types of interactions included the amount of time spent studying, socializing, sharing meals, and living with diverse others. The other measure of the campus racial climate is defined as students' perceptions of interactions among different racial/ethnic groups on campus in ways that fostered respect, trust, and friendship (Inkelas, Vogt et al., 2006).

Significance of Study

The current study adds to the small body of research on women of color in STEM fields and is significant for several reasons. This study includes Asian Pacific American and Multiracial/Multiethnic women, along with Black/African American, Latina, American Indian, as well as White/Caucasian women. Previous research on women of

color in STEM has focused only on women from under-represented racial/ethnic groups (see S. V. Brown, 1995; A. Johnson, 2001; Ong, 2005; Sosnowski, 2002) or only on Asian Pacific American women (see Chinn, 2002; K. E. Vogt, 2005), and none included women who were identified or categorized as Multiracial/Multiethnic. All of the racial/ethnic minority women in the sample are included in this study because their status as women of color suggests that they may have distinct experiences related to being in the racial and gender minority in STEM fields.

In addition, this study focuses on the outcome of overall sense of belonging, which permits an analysis of how relationships with peers and faculty relate to the extent to which undergraduate women in STEM majors affiliate and identify with this community and their institution. This is especially significant in understanding the experiences of women of color given their racial/ethnic and gender status in STEM fields. Themes related to feelings of belonging in science have been uncovered in qualitative research on women's experiences in STEM (see Seymour & Hewitt, 1997), including those of women of color (see A. Johnson, 2001; Ong, 2005; Sosnowski, 2002). Thus, the current study adds to the research on sense of belonging and expands upon this concept in the literature on women's participation in STEM.

Also, this study examines the significance of campus racial climate perceptions among women in STEM majors using two quantitatively derived measures of the campus racial climate. This is accomplished by using a large sample of women from a variety of racial/ethnic backgrounds, including Asian Pacific American and White/Caucasian women. Previous research demonstrating the significance of the racial climate for women of color in STEM majors has been qualitative in nature, and only included under-

represented racial/ethnic minority groups (see A. Johnson, 2001; Ong, 2005; Sosnowski, 2002). By examining the significance of the campus racial climate, the results of this study considers another factor that may contribute to the under-representation of women of color in STEM fields.

This study uses a sample drawn from a national dataset of living-learning programs that includes 34 institutions located in 24 states and the District of Columbia, and contains a viable sample of women of color to use for quantitative analysis, thus allowing results to be representative of the larger population. A large number of research universities are represented in the sample, which is advantageous for this study because these institutions award the majority of bachelor's degrees in engineering and half of the bachelor's degrees in the natural and agricultural sciences (NSF, 2004b). Among previous research focusing on women of color in STEM, only two (see Brown, S. V., 1995; Hanson, 2004) used large national datasets; the others were single institution studies (see Chinn, 2002; Johnson, A., 2001; Ong, 2005; Sosnowski, 2002; Vogt, K. E., 2005). In addition, most of the research on the contributions of living-learning programs to women in STEM majors examined individual programs on individual campuses (see Hathaway et al., 2001; Gandhi, 1999), and only one examined racial/ethnic group differences (Hathaway et al.). Thus, the dataset used for the current study permits the analysis of multiple programs at institutions across the country among women from different racial/ethnic groups.

Finally, the use of a theoretical framework to govern the inclusion of particular variables and provide a context for interpreting results also contributes to the significance of this study. Scholars have critiqued the research on women in STEM for failing to use

theoretical perspectives to ground studies and their findings (Dietz, Anderson, & Katzenmeyer, 2002; Hanson, 1996). This study is guided by two college impact models, Weidman's (1989) model of undergraduate socialization and Astin's (1991) input-environment-outcome conceptual framework, and incorporates a transformative perspective (Mertens, 2005) as a way of understanding the experiences of women of color in STEM majors. Utilizing college impact theory with a transformative perspective contributes to the theoretical significance of this study. This conceptual framework analyzes the extent to which specific collegiate environmental factors contribute to the experiences of women in STEM, and considers the ways campus environments rooted in the dominant culture contribute to the experiences of students from under-represented groups. Such an approach does not view women of color as deficient individuals who need improvement for success in STEM, but instead, views STEM environments and institutional cultures as the sites in need of transformation to attract and retain women from all racial/ethnic groups.

Chapter Summary

This chapter outlined the issues related to the under-representation of women in STEM majors and posited overall sense of belonging as an important construct in examining women's experiences in these fields. An argument was made for considering racial/ethnic group differences among women in STEM, rather than viewing all women as a monolithic group without regard to the influence of race and ethnicity. The various aspects of the college environment contributing to women's STEM undergraduate experiences and sense of belonging were identified, including the climate for racial and ethnic diversity, interactions with peers and faculty, the residence hall climate and

participation in living-learning programs, and academic self-confidence. The theoretical frameworks and specific variables included in this study were defined, and the purpose of the study and accompanying research questions were discussed in this chapter. The next chapter will describe the research on undergraduate women of color in STEM majors and the limitations associated with this body of research. Sense of belonging as a theoretical construct in the higher education research literature will be discussed, and the research linking sense of belonging with the variables used in this study is also examined.

Chapter 2: Review of Literature

This chapter reviews research drawn from the literature on undergraduate women and students of color in STEM to illustrate patterns of selection of and persistence in these majors. Then the research describing the experiences of undergraduate women of color in STEM majors is summarized. Next, sense of belonging as a construct is described, and its relevance for women of color in STEM is established. The climate for racial and ethnic diversity on campus is theorized and defined, and then discussed in relation to STEM environments. Factors identified from the research literature as predictors of sense of belonging are also examined. Most importantly, the review of the literature outlined in this chapter illustrates that perceptions of the racial climate and sense of belonging are important constructs for undergraduate success, yet have been unexamined as factors that may contribute to the experiences of women of color in STEM majors.

Background on Women and Minorities in STEM

The research discussed in this section comes from studies utilizing national datasets to examine STEM major selection, persistence, and degree attainment among undergraduate women and students of color. The purpose of including this body of literature is to show the likelihood of women from racial/ethnic minority groups to select and persist in STEM majors, and to identify factors that facilitate or inhibit these outcomes. For a better understanding of the experiences of women of color, it is useful to examine their patterns of selecting these majors and the factors influencing these choices.

STEM major selection. According to the findings from several studies, being a woman or an under-represented student of color decreased the likelihood of choosing

STEM majors upon entry to college (Astin & Astin, 1992; Huang et al., 2000; Smyth & McArdle, 2004). The evidence of the likelihood of women of color choosing STEM majors upon entering college varies, depending on the comparison group and type of major. When compared to all students, Hispanic and Asian/Asian Pacific American women were less likely to choose these majors (Leslie et al. 1998; Smyth & McArdle). On the other hand, being an under-represented woman of color had a positive influence on STEM major choice (Huang et al.). Black women were more likely to select biological science and less likely to choose engineering majors than White men (Leslie et al.). When comparing women across racial/ethnic groups, there is evidence that Black/African American, Hispanic, and Asian/Asian Pacific American women had greater intentions than White women in choosing these majors (Huang et al.; Smyth & McArdle), and that African American women were more likely to report being in a STEM major two years after high school than White women (Hanson, 2004).

Several factors contribute to the likelihood of choosing a STEM major for women and under-represented students of color, including high school math and science preparation (Huang et al., 2000), mother's level of education (Leslie et al., 1998), and parental expectation of college completion (Huang et al.). Attitudes toward and self-concepts about math and science also influenced major choices. Students with positive self-concepts, high levels of self-efficacy (Leslie et al.), the motivation to learn science, and confidence in their math abilities (Huang et al.) were the most likely to choose STEM majors.

Among women of color, parental support (Sosnowski, 2002) and having a parent or family member employed in an engineering or science occupation were important

factors associated with choosing a STEM major (Leslie et al., 1998; Sosnowski). Positive experiences with high school math and science (A. Johnson, 2001; Sosnowski), confidence in math abilities (Sosnowski), positive attitudes toward math and science (Hanson, 2004), and overall interest in science (A. Johnson) all related to women of color choosing a STEM major. They were also influenced to major in STEM because of their career aspirations, the enjoyment of the intellectual challenge associated with working with science and math (Johnson), and participation in outreach programs (Sosnowski).

There is evidence that being a woman of color is a positive influence when it comes to choosing certain STEM majors, and there are several reasons for their interests toward these career fields. However, the extent to which these factors continue to exert a positive influence over their persistence in these majors is the focus of the next section.

Persistence in STEM majors. The data from the research tell a consistent story about the persistence of under-represented students of color in STEM majors; they were less likely than White students to complete degrees in these fields (Astin & Astin, 1992; Bonous-Hammarth, 2000; Huang et al., 2000; Smyth & McArdle, 2004). Asian/Asian American students were the most likely to persist in their STEM degree programs (Astin & Astin; Bonous-Hammarth; Smyth & McArdle). Among men and women from all racial/ethnic groups, the evidence is mixed; Huang et al. found that more women persisted in their STEM degrees than men; Smyth & McArdle found the opposite. There is evidence that under-represented women of color have the lowest rates of persistence of all students who entered college with a STEM major. Among under-represented students of color, more men than women persisted in their STEM degree programs (Bonous-Hammarth; Grandy, 1998). Among women from various racial/ethnic groups, African

American, Chicana/Latina, and American Indian women had lower rates of persistence than White and Asian American women (Bonous-Hammarth).

A number of factors have been identified as influencing the persistence of students in STEM majors. Among these are SAT math scores (Astin & Astin, 1992; Bonous-Hammarth, 2000; Smyth & McArdle, 2004), high school grades (Astin & Astin; Bounous-Hammarth; Smyth & McArdle), parents' level of education (Astin & Astin; Huang et al., 2000; Leslie et al., 1998), having a parent employed in a STEM field (Astin & Astin; Leslie et al.), and plans to attend graduate school in a STEM field (Huang et al.). Related constructs such as intellectual self-confidence (Huang et al.), self-efficacy, and self-concept (Leslie et al.) were found to be positive influences on STEM degree persistence. African American (Russell & Atwater, 2005) and Hispanic (S. W. Brown, 2002) undergraduates in STEM reported that taking an academically demanding high school program and having supportive and encouraging teachers and families were sources of confidence and contributed to their success. Lastly, Grandy (1998) provided evidence that being committed to science by the sophomore year was a critical factor in the persistence of students of color (including Asian Americans), and that women of color had lower levels of this type of commitment. Racial/ethnic minority women indicated less ambition in the sciences, which was also strongly associated with persistence.

A large-scale qualitative study by Seymour and Hewitt (1997) identified several factors that contributed to students' decisions to leave STEM majors, including those of women and students of color. Data were collected from 335 participants at seven institutions through personal interviews and focus group sessions. Many women in the

study reported career-related factors as influencing their switching decisions. They felt non-STEM majors were more interesting and offered a better education, were no longer interested in the lifestyle that a career in science would demand, felt that career options in STEM were not worth the effort of earning the degree, and saw non-STEM careers as more appealing. Academic experiences also influenced women's desire to leave their major. Many thought faculty were poor teachers and advisors, felt overwhelmed by the curriculum, lost their confidence because of poor grades in early courses, and had difficulty with the material in at least one course. Only a small percentage reported leaving because they did not have peer study groups.

Decisions made by students of color to leave their STEM majors were also related to more appealing career choices (Seymour & Hewitt, 1997). Many indicated that they chose a STEM major for extrinsic reasons; they were encouraged or pressured by their teachers and families, were offered scholarships, or felt the need to choose careers that would offer financial security to their families. However, they lacked enough information about what it would take to be successful in these areas on the college level, and some had very little interest in a STEM career even if they excelled in math and science. Students of color also cited academic-related reasons for changing to a non-STEM major, including difficulty with the material in at least one course, inadequate high school preparation, loss of confidence because of poor grades in early courses, poor teaching, and the overwhelming nature of the curriculum.

As the research discussed in this section indicates, many factors play a role in the persistence of women of color in STEM majors. They are reported as having the lowest rates of persistence among students in these majors. The research of Seymour and Hewitt

(1997) provides some clues about the experiences of women of color, but because the data were analyzed by race and gender separately, it is not possible to draw direct conclusions for women of color. The next section attempts to overcome this limitation by discussing the small body of research that examined the experiences of women of color in STEM majors

Experiences of women of color in STEM. Much of the research on undergraduate women of color in STEM discussed in this section was done using a variety of qualitative methods (with the exception of K. E. Vogt, 2005) and was completed within the past 10 years. Some of this work included women from many racial/ethnic minority groups (see A. Johnson, 2001; Ong, 2005; Sosnowski, 2002), while others focused solely on Asian Pacific American/Islander women (e.g., Chinn, 2002; K. E. Vogt). These were single institution studies, conducted at predominantly White institutions (e.g., A. Johnson; Ong; K. E. Vogt) or a predominantly White STEM department (e.g., Sosnowski). All primarily focused on undergraduate women, with the exceptions of Chinn and Sosnowski whose studies included a few women in STEM graduate programs.

In an ethnographic study of 20 women who identified as Latina, African American, Asian American, Native American, and African, A. Johnson (2001) explored issues related to constructing and maintaining identities as scientists. The use of ethnography allowed for an examination of the cultural aspects of science classrooms and laboratories, and how this culture can discourage some women of color. Data were collected from formal interviews with eight women, focus groups, and observations of classrooms, labs, and the minority engineering program office.

Women of color described the challenges they faced in their STEM major (A. Johnson, 2001). Many were uncomfortable with participating in class because they felt conspicuous and often felt as if they were the only people not understanding the material because their peers were not asking questions in class. They disliked the large lecture-style classes, and were frustrated with how professors weeded students out of the majors and graded on the curve. Some of the women of color wanted to discuss diversity issues in class, but received little encouragement from their instructors, even when such discussions were relevant to the material presented in class.

The interactions with the faculty were complex for the women of color (A. Johnson, 2001). On the one hand, they desired more personal relationships and interactions with faculty that were not solely focused on science. They enjoyed working with professors who were passionate about science, who took time to get to know them as individuals, and who helped and/or cared about them. Some of the women of color had positive experiences doing research with faculty because it was a chance to apply their learning from the classroom, be intellectually challenged, strengthen their affiliation to their department, and connect to their goals of practicing science. On the other hand, many of these women avoided meeting with their professor's during office hours because they were afraid of looking incompetent and did not want to provide their professors additional opportunities to be condescending toward them. Other women working with faculty on research felt out of place because of racial stereotypes about their abilities, and were discouraged by faculty to continue their research activities.

The women in A. Johnson's (2001) study felt isolated from and avoided by their peers, in part because of their race/ethnicity and gender (A. Johnson, 2001). They were

shunned by White students, many of whom would not sit near women of color in class and avoided working with them as lab partners. They perceived that White students were more valued by peers and faculty. Many women described the ways they had to downplay their femininity, such as adopting masculine or gender neutral styles of dress and behaviors. These kinds of interactions contradicted the prevailing ideology of science as race and gender neutral, of which the women were quite aware. Other majors, particularly ethnic studies, were more appealing because of the opportunity to study race/ethnicity issues and interact with more people of color. They felt more welcomed by the department and thought the major was easier and less competitive. Some considered changing their majors because they were re-evaluating their career goals.

The ways in which these women of color understood and experienced their racial/ethnic identity varied among the participants (A. Johnson, 2001). Some did not let racism get in their way and saw themselves as individuals. Others' experiences with discrimination raised their awareness, such that they began discussing these issues with friends and confronting the behaviors and attitudes of others. Yet other women of color saw their racial/ethnic group membership as an asset because it gave them the freedom to succeed when most others expected them to fail. In spite of the difficulties they encountered while trying to develop their identities as scientists, these women were committed to hard work and were proud of their achievements. They wanted to serve or help others through science, and many intended a career in medicine.

Using a phenomenological approach, Sosnowski (2002) examined the experiences of undergraduate and graduate women in an engineering college at a large public research university. This type of research method captured the lived experiences of participants to

gain an in-depth understanding of their experiences in engineering. Included in the study were three African Americans and six Latinas who were interviewed individually. Additional data were collected from a focus group session and from observations of student interactions in the minority engineering program office, the college of engineering, open house events, and women in technology forums.

These women described the academic and social challenges they faced in pursuit of their STEM degrees (Sosnowski, 2002). Academically, they were frustrated with the STEM curriculum because of outdated teaching methods, dull content, and irrelevant general education requirements. The demanding curriculum left them feeling burned out. Many enjoyed and wanted more hands-on activities because it made abstract material more real and tangible. They described faculty as mean, poor teachers who embarrassed and demeaned students when they did not know the answers in class. Some women expressed that encounters with racist/sexist behavior from their instructors made them stronger, while for others, these types of encounters made them angry.

Socially, these women felt isolated because the demanding course schedule left them with little time to develop relationships/friendships with peers (Sosnowski, 2002). They had few opportunities to socialize with racial/ethnic peers except through activities sponsored by the minority-engineering program. These women felt no one could relate to their experiences, and expressed the need for role models who looked like them. All of these factors contributed to feelings of loneliness and isolation. In the absence of peer support, these women relied upon the support and encouragement from their mothers.

A study of 10 undergraduate women of color in physics explored how they developed their identities as scientists, women, and people of color (Ong, 2005). Using

an ethnographic approach, data were collected from annual interviews, and observations of classrooms, study groups, and labs at a large research university. In general, the women in the study indicated that being perceived as a member of the scientific community was a challenging, on-going, and complex process. They all received messages from faculty and peers that despite their academic achievements and accomplishments, they were not thought of as intellectually competent because they did not look like a "typical" scientist. They worked hard to dispel racial/ethnic and gender stereotypes. Results of the data analysis revealed the ways in which these women persevered in physics and constructed identities as women scientists of color.

There were women in the study who constructed fragmented identities by subverting their racial/ethnic and/or their gender identities to be seen as scientists (Ong, 2005). Some women could deny or minimize any racial/ethnic differences because their light-skinned complexion allowed them to pass as White. These women did not actively portray themselves as women of color and had no objections when they were perceived as White by others. This ability to pass helped them establish credibility and competence as scientists, and facilitated acceptance from White students. The women who were unable to pass as White perceived that their race/ethnicity influenced the way they were treated by peers and faculty. Many women attempted to suppress their gender identities by adopting masculine behaviors and appearances. This minimized their femininity, which they believed conflicted with behaviors associated with being a scientist. Examples of gender passing included dressing in ways that hid their bodies, gaining weight, wearing short hair styles, wearing little or no make-up, avoiding pastel-colored clothing, and speaking in ways that were perceived as less feminine.

Other women in the study constructed identities that enabled them to express simultaneously their racial/ethnic, gender, and scientific identities (Ong, 2005). An African American woman described how she manipulated the stereotype of the "loud Black girl" (Ong, p. 607) to her advantage by asking questions in class, debating with peers, and otherwise displaying her knowledge and competence about science. The pay-off for this behavior was establishing intellectual credibility among peers and faculty, resulting in recommendations for summer research opportunities and graduate programs. A Latina also learned to highlight her academic achievements to her male peers, who had previously thought of her as a "big breasted sorority chick" (Ong, p. 609). By publicizing her accomplishments, she too established intellectual credibility among those in the department, and was invited to join study groups and serve as an undergraduate teaching assistant.

In a study of Asian Pacific Islander women, Chinn (2002) examined the influence of gender and racial stereotypes, role expectations, and culture on their pursuit of a science career. Using narrative interviews as way of eliciting how individuals make meaning of their personal and social group identities, four women with Chinese or Japanese ethnic heritages described the challenges of maintaining science career aspirations. Many were discouraged by their families from pursuing an engineering or science career because it was seen as masculine and lessened their chances of finding a husband. These women experienced conflict between their cultural values that dictated that women conform to traditional gender roles, and the western values that supported their career aspirations in science. The women described the STEM environment as competitive in which they were seen as outsiders and thought that others had low

expectations of their abilities. They tried to fit in by taking on masculine behaviors. Finally, some of the women reported strained or difficult relationships with their fathers because of their career choices, even though many had fathers who worked in science/technology related fields.

K. E Vogt (2005) examined the influence of individual, cultural, and collegiate factors on academic self-efficacy and achievement among 228 Asian Pacific American women. Using path analysis, the findings pointed to several direct and indirect effects on the outcomes. Academic self-efficacy was directly influenced by high school grade point average, socio-economic status, a strong academic peer support network, negative perceptions of the gender climate, and greater adherence to and identification with Asian cultural values. Greater association with U.S. values and culture had a negative effect on academic self-efficacy. On the outcome of academic achievement, high school grade point average and academic self-efficacy had positive direct effects, while greater levels of Asian acculturation had a negative direct effect. Indirect effects included socio-economic status and negative perceptions of the gender climate. A measure of the racial climate, defined as perceptions of faculty/student interactions and racial sensitivity in the classroom, was not significantly associated with either outcome.

Summary. What is known about women of color in STEM undergraduate majors comes from a small body of research from both qualitative and quantitative traditions. Collectively, the portrait of women of color in STEM can be described as the following: they (a) were not likely to persist in these majors (Bonous-Hammarth, 2000; Grandy, 1998; Smyth & McArdle, 2004), (b) faced challenges related to their gender and racial/ethnic identities (Chinn, 2002; A. Johnson, 2001; Ong, 2005; Sosnowski, 2002; K.

E. Vogt, 2005), (c) were isolated from their peers, and (d) had difficult relationships with faculty (A. Johnson; Sosnowski).

These studies highlighted the racial/ethnic and gender identity issues that women of color had to navigate in the context of STEM. As it pertains to being a woman in STEM, there were negative perceptions of the gender climate (K. E. Vogt, 2005). Many women subverted their gender identities by dressing in ways to hide their bodies and adopting masculine behaviors and patterns of speaking to focus less attention on themselves as women and draw more attention to their intellectual abilities (Chinn, 2002; A. Johnson, 2001; Ong, 2005).

Women of color also found themselves negotiating their racial/ethnic identities in the midst of their STEM experiences. There were those with light skin whose racial/ethnic group membership was unidentifiable, which permitted them some immunity from racial stereotypes (Ong, 2005). Other women whose racial/ethnic minority group status appeared less ambiguous encountered racial stereotypes about their academic abilities (A. Johnson, 2001; Ong), and perceived that White students were more valued by faculty (A. Johnson). Their identities as women of color left them feeling both highly visible and invisible by faculty and peers (A. Johnson). For Asian Pacific American women, strong identification with their Asian culture contributed to greater academic self-efficacy, but lower academic achievement (K. E. Vogt, 2005). Those who identified more with American culture had lower academic self-efficacy (K. E. Vogt). The influence of cultural values and identity for Asian Pacific Islander women was also evident in Chinn's (2002) study, as they described the conflicts between cultural ideas of appropriate roles for women and their passion for science. Thus, there were costs and

benefits associated with the extent to which women of color embraced or denied their racial/ethnic identities.

In terms of interactions with their peers, women of color frequently experienced isolation - whether from their racial/ethnic peer group (Sosnowski, 2002), White students (A. Johnson, 2001), or from other women of color because of low enrollment in these majors (Sosnowski). Some were avoided by White students (A. Johnson), and others reported being excluded from activities that involved their male peers (Chinn, 2002). The nature of these peer interactions left women feeling lonely and out of place (A. Johnson; Sosnowski).

The results of these studies also indicated that women of color had mixed relationships with their STEM faculty. Some described difficult and unsatisfactory relationships with faculty. They felt their professors were condescending and demeaning toward students who did not understand the material (A. Johnson, 2001; Sosnowski, 2002). Consequently, they avoided going to office hours to get the assistance they needed (A. Johnson). These women wanted personal relationships with their faculty; however, the culture of STEM dictated that students did not discuss their personal lives and non-academic concerns with faculty (A. Johnson). On the other hand, some women of color reported positive experiences with faculty when they were involved in research activities (A. Johnson; Sosnowski).

Overall, the results from the research on women of color in STEM majors point to the influence of affective and interpersonal outcomes on their experiences. Because these studies grouped together women of color in their samples (e.g. A. Johnson, 2001; Ong, 2005; Sosnowski, 2002), or focused on women from one racial/ethnic group (e.g.

Chinn, 2002; K. E. Vogt, 2005), it is difficult to identify differences among racial/ethnic groups, including White women. In addition, it was unknown whether similar findings related to interpersonal and affective outcomes would emerge from a larger dataset of women of color using quantitative analyses, and whether there were differences among racial/ethnic groups. This study was an effort to fill these gaps in the literature.

Sense of Belonging

In the concluding chapter of *What Matters in College? Four Critical Years Revisited*, Astin (1993) noted the importance of peer and faculty relationships on students' college experiences. The peer group, Astin (1993) wrote, "is the single most potent source of influence on growth and development during the undergraduate years" (p. 398). A peer group consists of those individuals with whom students affiliate and identify, and from which acceptance is sought. From the perspective of individual students, membership in a peer group necessitates "some element of comparable or equal status" (Astin, 1993, p. 400), and the belief that there are important similarities between themselves and the peer group. From the group perspective, the peer group confers acceptance of membership and dictates the norms and expectations of its members.

The nature of students' relationships with faculty also influences their experiences in college (Astin, 1993). Interactions with faculty are important because they educate students about institutional norms and values, help them form attachments to the campus, and influence important outcomes (Pascarella & Terenzini, 2005). Faculty concerned with students' academic and personal problems and who readily availed themselves to students outside of class, were positively associated with students' bachelor degree attainment, intellectual self-esteem, and satisfaction with the overall college experience.

Conversely, faculty more concerned with research, publishing, and scholarship were negatively associated with students' satisfaction with their overall experience with college (Astin, 1993).

Theorizing sense of belonging. The effects of the peer group and faculty interactions on student persistence have been characterized as social and academic integration by Vincent Tinto (1993). Students are more likely to persist if their experiences in college serve to integrate them into the academic and social life of the institution. Integration is said to be thwarted if students perceive that they do not fit in "with the social and intellectual fabric of institutional life" (Tinto, 1993, p. 50) or if they are isolated from others and "unable to establish…the personal bonds that are the basis for membership in the communities of the institution" (Tinto, 1993, p. 56). The mutually dependent relationship of academic and social integration can serve to reinforce students' experiences of institutional membership, or cause conflict if one aspect of integration is more demanding than the other. For example, students may experience isolation from their peers if they are in academically demanding majors (Tinto, 1993). Ultimately, the extent to which students experience and achieve some form of academic and social integration influences not only their commitment to remain in college, but also to commitment to achieving their educational, personal, and career goals (Tinto, 1993).

Although the concept of integration as an integral aspect of persistence has been widely supported and studied (Braxton, 2000), scholars have questioned the appropriateness of applying this concept to racial/ethnic minority students (Pascarella & Terenzini, 2005). In particular, Hurtado and Carter (1997) argued that integration might be difficult for students of color who may feel isolated from the mainstream campus

community that offers little support and understanding for their cultural identities and practices. Such marginality is thought to affect students' abilities to be successful in college (Hurtado & Carter). Hurtado and Carter offered sense of belonging as a way of conceptualizing the extent to which the academic and social experiences of students of color influence their affiliation and identification with a peer group and their institution. More recently, Hoffman et al. (2003) suggested that sense of belonging is an important link in retention, in that the more students experience a sense of belonging, the more likely they will commit to the institution and persist until graduation.

Definitions and measures of sense of belonging. Sense of belonging has "both cognitive and affective elements in that the individual's cognitive evaluation of his or her role in relation to the group results in an affective response" (Hurtado & Carter, 1997, p. 328). Hoffman et al. (2003) defined sense of belonging as "the subjective sense of affiliation and identification with the university community" (p. 228) and as a reflection of the extent to which students are integrated into the campus community. In the research literature, sense of belonging has been measured in ways that vary in precision and complexity. Single items measuring sense of belonging were used by Nora and Cabrera (1996), in which respondents rated the extent to which they felt they belonged to their institution, and Gilliard (1996) who asked students to rate the extent to which they felt part of campus life regarding campus activities and student government. Mandell et al. (1992) used two individual items to measure the extent to which students felt a sense of community within their academic department and felt belonging to a general support network.

Complex measures of sense of belonging are found in research using composite measures to define this construct. Hurtado and Carter (1997) used a measure of sense of belonging containing three items relating to the extent students saw themselves as part of the campus community, felt they were a member of the campus community, and felt a sense of belonging to the campus community. Velásquez (1999) measured sense of belonging using four items that asked students to rate the extent to which they felt at home on campus, had good friends on campus, became acquainted with faculty and staff, and felt there were many co-curricular activities they were comfortable getting involved with. Reid and Radhakrishnan (2003) put forth a construct they described as the "general campus climate" that contained items similar to those found in sense of belonging constructs. Their measure of the general campus climate included four items relating to the degree to which students felt they fit in with other students, would choose the same college if they had to do it again, described the atmosphere on campus as friendly, and felt left out of things on campus (reverse coded).

The work of Hoffman et al. (2003) identified five dimensions of sense of belonging, providing a multifaceted measurement of this construct. The first dimension, defined as "perceived peer support," included eight items related to the nature of students' academic and social interactions with their peers. The second dimension, "perceived support/comfort from faculty," consisted of six items related to the nature of academic and social interactions students had with faculty. The third dimension, "perceived classroom comfort," contained four items related to the extent to which students felt comfortable participating in class. A fourth dimension, "perceived isolation," was comprised of four items related to the extent to which students interacted

with or were known by their peers. Lastly, "empathic faculty understanding" included four items related to students' perceptions of their professors' abilities to listen to and understand their problems. Most recently, D. R. Johnson et al. (2007) examined sense of belonging among first-year students from different racial/ethnic groups using the same five-item composite measure as the current study. Their measure of sense of belonging included items about the extent to which respondents felt a sense of belonging, felt like a member of the campus community, were comfortable on campus, would chose to attend the same college over again, and felt their college was supportive of them.

Prior research has shown differences among students in their perceptions of sense of belonging. Mandell et al. (1992) found that students in a science department reported less strong feelings of belonging than those in a humanities department, and seniors had greater sense of belonging than students from lower academic class levels. Students who participated in a learning community (Hoffman et al, 2003) or a living-learning program (Inkelas & Associates, 2004) reported greater sense of belonging than students who did not participate in such programs.

Additionally, racial and gender differences among students' perceptions of sense of belonging have been reported in the research literature. Students of color experienced a less strong sense of belonging than White students (Gilliard, 1996; Mandell et al., 1992; D. R. Johnson et al., 2007; Reid & Radhakrishnan, 2003). Women were more likely to report belonging to their academic department and to a general support network than men (Mandell et al.). Based on these studies, it could be that women of color would perceive less belonging because of their racial identity, or they could perceive greater belonging because of their gender identity. Because these studies did not account for the intersection

of race and gender, it is unclear the degree to which women of color experience sense of belonging as undergraduate students.

Sense of belonging among women of color in STEM. Sense of belonging among women of color is a concept worthy of examination in the context of STEM majors because in order for women "to survive and bond independently to science and science careers" (Seymour & Hewitt, 1997, pp. 260-261), they must conform to an environment that has "evolved in an exclusively white and male context" (Seymour & Hewitt, p. 132). STEM culture is competitive and hierarchical, and rewards individual achievement and assertiveness. Seymour and Hewitt argued that because STEM culture is male-centered and identified, the process of proving oneself worthy as a student is akin to male rites of passage in which boys prove themselves worthy of manhood by successfully overcoming a series of challenges. In STEM, the primary challenge is surviving the weed-out tradition. Because STEM is dominated by men and their values, they are most equipped to do well in these environments. The culture of the STEM environment often runs counter to ways in which women and students of color have been socialized, so many struggle to fit in with the expectations of this system (Seymour & Hewitt). Women may experience difficulty in STEM because they are socialized to be cooperative rather than competitive, seek approval and validation from others, underestimate their abilities and talents, and downplay their accomplishments and achievements (Fassinger, 2002). Many students of color come from cultures that view assertiveness and directness as inappropriate, place importance on community or family expectations above individual wishes, and expect personal relationships with their teachers (Seymour & Hewitt).

Many women in Seymour and Hewitt's (1997) study reported being treated like outsiders by male peers and faculty who deemed them incapable of doing science. These women encountered sexism from peers and faculty, were excluded from informal social and academic interactions with their male peers, and were discouraged by faculty in their pursuit of STEM majors and careers. These experiences took a toll on the women, such that they "began to feel isolated, insecure, intimidated, to question whether they 'belonged' in the sciences at all and whether they were good enough to continue" (Seymour & Hewitt, p. 256). Some women indicated that they did not know how to navigate and survive the STEM environment, but felt that men were more socially equipped to do well because they were in the majority and viewed as capable of doing science. Survival in STEM required women to adopt certain attitudes and behaviors, such as being assertive, competitive, and smart, which were seen as necessary to "win recognition for their 'right' to belong " (Seymour & Hewitt, p. 243). Even those women who successfully adopted these behaviors continued to be excluded by their male peers and faculty because they eschewed traditional gender roles to compete successfully with men.

Students of color reported feeling isolated from both their racial/ethnic peer group and other White students, resulting in loneliness and feeling surrounded by White people who were prejudiced against them (Seymour & Hewitt, 1997). This isolation was most pronounced among under-represented students of color, who experienced "doubt that they belonged…and were miserably lonely" (Seymour & Hewitt, p. 362) because of the lack of a racial/ethnic peer group in STEM. In spite of their actual abilities and preparation, the environment under-represented students of color found in STEM

undermined their self-confidence and caused them to question whether they belonged in STEM.

Summary. Sense of belonging has been identified as an indicator of the extent to which students are integrated into their institutions (Hurtado & Carter, 1997). In general, students of color experienced a less strong sense of belonging than White students (Gilliard, 1996; Mandell et al., 1992; D. R. Johnson et al., 2007; Reid & Radhakrishnan, 2003). Given the culture and environment in STEM, there is evidence to support that feeling a sense of belonging may be difficult for women and students of color (Seymour & Hewitt, 1997). Both groups in Seymour and Hewitt's study reported being treated as outsiders and questioning whether they belonged in science. Students of color also experienced isolation from their racial/ethnic peer group. These themes were also prevalent in the research on undergraduate women of color in STEM conducted by A. Johnson (2001), Ong (2005), and Sosnowski (2002).

For women of color in STEM, sense of belonging appears to be related to negative peer and faculty interactions (A. Johnson, 2001; Seymour & Hewitt, 1997; Sosnowski, 2002), racial/ethnic peer group interactions (Seymour & Hewitt; Sosnowski), racial climate perceptions, including racialized stereotypes (A. Johnson; Ong, 2005; Seymour & Hewitt), and lost confidence (Seymour & Hewitt). Given that themes related to the racial climate were embedded in the issues faced by women of color in STEM majors, the next section examines the relationship of the campus racial climate to the experiences of students of color, particularly at predominantly White institutions.

The Campus Climate for Racial and Ethnic Diversity

Because this study focused on women of color in a predominantly White environment, it was appropriate to consider the contribution of the campus climate for racial/ethnic diversity to their experiences in STEM majors. Women of color students will likely find themselves in STEM educational environments that are overwhelmingly populated by White people and men. In 2001, STEM faculty at four-year institutions were predominantly male (79.9%) and White (81.0%). Under-represented racial/ethnic groups were 6.0% of faculty, and Asian Pacific Islanders were 12.0% (NSF, 2004b). In 2001, 66.6% of the students earning STEM bachelor's degree were White; women of color earned 11.0% of these degrees in the same year (NSF, 2004b). Although it appears that the student body is more racially/ethnically diverse than the faculty in STEM, in general, women of color are represented in small numbers in both areas. White people remain a dominant presence in these fields, thus pointing to the need for an examination of the significance of the campus racial climate to women of color in STEM.

Definition and measures of the campus racial climate. According to Hurtado et al. (1999), the campus racial climate consists of four dimensions. First, the historical legacy of inclusion or exclusion draws attention to the length of time people from racial/ethnic minority groups have been present on a campus. This is an important consideration given that many institutions had long-standing policies that denied or severely limited access to racial/ethnic minority students and women (Hurtado, 2003). Although many colleges and universities have eliminated such *de jure* policies, aspects of this legacy remain rooted in institutional cultures that continue to benefit historically dominant groups, resulting in *de facto* practices of discrimination (Hurtado et al.). The second dimension is compositional diversity (Milem, Chang, & Antonio, 2005), which is the number of racial/ethnic

minority and gender groups represented on campus (Hurtado et al.; Milem et al.). Third is the psychological climate, which is comprised of the attitudes and perceptions that people from different racial/ethnic groups have toward each other. This includes perceptions of prejudice and discrimination, opinions of inter-group relations, and views about the institution's commitment to diversity. Lastly, the behavioral dimension of the campus racial climate consists of the interactions between people from different racial/ethnic groups. Although the campus racial climate may be most directly affected by a specific institutional context, it is also influenced by factors beyond the campus, such as government policies and programs, and the larger social context (Hurtado et al.).

In defining and measuring the campus racial climate, it appears that many researchers have focused on constructs representing the psychological and behavioral dimensions. Measures of the campus racial climate have included items related to the degree of racial tension, conflict, and discrimination on campus (see Ancis et al., 2000; Hurtado, 1992; Nettles et al., 1986; Nora & Cabrera, 1996; Reid & Radhakrishnan, 2003; Smedley, Myers, & Harrell, 1993), and sensitivity, respect, or awareness about racial diversity (Ancis et al.; Nettles et al.; Reid & Radhakrishnan). Items related to perceptions of racial discrimination or insensitivity from faculty (Ancis et al.; Gilliard, 1996; Nettles et al.; Nora & Cabrera; Reid & Radhakrishnan) and feelings of support or trust from administrators (Hurtado; Nettles et al.) have also been defined as measures of the racial climate on campus.

Peer interactions are also important in studying the campus racial climate, as measured by racial insensitivity or discrimination from students (Ancis et al., 2000; Gilliard, 1996; Nettles et al., 1986; Reid & Radhakrishnan, 2003), cross-racial

interactions (Chang, 1999; Hurtado, 1992; Reid & Radhakrishnan), and stresses associated with interactions with White students and being in a predominantly White environment (Smedley et al., 1993). The extent to which students discussed racial/ethnic issues (Chang; Nettles et al.) and institutional commitment to attract and support students of color have also been included as indicators of the campus racial climate (Nettles et al.; Gilliard; Reid & Radhakrishnan).

Effects of the campus racial climate. Prior research documents that different students have different experiences and perceptions of the campus racial climate. Students of color reported more negative perceptions of the campus racial climate than White students (Ancis et al., 2000; Gilliard, 1996; Nettles et al., 1986; Nora & Cabrera, 1996; Reid & Radhakrishnan, 2003). Among racial/ethnic minority groups, African Americans were the most likely to experience a negative campus racial climate (Ancis et al.; Hurtado, 1992; Reid & Radhakrishnan; Smedley et al., 1993). In addition, African American and Asian Pacific American students reported more experiences of racism from faculty than White students (Ancis et al; Cabrera et al., 1999; Hurtado et al., 1994).

Students' experiences with the campus climate for racial diversity have been found to influence important college outcomes. Among students of color, persistence was negatively affected by perceptions of prejudice and discrimination (Cabrera et al., 1999; Nora & Cabrera, 1996). Feelings of racial discrimination were negatively associated with college grade point average for students of color (Nettles et al., 1986; Nora & Cabrera). Perceptions of a hostile campus racial climate negatively affected the transition to college (Hurtado & Carter, 1997), and the stress associated with being a racial/ethnic minority student on a predominantly White campus negatively affected first-year students'

psychological and academic adjustment to college (Smedley et al., 1993). Lastly, negative perceptions of the campus racial climate contributed to students of color feeling they lacked a sense of belonging (Gilliard, 1996; Hurtado & Carter; D. R. Johnson et al., 2007; Nora & Cabrera; Reid & Radhakrishnan, 2003). Although the research points to the effects of negative experiences with the campus racial climate, there were positive outcomes associated with racial/ethnic diversity interactions. Chang (1999) found that socializing with someone of different race and discussing racial/ethnic issues were indirectly associated with retention among students from different racial/ethnic groups, including White students.

The racial climate in STEM. There is some evidence of the impact of racial/ethnic diversity on the persistence of students of color in STEM. The presence of "minority support" (Grandy, 1998, p. 595), defined as minority and female role models and advisors, same race/ethnic group peers, and minority relations staff, had the strongest direct effect on commitment to science careers, which in turn had a strong effect on persistence in STEM (Grandy, 1998). Thus, the availability of support mechanisms for students of color had an indirect effect on persistence. Additionally, these programs appeared to have a greater influence on persistence for women of color rather than their male peers (Grandy, 1998). Minority support programs are thought to serve as a potential buffer to the negative racial climate (Grandy, 1998; Seymour & Hewitt, 1997). Students of color who remained in STEM majors reported the critical role these programs played in their retention; those who switched from STEM majors indicated that support programs for students of color were either inadequate or non-existent on their campus, and contributed to their decision to change majors (Seymour & Hewitt).

Other research offers descriptive evidence of students' perceptions and experiences with the racial climate in STEM. Under-represented students and women of color described coping with negative racial stereotypes about their academic abilities (A. Johnson, 2001; Ong, 2005; Seymour & Hewitt, 1997), especially from White students who attributed their presence on campus to affirmative action programs (Seymour & Hewitt). Asian Pacific American students were viewed as having natural abilities in math and science, and were often perceived as citizens from other countries rather than from the United States (Seymour & Hewitt). Students and women of color also described racist attitudes from faculty and peers, who avoided them and questioned their presence in these majors (A. Johnson; Ong; Seymour & Hewitt; Sosnowski, 2002). In addition, some women of color reported that they wanted to discuss race and gender issues in their science classes, but were discouraged by faculty from doing so (A. Johnson).

Seymour and Hewitt (1997) speculated that competition over limited resources, such as scholarship and job opportunities, was at the root of the racism experienced by students of color in STEM. Many White students in the study were angry about the availability of scholarships designated for under-represented students of color. Some questioned the legitimacy of the minority status of those awarded the scholarships, while others believed recipients lacked the academic merit or financial need to warrant a scholarship. White students in the study also believed that students of color would have more advantages in gaining employment after graduation because of preferential hiring practices.

Summary. In the face of growing racial/ethnic diversity among college students, the campus racial climate is an important dimension to consider in the experiences of

students of color (Hurtado et al., 1999). The campus racial climate may be especially salient for women of color in STEM majors, who may find themselves in academic departments lacking diversity along both racial/ethnic and gender lines. Women of color reported feelings of isolation because they lacked a racial/ethnic peer group and had few faculty of color role models (A. Johnson, 2001; Ong, 2005; Sosnowski, 2002). These feelings of alienation were heightened by the racist and discriminatory attitudes and behaviors of White faculty and students towards students of color in general (Seymour & Hewitt, 1997) and women of color in particular (A. Johnson; Ong; Sosnowski).

The evidence suggests that students from different racial/ethnic backgrounds have different perceptions of the campus racial climate. Students of color were more likely than White students to perceive a negative campus racial climate (Ancis et al., 2000; Nora & Cabrera, 1996; Reid & Radhakrishnan, 2003), and African Americans reported more negative perceptions of the campus racial climate than other students of color (Ancis et al.; Hurtado 1992). Given these findings, it is likely that among STEM majors, women of color and White women will have different perceptions of the campus racial climate, and that differences in these perceptions exist among women of color.

The presence of a hostile campus racial climate has been shown to negatively affect students' psychological experiences of their institutions (Hurtado et al., 1999), including their sense of belonging within predominantly White institutions (Hurtado & Carter, 1997; D. R. Johnson et al., 2007; Nora & Cabrera, 1996; Reid & Radahakrishnan, 2003). Considering the lack of racial/ethnic diversity in STEM, it is possible that sense of belonging for women of color in STEM is related to their perceptions of the campus

racial climate as well. Such a relationship has yet to be established through empirical research, and is a goal of this study.

Thus, success for women of color in STEM appears to be predicated upon their ability to find a community in which they feel a part. However, such a community can be difficult to identify within a racial/ethnic climate that is predominantly White and male. Given the salience of students' sense of belonging on ensuing and important student outcomes such as adjustment to college (Hurtado & Carter, 1997), persistence (Nora & Cabera, 1996), peer and faculty interactions (Hoffman et al., 2003; Hurtado & Carter), and academic achievement (Gilliard, 1996), it is important to consider the facets of students' backgrounds and their college experiences that predict sense of belonging for women of color in STEM.

Predictors of Sense of Belonging

The research literature has yet to identify predictors of sense of belonging for women of color in STEM majors. However, there is empirical evidence for factors related to the sense of belonging for students of color. These include students' background and academic characteristics, institutional features, interactions with faculty and peers, living-learning programs and perceptions of the residence hall climate, and perceptions of the campus racial climate, which are described below in further detail.

Background characteristics. In considering students' background characteristics that relate to sense of belonging, race/ethnicity appears to be the most important. Prior research has shown differences in feeling a sense of belonging among students from different racial/ethnic backgrounds (Gilliard, 1996; D. R. Johnson et al., 2007; Mandell et al, 1992; Nora & Cabrera, 1996). Other background characteristics, including socio-

economic status, parents' level of education and high school grades have not proven to be significant predictors of sense of belonging (Gilliard; D. R. Johnson et al.), while students' SAT or ACT scores have not been tested for their relationship to sense of belonging. The aforementioned background characteristics are included in the present study because they have been used in previous studies of undergraduate women and/or students of color in STEM majors using national datasets (see Astin & Astin, 1992; Bonous-Hammarth, 2000; Elliot et al., 1996; Grandy, 1998; Huang et al., 2000; Leslie et al., 1998; Smyth & McArdle, 2004; Strenta et al., 1994).

Academic characteristics. Prior research has examined the relationship between students' academic characteristics and their sense of belonging. Mandell et al. (1992) found that among men and women, higher academic class standing predicted belonging to an academic department. Gilliard (1996) found that among White students, lower academic class standing predicted their sense of belonging to their institution.

The relationship between measures of academic self-concept and sense of belonging appears to be unclear. Among Latino students, Hurtado and Carter (1997) found that academic self-concept had no direct or indirect effect on sense of belonging. Gilliard (1996) found that satisfaction with academic performance during college had a significant, yet indirect relationship to sense of belonging among African American students.

Although the findings vary on the relationship between academic self-concept and sense of belonging, academic self-concept is an important construct to include in the present study because it is a mainstay in the research on women and students of color in STEM. Relationships were reported between some form of academic self-concept and a

variety of outcomes, including initial choice of STEM major (Astin & Astin, 1992; Hackett et al., 1992; Huang et al., 2000; Leslie et al., 1998), grade point average (C. Vogt, 2003; K. E. Vogt, 2005), and persistence in a STEM major (Huang, et al.; Seymour & Hewitt, 1997; Strenta et al., 1994). In addition, diminished levels of confidence contributed to the decisions of women and students of color to change to non-STEM majors (Seymour & Hewitt).

Institutional characteristics. Several types of institutional characteristics have been examined as predictors of sense of belonging. Among students of color in general (D. R. Johnson et al., 2007) and Latino students in particular (Hurtado & Carter, 1997), institutional selectivity had no significant effect on their sense of belonging. Gilliard (1996) found the negative influence of institutional type (specifically doctoral granting institution) to be significant for sense of belonging among African American students in the first two blocks of a hierarchical multiple regression analysis before the inclusion of other collegiate factors.

Faculty interactions. Interactions with faculty have been found to be significant predictors of sense of belonging among students of color in general (Nora & Cabrera, 1996; Reid & Radhakrishnan, 2003), yet the relationship shows some inconsistent patterns. Among African American students, Gilliard (1996) found that the influence of faculty interactions had a significant indirect effect on sense of belonging. Hurtado and Carter (1997) found that faculty interactions were correlated with sense of belonging among third-year Latinos, while D. R. Johnson et al. (2007) found a negative relationship between faculty interactions and sense of belonging among first-year Hispanic/Latino students. Among all students, sense of belonging to an academic department was

predicted by the extent to which students perceived there to be a sense of unity between faculty and students in the department (Mandell et al., 1992).

Astin and Astin (1992) reported the influence of faculty interactions on persistence in STEM majors. In particular, working with faculty on a research project and assisting faculty with teaching were significant predictors of persistence in physical and biological science majors among all students. These interactions with faculty were also predictors of maintaining career aspirations as a science researcher or practitioner (Astin & Astin).

Data from qualitative research indicate that some women do not have positive interactions with STEM faculty. Women described faculty who discouraged them from pursuing a STEM major, were rude to them in class, and intentionally made them feel uncomfortable so they would leave their major (Seymour & Hewitt, 1997). They also felt excluded from informal and social interactions the faculty had with male students. These types of interactions with faculty led some women to question whether they belonged in their STEM major (Seymour & Hewitt).

Women of color reported similar types of experiences with the faculty in their STEM major. They perceived faculty as distant in their relationships with students, and feared contact with those who criticized students for not knowing the correct answers (A. Johnson, 2001; Sosnowski, 2002). In addition, women of color experienced racist and sexist behavior and attitudes from faculty in the form of racial and gender stereotypes about their ability to do science (A. Johnson; Ong, 2005; Sosnowski).

Living-learning programs and residence hall climate. In the wake of calls for reform in undergraduate education, particularly at large research universities (e.g., The

Boyer Commission, 1998), living-learning programs were created on many college campuses (Inkelas, Johnson, Lee, et al., 2006). As the Boyer Commission noted, large research universities are "intellectual cities" (p. 34) that can be "baffling and overwhelming to students, making them feel lonely, remote, and too anxious for optimal learning" (p. 34). The Boyer Commission recommended that research universities provide opportunities for students to develop smaller, more manageable communities within the larger institutional environment. Living-learning programs represent one type of educational initiative that helps students connect with a smaller community of peers and faculty, and facilitates their involvement and integration into their learning environment. As such, living-learning programs can be ideal ways to help students experience belonging and connection to their institution (Inkelas, Johnson, Lee et al.). Given that living-learning programs are largely found at research universities (The Residential Learning Communities International Registry, 2006), and a large percentage of undergraduate students in STEM majors graduate from research universities (NSF, 2004b), it is worthwhile to investigate the relationship between these programs and the under-representation of women of color in STEM majors.

Prior research has shown that residence halls can be important vehicles for facilitating sense of belonging among students. Those who lived on campus reported a greater sense of belonging than students who lived at home with their families of origin (Mandell et al., 1992), and living on campus was a significant predictor of sense of belonging among Latino students (Hurtado & Ponjuan, 2005). Participants in living-learning programs or residential learning communities reported greater sense of

belonging than students who did not participate in these programs (Hoffman et al., 2003; Inkelas & Associates, 2004).

Participation in STEM-related living-learning programs positively influenced the retention rates for women in these majors. They had higher rates of first-to second year retention in their major, overall major retention (Gandhi, 1999), and retention in science majors and earning science degrees (Hathaway et al., 2001) than their female peers in STEM who did not participate in living-learning programs. Participants in these programs reported greater social adjustment to college (Gandhi), faculty mentoring experiences, and growth in the ability to apply something learned in one course to material in another course (Inkelas et al., 2005). However, STEM-related living-learning programs targeted at women do not benefit all participants equally; under-represented women in these programs had lower retention rates than their White and Asian female peers (Hathaway et al.). These programs were predominantly White (81.0%), followed by Asian Pacific American women (9.8%), and under-represented women of color (8.4%) (Inkelas et al., 2005).

It may be that the climate in the residence hall is a key aspect of the educational benefits of living on campus. The climate in the residence hall has been linked to first-to-second year retention, plans to graduate from institution of enrollment, and greater peer and faculty interactions among first-year students (Berger, 1997). There is evidence suggesting that the climate in living-learning programs is distinct from that of traditional residence halls. Students in living-learning programs had more positive perceptions of the residence hall climate as being academically and socially supportive than those who lived in traditional residence halls (Inkelas, Vogt, et al., 2006; Inkelas & Weisman, 2003).

Among students participating in living-learning programs, women were more likely than men, and African American students were more likely than students from other racial/ethnic groups to describe a supportive residence hall climate (Inkelas, Vogt, et al.). Women in STEM majors in any type of living-learning program reported a more academically supportive residence hall climate than their counterparts living in traditional residence halls (Inkelas et al., 2005). Lastly, for first-year students across all racial/ethnic groups, perceptions of the residence hall as socially supportive was a significant predictor of their sense of belonging (D. R. Johnson et al., 2007).

Peer interactions. Research has shown the influence of various types of peer interactions on sense of belonging for students of color. Hurtado and Carter (1997) found that discussing course content with another student was significantly correlated with sense of belonging among second-year Latino students, and among third-year students, tutoring another student was also correlated with sense of belonging. Velásquez (1999) found that, among Chicano students, social interactions with White students positively influenced their sense of belonging. Among African American students, satisfaction with the social life on campus, involvement with social activities (Gilliard, 1996), and co-curricular involvement among Asian Pacific American students (D. R. Johnson et al., 2007) were significant predictors of sense of belonging. Mandell et al. (1992) found the perception of the academic department as offering many spontaneous social activities for students was a significant predictor of students' feeling a sense of belonging to their academic department. Only the results from Nora and Cabrera (1996) indicated that peer interactions had no effect on students' sense of belonging to their institution.

In the context of STEM majors, the competitive environment put a strain on peer relationships and did not foster positive interactions (Seymour & Hewitt, 1997). Students were not willing to collaborate with each other and were protective of their knowledge and skills, out of fear that working together would enable their peers to earn better grades. Women had to cope with additional difficulties in their relationships with their male peers (A. Johnson, 2001; Ong, 2005; Seymour & Hewitt; Sosnowski, 2002). They felt that male students focused too much on women's appearance, often making sexually suggestive remarks and jokes. To avoid these kinds of interactions, the women discussed how they altered their appearance such as dressing in ways that were masculine so they would be taken seriously and accepted by their male peers (Chinn, 2002; A. Johnson; Ong; Seymour & Hewitt). In the labs, women reported that men often took charge of the work group, gave orders, helped them when the women did not need or want it, and sometimes took credit for their work (A. Johnson; Seymour & Hewitt). Women of color described feeling isolated from peers in their racial/ethnic group, as well as from White students (A. Johnson; Sosnowski). Some felt the demands of their majors gave them little opportunity to establish meaningful relationships with their peers, especially with other women students (Sosnowski).

Campus racial climate perceptions. There is evidence that sense of belonging for students of color is negatively affected by perceptions of a poor campus racial climate (Nora & Cabrera, 1996; Reid & Radhakrishnan, 2003). However, important distinctions between and among racial/ethnic minority groups exist. The impact of the campus racial climate appeared to be greatest for African American students in those studies comparing multiple racial/ethnic minority groups (D. R. Johnson et al., 2007; Reid &

Radhakrishnan). Sense of belonging for African Americans was also related to perceptions of racial discrimination from campus administrators (Gilliard, 1996) and beliefs that the university was committed to attracting students of color and fostering respect for cultural differences (Reid & Radhakrishnan).

Among Latino students, perceptions of a hostile campus racial climate negatively affected their sense of belonging (Hurtado & Carter, 1997; Reid & Radhakrishnan, 2003). However, perceptions of discrimination was not a significant predictor of sense of belonging among Chicano students (Velásquez, 1999) nor were perceptions of a positive campus racial climate related to sense of belonging for first-year Hispanic/Latino students (D. R. Johnson et al., 2007). Interaction with a diverse peer group was significant only for Hispanic/Latino students when compared to students from other racial/ethnic groups (D. R. Johnson et al.). For Asian Pacific American students, their sense of belonging was also related to their perceptions of the campus racial climate (D. R. Johnson et al.; Reid & Radhakrishnan).

Chapter Summary

The research on women and under-represented students of color indicate that, among students in STEM majors, women of color are the least likely to persist (Bonous-Hammarth, 2000; Grandy, 1998; Smyth & McArdle, 2004). Although many women and under-represented students enter college with intentions of majoring in a STEM field (Hanson, 2004; Huang et al., 2000; Smyth & McArdle), these goals somehow go unrealized in the process of their undergraduate experiences. The work of qualitative research identifies aspects of the collegiate environment that have a negative effect on the STEM educational experiences of women and students of color, separately, (Seymour &

Hewitt, 1997) and women of color in particular (A. Johnson, 2001; Ong, 2005; Sosnowski, 2002). Factors contributing to the difficulties women of color have in STEM include experiences of racial and gender discrimination, isolation from their peers, a lack of role models of color, and difficult interactions with peers and faculty. As an educational initiative, living-learning programs focused on women in STEM have successfully influenced the retention of women in these majors (Hathaway et al., 2001). However, under-represented women of color in these programs had the lowest retention rates (Hathaway et al.) and fewer participants (Inkelas et al., 2005).

Together, this body of research represents the foundation of understanding the experiences of undergraduate women of color in STEM majors. However, several limitations exist among this body of work. Some studies analyzed data only by gender (Astin & Astin, 1992; Seymour & Hewitt, 1997), or by race/ethnicity (Bonous-Hammarth, 2000; Seymour & Hewitt); thus, only tentative assertions can be made about women of color. Other research using large national datasets (e.g., Grandy, 1998; Huang et al., 2000; Leslie et al., 1998; Smyth & McArdle, 2004) offered analyses by race/ethnicity and gender, but viewed women of color as deficient in certain academic and personal characteristics leading to positive STEM outcomes, rather than examining the influence of college environment on their experiences. This group of research also focused on cognitive-based outcomes, rather than the affective and interpersonal experiences of women of color in STEM education. In addition, the research focused explicitly on undergraduate women of color are few in number, were single institution studies, and had small sample sizes not permitting analysis by racial/ethnic group or generalizability to the larger population of women of color in STEM (e.g., A. Johnson,

2001; Ong, 2005; Sosnowski, 2002). Thus, very little is known about how women from different racial/ethnic groups compare in their STEM experiences.

The campus racial climate has been shown to influence important college outcomes such as the transition and adjustment to college (Hurtado & Carter, 1997; Smedley et al., 1993), grade point average, (Nettles et al., 1986; Nora & Cabrera, 1996), and persistence (Cabrera et al., 1999; Nora & Cabrera). Research suggests that women of color in STEM experience a negative climate for race (A. Johnson, 2001; Ong, 2005; Sosnowski, 2002). However, when available, students of color reap the educational benefits of racial/ethnic diversity in STEM majors and departments (Grandy, 1998). Given these findings, perceptions of the campus racial climate among women of color in STEM warrants further investigation and analysis.

Missing from the research literature is an examination of the extent to which women of color are able to achieve some form of academic and social integration into STEM environments, and the relationship of participation in STEM-related living-learning programs to this process. As a measure of integration, sense of belonging has been examined to understand the extent to which racial/ethnic minority students become part of the academic and social aspects of the campus community (Hurtado & Carter, 1997; D. R. Johnson et al., 2007; Nora & Cabrera, 1996; Reid & Radhakrishnan, 2003). Establishing a sense of belonging facilitates students' adjustment to college (Hurtado & Carter), and ultimately has a positive relationship with their retention (Hoffman et al., 2003). Among the strongest predictors of sense of belonging are perceptions of the campus racial climate (Gilliard, 1996; Hurtado & Carter; D. R. Johnson et al.; Nora & Cabrera; Reid & Radhakrishnan). Other factors associated with sense of belonging

include gender (Mandell et al., 1992), race/ethnicity (Gilliard; D. R. Johnson et al.; Mandell et al.; Reid & Radhakrishnan), academic class year (Gilliard; Mandell et al.), academic self-concept (Gilliard), institutional type (Gilliard), interactions with faculty (Gilliard; Hurtado & Carter; D. R. Johnson et al.; Nora & Cabrera; Reid & Radhakrishnan), and peer interactions (Gilliard; Hurtado & Carter; D. R. Johnson et al.; Mandell et al.; Velásquez, 1999). By using theories of college impact as the conceptual framework of this study, the significance of the college environment, rather than just individual student characteristics, is examined in relation to the experiences of women of color in STEM.

Considering that research on sense of belonging has largely focused on students of color in predominantly White settings (Gilliard, 1996; Hurtado & Carter, 1997; D. R. Johnson et al., 2007; Velásquez, 1999), sense of belonging is an appropriate phenomenon to investigate among women of color in STEM majors. Accordingly, this study examines the relationship between perceptions of the campus racial climate and sense of belonging among undergraduate women of color in STEM majors.

Chapter 3: Methodology

This chapter begins with a statement of the research questions and hypotheses examined in this study. Elements of the research design are discussed, including descriptions of the dataset, data collection procedures, the survey instrument, and the study's sample. The conceptual framework guiding the study, dependent and independent variables, and data analysis procedures are also described in this chapter.

Research Questions

This study was a secondary analysis of multi-institutional, cross-sectional, self-reported data collected from a survey administered by the National Study of Living-Learning Programs (NSLLP) in 2004. Quantitative data analysis methods were used, including analysis of variance, hierarchical multiple regression, and partial correlation procedures. The research questions and hypotheses for this study were the following:

1. Are there differences in overall sense of belonging among undergraduate women in STEM majors from different racial/ethnic groups and among those who participate in different types of STEM-related living-learning programs?

Hypothesis 1a: Differences in overall sense of belonging will exist among women from different racial/ethnic groups; women of color will report a less strong overall sense of belonging than White/Caucasian women.

Hypothesis 1b: Women in STEM majors participating in living-learning programs will report a stronger overall sense of belonging than the comparison group who were not participants in living-learning programs.

Hypothesis 1c: Differences in overall sense of belonging will exist among women from different racial/ethnic groups participating in different types of STEM-related living-learning programs.

2. Are there differences in the two measures of perceptions of the campus racial climate (defined as positive interactions with peers from different racial/ethnic groups from one's own, and perceptions of a positive campus racial climate) among undergraduate women in STEM majors from different racial/ethnic groups and among those who participate in different types of STEM-related living-learning programs?

Hypothesis 2a: Differences in the two measures of campus racial climate perceptions will be found among women from different racial/ethnic groups. Women of color will report more positive interactions with diverse peers and perceive a less positive campus racial climate than White/Caucasian women., and Black/African American women will perceive a less positive campus racial climate than women from other racial/ethnic groups.

Hypothesis 2b: Women in STEM majors participating in living-learning programs will perceive a more positive campus racial climate and report more positive interactions with diverse peers than the comparison group who did not participate in living-learning programs.

Hypothesis 2c: There will be significant differences on the two measures of campus racial climate perceptions among women from different racial/ethnic groups who participate in different types of STEM-related living-learning programs.

3. How well does the conceptual framework, developed from the empirical and

theoretical literature, help to understand overall sense of belonging for women of color in STEM majors, and what amount of variance in overall sense of belonging is explained by the conceptual framework?

Hypothesis 3: The conceptual framework developed for this study will predict, successfully and significantly, overall sense of belonging for women of color in STEM majors.

4. What is the relationship between perceptions of the campus racial climate and overall sense of belonging among undergraduate women STEM majors from different racial/ethnic groups, after controlling for significant predictors from the conceptual framework, including background characteristics, confidence in academic and math abilities, faculty and peer interactions, and perceptions of the residence hall climate?

Hypothesis 4: Perceptions of the campus racial climate will be significantly correlated with overall sense of belonging, after controlling for significant predictors from the conceptual framework, including background characteristics, confidence in academic and math abilities, faculty and peer interactions, and perceptions of the residence hall climate.

Theoretical and Conceptual Framework

The conceptual framework guiding the current study combined two college impact models, Weidman's (1989) model of undergraduate socialization and Astin's (1991) input-environment-outcome (I-E-O) model, with a transformative perspective (Mertens, 2005). Weidman's model theorized the ways in which institutional characteristics and social interactions influence affective or non-cognitive outcomes among college students. The process of socialization begins with the expectations of what students want to get from their collegiate experience. Once in college, students are

exposed to various socializing agents, including peers, faculty, parents, and interactions with individuals outside of the collegiate environment. These agents of socialization convey to students norms and expectations related to their membership in the college community, and influence the goals and objectives students have for attending college. Students determine the extent to which these socializing agents are important and influential to them, and then retain or modify their goals and objectives.

There are several components included in the model of undergraduate socialization (Weidman, 1989). Student background characteristics include factors such as race/ethnicity, gender, socio-economic status, academic performance in high school, and expectations and hopes for the college experience. Students also bring with them expectations and pressures from parents and other important people who are not part of the college environment; Weidman refers to this as a non-college reference group. These out-of-college influences may compete with the requirements and expectations of college and may result in conflicts for students. The college campus is then experienced academically and socially, in ways that are formal and informal. The formal academic context consists of the institutional mission, academic major departments, degree requirements, grades, and interactions with faculty. The informal academic context consists of the unwritten academic expectations faculty have for students. The formal social context of college includes size, available co-curricular activities, and place of residence. The informal aspect of the social context is interaction with the peer group. It is within these contexts that the process of socialization occurs, through interpersonal interactions. The more frequent and meaningful these interactions are, the more influence the socializing agent has over students' commitments to their desired outcomes for

attending college. In addition, students' own perceptions of their college experience influence the socialization process because these perceptions reflect the degree to which they feel a part of or integrated into the institution. The result of these interactions and perceptions is a "normative pressure" (Weidman, p. 301) that serves to reinforce or undermine students' experiences and intended outcomes of college.

The Weidman (1989) model was appropriate for this study for several reasons. First, the model incorporates the contributions of the college environment on non-cognitive outcomes, such as sense of belonging. Next, it accounts for students' interpersonal interactions (faculty and peers), as well as their perceptions (campus racial climate) related to their college experience. The model draws attention to the academic contexts of students' experiences (interactions with faculty), as well as their social contexts (interactions with their peers), both of which have been shown to influence the experiences of women in STEM majors (Seymour & Hewitt, 1997), especially women of color (A. Johnson, 2001; Ong, 2005; Sosnowski, 2002). Use of this theoretical perspective begins to reveal the socialization process of women of color into STEM careers. This is important because many of the potential agents of socialization are White and male, with few racial/ethnic minority women available as additional socializing agents.

Astin's (1991) input-environment-outcome (I-E-O) model was used to analyze the relationship of the independent variables to overall sense of belonging. This conceptual framework also guided the 2004 NSLLP (Inkelas, Vogt et al., 2006). The model allows researchers to assess the relationship between college environments and the growth and development of college students (Astin, 1993). The underlying assumption of the model

is that outcomes of college are related to student inputs and exposure to the collegiate environment. By controlling for the inputs, the relationship of the collegiate environment to outcomes of interest can be more accurately determined and better understood (Astin, 1991). Inputs refer to the background characteristics of students at the time they enter college. Other inputs are related to students' aspirations, expectations, self-perceptions, attitudes, values, and cognitive functioning prior to college entry (Astin, 1991). Initial levels of inputs can be determined using pre-test measures, or by asking students to predict or rate their expectations about the outcomes of interest (Astin, 1991). There are also inputs classified as "bridge measures," that is, they are both a characteristic of the student and the college environment.

Environments encompass the programs, polices, curriculum, people, and events that students encounter during college (Astin, 1991). These environments can be thought of distal ("between-institution"), or as proximal ("within institution"). Between institutional environments are those aspects of an institution that all students experience, such as size, type, and control. Within institutional environments are aspects of an institution that only some students experience, such as major department, involvement in a specific co-curricular activity, or interactions with peers. For some aspects of the college environment, there are characteristics that can be considered as "intermediate outcomes"; that is, they can be outcomes themselves and serve as precursors to the outcome of interest (Astin, 1993). According to Astin (1991), "the more proximate the measure is to the student, the greater the significance that measure is likely to have for most student outcomes" (p. 82). Lastly, the outcomes are those aspects of students' development that are related to their experiences in the college environments. Outcomes

are either cognitive or affective, and come from data that are psychological or behavioral in nature (Astin, 1991).

Mertens (1999, 2005) defined transformative research as a process that focuses on the experiences of marginalized groups and how they are oppressed by dominant groups, analyzes how and why social inequities are manifested in the unequal power relationships between dominant and marginalized groups, links the results of the research process to social and political action, and situates the results of the research within the context of unequal power structures rather than characterize the participants as somehow deficient or at fault. A transformative approach was incorporated into the current study for several reasons. First, such a perspective allows for a focus on the experiences of women of color and consideration of how race/ethnicity contributes to the experiences of women in STEM majors. Second, consideration could be given to the dynamics of power, privilege, and oppression between women of color and predominantly White institutions and predominantly male STEM environments in the discussion of the study's findings. Third, ideas related to the transformation of STEM education into inclusive learning environments for women from all racial/ethnic groups could be discussed in light of the results. Finally, a transformative perspective allows me as the researcher to acknowledge the influence of my identity as an African American woman who worked with under-represented women of color in STEM on my interest in the current study and name this subjectivity as a lens through which I made meaning of the findings.

The application of the I-E-O framework (Astin, 1991) to Weidman's (1989) model of undergraduate socialization and the variables used from the 2004 NSLLP with a transformative approach is shown in Table 1. The transformative perspective is centered

in the top row of the table, indicating that it served as the context within which the college impact theories were located. Serving as inputs are the variables representing student background characteristics, parental socialization, and non college reference groups. The college environments are represented as the academic and social contexts. Finally, the outcome is represented by a non-cognitive outcome of the socialization process.

National Study of Living-Learning Programs

The 2004 NSLLP dataset is a multi-institutional sample drawn from 34 four-year universities across the United States and the District of Columbia (Inkelas & Associates, 2004). Of the participating institutions, 29 were included in the current study because respondents indicated their enrollment in schools/colleges related to a STEM field (e.g., College of Engineering, School of Technology, and College of Life Sciences). The remaining four institutions were not included because none of the respondents reported enrollment in an STEM-related school/college.

Institutions in the study. Among the institutions used for the current study, 4 are private and 25 are public. According to the Carnegie classifications at the time of the 2004 NSLLP, 23 were classified as Research Extensive, one classified as Research Intensive, and five classified as Master's Colleges and Universities. The institutional composition of this sample was an advantage for the study because, according to the NSF, 78.0% of the bachelor's degrees in engineering, and 50.0% of the bachelor's degrees in the natural and agricultural sciences were awarded at research and doctoral granting institutions (NSF, 2004b) Among the 50 leading institutions awarding bachelor's degrees to women in STEM fields from 1997-2001 (NSF, 2004b), 13 were

Table 1
Conceptual Framework of Study

Transformative Perspective		
Astin (1991)	Weidman (1989)	2004 NSLLP Variables
Inputs	Student characteristics	Race/ethnicity; high school grades; SAT scores; pre-test measure of sense of belonging
	Parental socialization	Parental level of education
	Non college reference group	Socialize with friends from home
Environments	Academic context	Academic class year; ratings of academic self-confidence and math abilities; institutional Carnegie classification; faculty interactions; STEM-related living-learning program participation
	Social context	Peer interactions; perceptions of the residence hall climate; perceptions of the campus racial climate
Outcome	Socialization outcome	Overall sense of belonging

included in this study. In addition, 8 institutions in this study were identified by the NSF as being among the top 25 institutions granting STEM bachelor's degrees to African Americans, while 7 were noted as being among the top 50 institutions awarding these degrees to Latino/as (NSF, 2000).

Five institutions enrolled 57% (n = 982) of the women who participated in the current study: Colorado State University, Louisiana State University, Pennsylvania State University, University of California – Irvine, and University of Maryland – College Park. Among women of color in the sample, 78% (n = 388) came from five institutions: Clemson University, University of California – Irvine, Pennsylvania State University, Louisiana State University, and University of Maryland – College Park. Four institutions had no women of color represented in the current study: Western Kentucky University, Indiana University, University of Tennessee – Knoxville, and Northern Illinois University. Participants in women-only STEM living-learning (LL) programs came from eight institutions: Florida State University; North Carolina State University, Northeastern University, Pennsylvania State University, Purdue University, Syracuse University, University of Illinois, and University of Wisconsin. Participants in co-ed STEM LL programs came from 10 institutions: Arizona State University, Central Washington University, Colorado State University, Louisiana State University, Northeastern University, Northern Illinois University, Pennsylvania State University, Purdue University, University of Missouri, and University of Tennessee – Knoxville. For a listing of the institutions included in the study, see Appendix A.

The analysis of institutions in this sample enrolling women in STEM majors and supporting STEM LL programs is limited because just one institutional characteristic –

Carnegie classification - was included in the study. Other institutional variables, such as geographic location, setting (e.g., urban, suburban, or rural), and racial/ethnic composition of the student body were not accounted for in this study. Such information would provide a richer portrait of the institutions in this study and further contextualize the experiences of the women in the sample.

Data collection. Institutions participating in the 2004 NSLLP obtained two sample groups: a random sample or full population of students in living-learning programs, and a randomly sampled comparison group of students living in college housing but not in a living-learning program. These samples were comparable in terms of race, gender, and academic class level (Inkelas & Associates, 2004). Data for each participating institution were collected via the Internet for a period of at least five weeks between January and March 2004. At all institutions, data collection commenced no earlier than two weeks after the start of the spring semester, and ended by March 19, 2004. All participating institutions obtained institutional review board (IRB) approval from their home campus prior to beginning their data collection (Inkelas & Associates). Institutions were charged a fee to participate in the 2004 NSLLP.

The data collection process was handled by MSIResearch, a data collection firm. The samples of students drawn were sent an email invitation by MSIResearch to participate in the survey. The email appeared to be sent from the study's principal investigator, and the subject line listed the name of the study (Inkelas & Associates, 2004). Participants were each given a web address and a unique survey identification number to access the survey. Located on the first page of the survey was a consent form for participation in the study. If participants agreed, they were then directed to the survey.

The identification number given to participants allowed them to return to the survey if they did not complete it in one sitting. The ID number also allowed participants to be tracked as to whether they completed the survey. Participants with incomplete surveys were sent up to three email reminders by MSIResearch to encourage them to complete the survey. In addition, some institutions made extra contacts with their students to increase the response rate. If these efforts resulted in a change in the original data collection protocol, institutions were instructed to obtain approval from their IRB office (Inkelas & Associates). Several institutions offered incentives for student participation in the survey. Incentives included sweepstakes contests for gift certificates to campus bookstores and local businesses, PDAs (personal digital assistants), MP3 players, and DVD players. Potential respondents were told of the incentive in all email communications by MSIResearch (Inkelas & Associates).

The total sample drawn for the 2004 NSLLP study included 71,728 students, and resulted in 23,910 participants, yielding a 33.3% response rate (Inkelas & Associates, 2004). Crawford, Couper and Lamia (2001) assert that a response rate between 30.0%-40.0% is average for Internet survey data collection techniques. Several factors underlie why some students selected for participation were not included in the 2004 NSLLP study. About 3.0% of the emails were returned as undeliverable to the sender. Less than 1.0% of the students identified did not consent to take the survey. In this case, participants were not permitted to access the survey and were thanked for their interest. Lastly, less than 1.0% informed the staff either at the NSLLP or on their campus that they did not wish to participate in the study. Students making such requests did so via email or telephone

contact. These requests were noted in the sample database, and honored such that no further communication occurred with these students (Inkelas & Associates).

Sample. The sample used for this study was drawn based on women participants' responses to a question inquiring about the school/college they were enrolled in at their institution. This question was customized for each school to reflect the names and titles used on their campus. Participants whose school/college was associated with a STEM field (e.g., School of Engineering, College of Life Sciences, College of Agriculture, and School of Technology) were included in this sample (Inkelas & Associates, 2004). In cases where there was a question as to whether the school/college was STEM-related, I obtained information from the university's web site to determine if the majors in the school/college qualified as science, technology, engineering, or math. Thus, a limitation of this dataset is that major field was not directly queried of participants. As a result, the actual number of women majoring in an STEM within the 2004 NSLLP dataset may be different from the number reported here.

The total number of respondents to the 2004 NSLLP enrolled in a STEM-related college/school was 3,901. Of these respondents, 44.0% (n = 1,722) were women. The number of respondents who indicated their racial or ethnic identity was 3,716, including 1,712 (46.0%) women. The sample for this study of women in STEM fields across racial and ethnic groups consists of 92 African American/Black, 278 Asian Pacific American, 6 Native American, 57 Latina, 1,199 White/Caucasian, and 69 Multiracial/Multiethnic women; 11 women did not indicate their race or ethnicity. For all racial/ethnic groups, women comprised between 44.0%-55.0% of the sample of STEM students. Nationally, women are not represented this well in STEM undergraduate majors. According to data

contained in a 2002 NSF (2003) report, the percentages of first-year women students from all racial/ethnic groups intending to major in a STEM field ranged between 25.0%-35.0%. The large representation of women in STEM majors in the sample may be attributed to the over-representation of research universities in the 2004 NSLLP (n = 24), which confer a large percentage of STEM degrees nationally (NSF, 2004b), as well as the presence of 13 of the top 50 institutions that granted bachelor's degrees in STEM to women between 1997 and 2001 (NSF, 2004b). Among the women respondents who indicated their academic class year, 1,046 are first-year students, 353 are sophomores, 214 are juniors, and 87 are seniors; 22 did not indicate their academic class year. Lastly, all of the respondents lived on campus at the time they completed the survey.

Instrumentation. The goal of the 2004 NSLLP was to assess the contributions of participation in a living-learning program on a variety of college environment and outcome measures; thus, the survey instrument used was developed for this purpose. The survey consisted of two parts: a base questionnaire and a custom question section (Inkelas & Associates, 2004). The base questionnaire was developed by researchers for the NSLLP through two years of pilot testing and review. A beta test of the survey occurred on one campus in the spring of 2001. A pilot test occurred in the spring semester of 2003 at four universities. To reduce the number of variables, principle axis factor analysis with orthogonal rotation (Inkelas, Vogt et al., 2006) was used to develop composite measures. Factors with an eigenvalue of 1.0 or greater were used to create the scales.

The second part of the questionnaire consisted of customized items for each participating institution such as the respondent's school/college of enrollment, the name

of the residence hall the respondent lived in, and the name of the living-learning program the respondent participated in, if applicable. The remaining customized questions were written by each school seeking specific information from its participants (Inkelas & Associates, 2004). Each institution was given the opportunity to ask up to 10 additional custom questions.

Reliability and validity. Using the results of the pilot survey, the composite measures were tested for reliability and validity. The reliability or internal consistency of the measures was tested using Cronbach alpha. Scales with Cronbach alpha coefficients greater than .6 were retained (Inkelas, Vogt et al., 2006). The Cronbach alpha reliability for the scales from the 2003 pilot study ranged between .623 and .898. The reliability of the composite measures was re-tested with the 2004 data with Cronbach alpha reliability ranging from .624 to .918 (Inkelas & Associates, 2004). Based on the 2003 pilot test, the composite measures were found to be consistent across the four institutions after conducting separate reliability tests by institution. The Cronbach alpha coefficients were similar, thus indicating the reliability of the measures (Inkelas, Vogt et al.).

The reliability of the composite measures was re-tested on this study's sample prior to data analysis. Although the sample is drawn from the larger 2004 NSLLP study on which the composite measures were developed and tested, it was necessary to determine if the scales were reliable with this sub-sample. Results of the reliability tests for the sample used in the current study show Cronbach alpha coefficients ranging from .665 to .901, indicating the internal consistency of the measures used for this sub-sample of the 2004 NSLLP. Appendix C contains the Cronbach alpha coefficients for both the larger 2004 NSLLP sample, and the sub-sample used in the current study.

The measures of the instrument were evaluated through content and construct validity procedures. The instrument was reviewed by 15 living-learning program administrators prior to the pilot survey to establish content validity. After each administration of the survey, items were revised for clarity (Inkelas & Associates, 2004). Construct validity was verified by similar scales that were highly correlated (Inkelas, Vogt et al., 2006). Expected group differences, such as those between living-learning and comparison groups, also verified construct validity. The results of these validity tests were supported by findings from previous research and higher education theory (Inkelas & Associates).

Variables in the Study

The dependent variable used in this study, *overall sense of belonging,* was a composite measure made up of the following five items:

- I feel a sense of belonging
- I feel a member of the campus community
- I feel comfortable on campus
- I would choose the same college over again
- My college is supportive of me

Respondents rated the extent to which they agreed with these statements on a scale where 1 = strongly disagree, 2 = disagree, 3 = agree, and 4 = strongly agree. The scale index ranged from 5 – 20, with a high value indicating greater sense of belonging. The Cronbach alpha coefficient for the sample used in the current study was .901.

The independent variables used in this study were a combination of single-item and composite measures (see Appendix B for a complete description of all variables used

in the study). Single item measures included race/ethnicity, parental levels of education, average high school grades, SAT or ACT scores, a quasi pre-test measure of sense of belonging (participants were asked to think back to before they started college), academic class year, institutional Carnegie classification, socialize with friends from home, and confidence in math ability. STEM-related living-learning (LL) program participation contained four types of LL programs coded as: 1= women-only STEM LL programs (commonly known as WISE programs, designed for women with interests in science, math, and engineering majors); 2 = co-educational STEM LL programs (designed for both female and male students with interests in STEM fields and focused in general science areas or specific STEM disciplines); 3 = other types of LL programs (e.g., Honors; New Student Transition, and Multicultural/Diversity programs); and 4 = no type of LL program participation (Inkelas et al., 2005). The living-learning programs were categorized in this way to understand the contributions of the two types of LL programs with the distinct purpose of supporting STEM students in general (co-ed STEM LL programs) and women STEM students in particular (women-only STEM LL programs). In addition, it was also important to distinguish the experiences of students participating in other types of LL programs (e.g. Honors, New Student Transition) from students not in any type of LL program because of documented differences found between LL program students and those who did not participate in such programs (see Inkelas & Associates, 2004)

Composite measures in this study included levels of academic self-confidence, frequency of course-related interactions with faculty and mentoring experiences with faculty, perceptions of the residence hall climate as being academically and socially

supportive, frequency of peer discussions of academic/career-related and socio-cultural issues, frequency of interactions with peers from different racial/ethnic groups, and perceptions of a positive campus racial climate (Inkelas & Associates, 2004).

The measure of *academic self-confidence* included these five self-reported items:

- Research ability
- Problem-solving ability
- Working independently
- Computer ability
- Library skills

Using the scale of 1 = not at all confident, 2 = somewhat confident, 3 = confident, and 4 = very confident, respondents rated their confidence in these areas. The scale index for this measure ranged from 5 -20, with a high value indicating greater self-confidence. The Cronbach alpha coefficient for this measure in the sample used in this study was .742.

Course-related faculty interaction was a composite measure of the following four items:

- Visited informally with instructor before/after class
- Made appointment to meet instructor in his/her office
- Asked instructor for information related to course
- Communicated with instructor via email

On a scale where 1 = never, 2 = a few times a semester, 3 = a few times a month, and 4 = once or more a week, participants reported the frequency of these activities with their faculty. The scale index on this measure ranged from 4 -16, with a high value indicating

greater faculty interaction. This measure had a Cronbach alpha of .770 for the sample used in the current study.

Faculty mentoring was a measure composed of these six items:

- Worked with instructor on independent project
- Worked with instructor involving his/her research
- Discussed personal problems or concerns with instructor
- Visited informally with instructor on social occasion
- Went to a cultural event with instructor or class
- Discussed career plans and ambitions with instructor

Respondents rated the frequency of these activities with their faculty on a scale where 1 = never, 2 = once to a few times a semester, 3 = a few times a month, and 4 = once or more a week. The scale index ranged from 6 – 24, with a high value indicating greater faculty mentoring experiences. This measure had a Cronbach alpha of .665 for the current study.

The composite measure of *academically supportive residence hall climate* consisted of six items:

- Environment supports academic achievement
- Most students study a lot
- Most students value academic success
- It's easy to form study groups
- Adequate study space is available
- Staff helps with academics

Respondents rated their agreement to these statements on a scale where 1= strongly disagree, 2 = disagree, 3 = agree, and 4 = strongly agree. The response scale index ranged

from 6 – 24, with a high value indicating greater academic support. The Cronbach alpha for this measure was .825 in the sample used in the current study.

The measure of *socially supportive residence hall climate* contained eight items:

- Appreciate different races/ethnicities
- Appreciate different religions
- Help and support one another
- Would recommend this residence hall
- Intellectually stimulating environment
- Different students interact with each other
- Appreciation for different sexual orientation
- Peer academic support

Respondents rated their agreement to these statements using a scale where 1= strongly disagree, 2 = disagree, 3 = agree, and 4 = strongly agree. The response scale index ranged between 8 – 32, with a high value indicating greater social support. The Cronbach alpha for this measure was .877 for the sample used in the current study.

The composite measure *peer discussion of academic/career issues* consisted of these four items:

- Discussed something learned in class
- Shared concerns about classes and assignments
- Talked about current news events
- Talked about future plans and career ambitions

Using a scale of 1 = never, 2 = a few times a semester, 3 = a few times a month, and 4 = once or more a week, respondents indicated the frequency of these interactions with their

peers. The response scale index ranged between 4- 16, with a high value indicating more frequent discussions. The Cronbach alpha for this measure was .709 for the sample used in the current study.

The measure of *peer discussion of socio-cultural issues* contained the following six items:

- Discussed social issues such as peace, human rights, and justice
- Discussions with students whose personal values are different from your own
- Discussed views about multiculturalism and diversity
- Held discussions with those with different religious beliefs from your own
- Talked about different lifestyles and customs
- Discussions with students whose political opinions are very different from your own

Using a scale of 1 = never, 2 = a few times a semester, 3 = a few times a month, and 4 = once or more a week, respondents indicated the frequency of these interactions with their peers. The response scale index ranged between 6 – 24, with a high value indicating more frequent discussions. The Cronbach alpha for this measure was .850 for the sample used in the current study.

Positive interactions with diverse peers was a measure of the following nine items:

- Attending social events together
- Sharing a meal together
- Having intellectual discussions outside of class
- Sharing personal feelings and problems

- Studying together
- Discussing race relations outside class
- Doing extracurricular activities together
- Rooming together
- Dating

Using a scale where 1 = not at all, 2 = a little, 3 = a lot, and 4 = all of the time, respondents rated the frequency of these activities with students from racial/ethnic groups different from their own. The scale index for this measure ranged between 9 – 36, with a high value indicating greater interaction. The Cronbach alpha for this measure was .900 for the sample used in the current study.

Perceptions of a positive campus racial climate was a measure of these six items:

- Transracial student interaction
- Transracial friendship
- Transracial trust and friendship
- Campus commitment to success of students of color
- Transracial dating
- Professors respect students of color

Respondents rated the extent these items described their college campus on a scale where 1= little or none, 2 = some, 3 = quite a bit, and 4 = a great deal. The scale index ranged between 6 – 24, with a high value indicating more positive perceptions. For the sample used in the current study, the Cronbach alpha for this measure was .813.

For a complete description of all the composite measures used in the study, including the factor loadings for the items (developed from the 2004 NSLLP) that comprise each measure and all Cronbach alpha coefficients, see Appendix C.

Data Analyses

This study used descriptive and multivariate statistical procedures to examine the relationship between perceptions of the campus racial climate and overall sense of belonging among women from different racial/ethnic groups in undergraduate STEM majors. The research questions examined were the following:

1. Are there differences in overall sense of belonging among undergraduate women in STEM majors from different racial/ethnic groups, and among those participating in different types of living-learning programs?
2. Are there differences on the two measures of the perceptions of the campus racial climate among undergraduate women in STEM majors from different racial/ethnic groups, and among those participating in different types of living-learning programs?
3. How well does the conceptual framework, developed from the empirical and theoretical literature help to understand overall sense of belonging for women of color in STEM majors, and what amount of variance in overall sense of belonging is explained by the conceptual framework?
4. What is the relationship between perceptions of the campus racial climate and overall sense of belonging among undergraduate women STEM majors from different racial/ethnic groups, after controlling for the significant predictors from the conceptual framework, including background characteristics, confidence in academic

and math abilities, faculty and peer interactions, type of living-learning program, and perceptions of the residence hall climate?

Several procedures were conducted to prepare the data for analysis. As previously discussed, the reliability of the composite measures were re-tested for internal consistency with the sub-sample of the 2004 NSLLP. To prepare the data for the hierarchical regression analysis, categorical variables were converted into dichotomous variables. The race/ethnicity variable was converted from five groups to two, where 0 = White/Caucasian women and 1 = women of color. The variable women of color was inclusive of Black/African American, Asian Pacific American, Latina, American Indian, and Multiracial/Multiethnic women. Respondents' ACT composite scores were converted to SAT combined verbal and math scores, using concordance data available from the College Board (Schneider & Dorans, 1999). These converted scores were then combined with existing SAT combined score data for the SAT variable. Lastly, to determine the unique contribution of each LL program type to overall sense of belonging, each of the three program types were entered separately into the regression analysis, with "no LL program participation" serving as the referent category.

Chi-square analyses were used to develop a portrait of the sample by exploring any significant differences on background characteristics. The first research question was analyzed using two-way analysis of variance (ANOVA) to determine if women from various racial/ethnic groups who participated in different types of living-learning programs had different estimates of their overall sense of belonging. The second research question was examined also using two-way ANOVA procedures to determine if women from various racial/ethnic groups who participated in different types of living-learning

programs had different perceptions of the campus racial climate, which was reflected through two composite measures: (a) interactions with diverse peers, and (b) perceptions of a positive campus racial climate. The small number of American Indian women (n = 6) precluded their inclusion in the chi-square and ANOVA analyses; therefore the racial/ethnic groups used in these analyses were Black/African American, Asian Pacific American, Latina, Multiracial/Multiethnic, and White/Caucasian.

The third research question was addressed using hierarchical multiple regression analysis. This is a procedure "in which blocks of predictors are forced into the equation…for the sole purpose of noting whether blocks entered at later stages add meaningfully to the prediction of the criterion" (Pedhazur, 1997, p. 229). This technique of incrementally partitioning the variance (Pedhazur) allows for the researcher to understand how much each variable or set of variables contributes to explaining the variance in the dependent variable, after controlling for other variables in the model. The order in which the variables are entered into the model is theoretically driven, not arbitrarily assigned (Pedhazur).

The I-E-O model (Astin, 1993) uses hierarchical multiple regression procedures to analyze "the effects of environmental factors on student outcomes…to exert as much control as possible over potentially biasing student input variables before examining the possible effects of environmental variables" (p. 90). Astin (1993) specifies the order in which the variables are to be entered into the blocks. The first block contains the inputs to control for the characteristics students have when they begin college. The second block contains "bridge variables," which are measures that can be considered as both inputs as well as college environments since their effects span the pre-college to college period.

Block three contains the between-institution measures representing environments that are distal aspects of the institution, and experienced by most students. Blocks four, five, six, and seven contain the within-institution measures that are more proximate aspects of the college environment; in addition, block seven contains the intermediate outcomes.

Combining theoretical and empirical precedents set by prior research, I developed the following conceptual framework for this study of predictors of overall sense of belonging for women of color in STEM:

- Block One (Inputs): Race/ethnicity, father's and mother's level of education (representing Weidman's (1989) concept of parental socialization), SAT combined score, high school grade average, socialize with friends from home (representing Weidman's concept of a non-college reference group), and a pre-test measure of sense of belonging.
- Block Two (Bridge variables, representing Weidman's informal academic context): Self-ratings of academic and math confidence levels.
- Block Three (Between-institution measure, representing Weidman's formal academic context): Institutional Carnegie classification.
- Block Four (Within-institution measures, representing Weidman's formal and informal academic context): Academic class year, and interactions with faculty, including course-related faculty interactions and faculty mentoring experiences.
- Block Five (Within-institution measures, representing Weidman's formal and informal social context): Type of living-learning program participation, and perceptions of the residence hall climate as academically and socially supportive.

- Block Six (Within-institution measures, representing Weidman's informal social context): Interactions with peers, including academic/career discussions with peers and socio-cultural discussions with peers.
- Block Seven (Intermediate outcomes, representing Weidman's informal social context): Interactions with diverse peers and perceptions of a positive campus racial climate.

The fourth research question was addressed using partial correlation procedures. Such analysis allows for the relationship between two variables to be assessed while "partialing out the effects of one or more control variables" (Green & Salkind, 2005, p. 263). For the current study, partial correlation was conducted for each racial/ethnic group to determine the relationship between perceptions of the campus racial climate and overall sense of belonging after partialing out the effects of any of the independent variables found to be significant predictors of sense of belonging from the hierarchical multiple regression analysis. Partial correlation was not conducted for American Indian women because of their small number in the sample.

Chapter Summary

This study used college impact theory to examine the relationship between perceptions of the campus racial climate and overall sense of belonging, along with academic and math confidence, faculty and peer interactions, type of living-learning program participation and perceptions of the residence hall climate, among undergraduate women from different racial/ethnic groups in STEM fields. The study utilized existing data from the 2004 NSLLP that were analyzed using ANOVA, hierarchical multiple regression, and partial correlation procedures. The method used for this study provided an

opportunity to identify additional factors that support or hinder the participation of women of color in STEM undergraduate fields, and determine any differences or similarities among women from various racial/ethnic groups.

Chapter 4: Results

The purpose of this study was to examine the relationship between self-reported measures of perceptions of the campus racial climate and the overall sense of belonging among women from different racial/ethnic groups in undergraduate STEM fields. In addition, this study examined whether other factors of the college environment, including STEM living-learning (LL) program participation, peer and faculty interactions, perceptions of academic self-confidence, and perceptions of the residence hall climate also related to overall sense of belonging for undergraduate women in STEM majors. This chapter presents results from several types of data analyses, including a descriptive analysis of participants' demographic and background characteristics, and three factorial ANOVAs on differences among racial/ethnic groups and type of LL program for (a) overall sense of belonging, and (b) two measures of students' perceptions of the campus racial climate: positive interactions with diverse peers and perceptions of a positive campus racial climate. Hierarchical multiple regression analysis was used to test the utility of the conceptual framework in understanding overall sense of belonging for undergraduate women of color in STEM majors, including the amount of variance explained by the conceptual framework. Lastly, partial correlation analysis was used to understand the relationship between perceptions of the campus racial climate and overall sense of belonging among undergraduate women in STEM majors from different racial/ethnic groups, after accounting for significant predictors identified from the hierarchical multiple regression analysis.

Demographic Characteristics

The descriptive analysis revealed a rich portrait of the participants in this study. Tables 2 and 3 contain the complete findings from the descriptive analysis. Among the 1,722 undergraduate women STEM majors in this study, 29% were women of color (n = 502), including 16.4% Asian Pacific American, 5.4% Black/African American, 4.1% Multiracial/Multiethnic, 3.4% Latina, and 0.4% American Indian. The majority of the sample, 60.7% (n = 1046), were first-year students at the time they completed the survey.

Many participants had at least one parent with a bachelor's degree, with 59.9% reporting fathers and 56.7% reporting mothers with a bachelor's degree or higher. Chi-square distributions (Table 3) indicated significant differences among the sample in both father's and mother's levels of education. Less than 50% of Black/African Americans and Latinas had fathers with a bachelor's degree or higher, compared to women from the other racial/ethnic groups. Black/African American (26.4%) and Latina (31.6%) women were more likely to report father's level of education as high school or less. Women of color (except Multiracial/Multiethnic women) reported more mothers with a high school education or less, compared to White women.

In describing their high school performance, 55.8% (n = 961) reported grade averages of A or A+. A wide range of SAT combined scores was observed, with 18.6% reporting scores of 1350 or higher; 18.8% reporting scores between 1260-1340; 19.7% reporting 1150-1250; and 15.4% reporting scores at or below 1140. Among those who took the ACT, 24.4% (n = 421) reported composite scores of 27 or higher. Chi-square distributions (Table 3) revealed significant differences among racial/ethnic groups. Fewer Latinas (35.7%) reported average high school grades as A+ or A, compared to the large

percentages of Asian Pacific American (66.7%) and White/Caucasian (60.9%) women. Black/African American (56.3%) and Latina (45.5%) women were more likely to report SAT scores of 1140 or less than women from the other racial/ethnic groups.

Finally, in terms of LL program participation among the sample, 7% were in women-only STEM programs (designed to support women who are pursuing STEM majors), 7% were in co-educational STEM programs (designed for students majoring in general science or specific STEM disciplines), 33.6% were in other types of LL programs (those not related to STEM fields, e.g., Honors and New Student Transition), and 52.5% did not participate in any type of LL program. Chi-square distributions (Table 3) revealed significant differences among racial/ethnic groups. Asian Pacific American women had the lowest rates of participation in either type of STEM LL (6.1% combined). Under-represented women of color and Multiracial/Multiethnic women were more likely to report participating in co-ed STEM LL programs than in women-only STEM programs. White/Caucasian women reported the highest rates of participation in women-only STEM programs (8.2%), followed by Black/African American (6.5%) and Latinas (5.3%). Women of color were more likely to not participate in any type of LL program (ranging from 60.9% - 63.2%), compared to White/Caucasian women whose rates of LL v. non-LL program participation were nearly equal (50.8% in LL; 49.2% not in LL).

Table 2
Demographic Characteristics of Sample

Characteristic	*n*	%
Race/ethnicity		
Black/ African American	92	5.4
Asian Pacific American	278	16.3
American Indian	6	0.4
Latina	57	3.4
Multiracial/Multiethnic	69	4.1
White/Caucasian	1199	70.5

Table 2 (continued)

Characteristic	*n*	%
Father's level of education		
High school or less	277	16.1
Some college	248	14.4
Associates degree	101	5.9
Bachelors degree	518	30.1
Masters degree	345	20.0
Doctorate or professional degree	169	9.8
Don't know	51	3.0
Mother's level of education		
High school or less	267	15.5
Some college	281	16.3
Associates degree	156	9.1
Bachelors degree	570	33.1
Masters degree	347	20.2
Doctorate or professional degree	59	3.4
Don't know	32	1.9
Average high school grades		
A+ or A	961	55.8
A- or B+	585	34.0
B	131	7.6
B- or C+	29	1.7
C or C-	9	0.5
No high school GPA	4	0.2
SAT combined score		
1350 or higher	320	18.6
1260-1340	324	18.8
1150-1250	339	19.7
1140 or less	266	15.4
ACT composite score		
30 or higher	211	12.3
27-29	209	12.1
24-26	159	9.2
23 or less	149	8.7
Academic class level		
First-year	1046	60.7
Sophomore	353	20.5
Junior	214	12.4
Senior	87	5.1
Living-learning program participation		
Women-only STEM	120	7.0
Co-ed STEM	120	7.0
Other type of LL program	578	33.6
No type of LL program	904	52.5

Table 3

Chi-Square Distribution of Differences by Race/Ethnicity on Selected Demographic Characteristics (in percentages)

	Black/African American (*n* =92)	Asian Pacific American (*n* =278)	Latina (*n* =57)	Multiracial/ Multiethnic (*n* =69)	White/ Caucasian (*n* =1199)	Chi-square
Father's level of education						X^2 (24, N = 1686) = 75.316, p = .000
Don't know	9.9	5.8	7.0	2.9	1.6	
High school or less	26.4	18.8	31.6	19.1	14.4	
Some college	17.6	13.0	17.5	16.	14.2	
Associates degree	5.5	12.0	5.3	4.4	6.5	
Bachelors degree	18.7	27.4	22.8	29.4	32.3	
Masters degree	11.0	18.8	8.8	16.2	22.0	
Doctorate or professional degree (JD, MD, PhD)	11.0	11.9	7.0	11.8	9.4	
Mother's level of education						X^2 (24, N = 1688) = 95.710, p = .000
Don't know	3.3	4.7	1.8	1.5	1.1	
High school or less	19.6	24.5	30.9	10.4	12.5	
Some college	26.3	15.5	23.6	22.4	14.9	
Associates degree	7.6	5.4	7.3	14.9	9.9	
Bachelors degree	21.7	30.2	25.5	23.9	36.0	
Masters degree	14.1	15.5	9.1	20.9	22.5	
Doctorate or professional degree (JD, MD, PhD)	4.3	4.3	1.8	6.0	3.1	
Average high school grades						X^2(20, N = 1693)= 65.359, p = .000
A+ or A	42.4	44.6	35.7	44.9	60.9	
A- or B+	40.2	45.0	50.0	42.0	30.1	
B	13.0	8.3	7.1	10.1	6.8	
B- or C+	3.3	1.1	7.1	1.4	1.4	
C or C-	1.1	0.4	0.0	1.4	0.5	
No high school GPA	0.0	0.7	0.0	0.0	0.2	

*p < 05; ** p < .01; ***p < .001

Table 3 (continued)

	Black/African American (*n* =92)	Asian Pacific American (*n* =278)	Latina (*n* =57)	Multiracial/ Multiethnic (*n* =69)	White/ Caucasian (*n* =1199)	Chi-square
SAT combined score						$X^2(12, N = 1235) = 86.635, p = .000$
1350 or higher	7.8	27.2	13.6	8.9	28.0	
1260-1340	15.6	24.7	11.4	25.0	28.1	
1150-1250	20.3	28.5	29.5	42.9	26.0	
1140 or less	56.3	19.6	45.5	23.2	17.9	
ACT composite score						$X^2(12, N = 718) = 74.791, p = .000$
30 or higher	2.2	25.0	25.0	11.5	32.5	
27-29	13.0	13.0	12.5	30.8	30.0	
24-26	21.7	35.0	37.5	30.8	21.4	
23 or less	63.0	25.0	25.0	26.9	16.1	
Living-learning program type						$X^2(12, N = 1695) = 35.072, p = .000$
Women only STEM	6.5	3.6	5.3	2.9	8.2	
Co-ed STEM	8.7	2.5	10.5	8.7	7.6	
Other type of LL program	23.9	33.5	21.1	27.5	35.0	
No type of LL program	60.9	60.4	63.2	60.9	49.2	

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

Factorial Analyses

Three factorial ANOVAs were conducted to examine the relationship between race/ethnicity and type of LL program on overall sense of belonging, positive interactions with diverse peers, and perceptions of a positive campus racial climate. For all factorial ANOVAs, five racial/ethnic groups were included: Black/African American, Asian Pacific American, Latina, White/Caucasian, and Multiracial/Multiethnic. Given the small number of American Indian women in the sample (n = 6), they were excluded from these analyses.

Due to the unbalanced nature of the factorial designs, F tests using Type II sum of squares were generated to give more weight to the larger cell means when computing the marginal means (Tabachnick & Fidell, 2007). According to Cohen (1988), weighting the marginal means in an unbalanced design is appropriate when the research design seeks to examine the condition of a naturally occurring population (rather than those artificially created in experimental research). In such cases, the sizes of the subpopulations must be considered in relation to the population of all groups combined. Although equal weighting of sample sizes (Type III sum of squares approach) produces a larger F statistic and indicates greater power, the smaller F generated by the Type II sum of squares can better detect differences existing in the naturally occurring population, thereby increasing the ability to interpret and generalize results to the overall population (Tabachnick & Fidell; Cohen).

Sense of belonging. A 5 x 4 ANOVA was conducted to examine the relationship between race/ethnicity and type of LL program on the overall sense of belonging of women in STEM majors. The means and standard deviations for overall sense of

belonging among the sample are presented in Table 5. The assumption of equal variances was violated due to the unequal size of the groups; therefore, a more conservative alpha of .01 was used to determine significance. The ANOVA (Table 4) indicated there was a significant main effect for race/ethnicity, F (4, 1462) = 10.690, p =.000; however, partial η^2 = .028 indicated a small effect size, meaning the differences among the groups, though significant, were small. There was no significant main effect for type of LL program, F (3, 1462) = .492, p = .688 or a significant interaction between racial/ethnic background and type of LL program for overall sense of belonging, F (12, 1462) = .435, p = .950. Given the significant main effect of race/ethnicity on overall sense of belonging, follow-up tests were conducted using Tukey's HSD procedure. Results (presented in Table 5) indicated that Black/African American, Asian Pacific American, and Multiracial/Multiethnic women experienced a less strong overall sense of belonging than White/Caucasian women.

Table 4
5 x 4 ANOVA for Effects of Race/Ethnicity and Type of LL Program on Overall Sense of Belonging

Source	*Sum of Squares*	*df*	*Mean Square*	*F*	*p*	*Partial Eta Squared*
Race/ethnicity	360.228	4	90.057	10.690	.000	.028
LL Program Type	12.444	3	4.148	.492	.688	.001
Interaction	43.999	12	3.667	.435	.950	.004
Error	12316.257	1462	8.375			
Total	12746.880	1481				

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

Table 5

Mean Scores of Overall Sense of Belonging by Race/Ethnicity and Type of LL Program

	(1) Black/African American		(2) Asian Pacific American		(3) Latina		(4) Multiracial/ Multiethnic		(5) White/ Caucasian		Total			
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	Tukey's HSD for race/ethnicity
LL Program Type														
Women-only STEM	14.20	1.64	14.80	4.21	16.00	1.73	15.00	0.00	16.60	2.72	16.28	2.87		
Co-ed STEM	15.50	2.74	15.67	3.61	14.33	3.88	16.33	1.37	16.46	2.85	16.23	2.89		
Other type of LL Program	15.26	2.28	15.60	2.73	15.09	3.39	15.35	3.89	16.67	2.88	16.37	2.92		
No type of LL Program	15.52	3.03	15.37	2.68	15.97	3.20	15.11	4.27	16.41	2.85	16.08	2.95		
Total	15.37	2.75	15.43	2.78	15.59	3.23	15.30	3.90	16.52	2.85	16.20	2.93	10.69***	5>1,2, 4

* p < .05;** p < .01;*** p < .001

Hypothesis 1a. Differences in overall sense of belonging will exist among women from different racial/ethnic groups; women of color will report a less strong overall sense of belonging than White women. This hypothesis was partially supported. Significant differences in sense of belonging were found among women from different racial/ethnic groups, and women of color (except Latinas) reported a less strong sense of belonging than White/Caucasian women.

Hypothesis 1b. Women in STEM majors participating in living-learning programs will report a stronger overall sense of belonging than the comparison group who were not participants in living-learning programs. This hypothesis was rejected. No significant differences in overall sense of belonging were found between women in STEM majors in living-learning programs and those in the comparison group.

Hypothesis 1c. Differences in overall sense of belonging will exist among women from different racial/ethnic groups participating in different types of STEM-related living-learning programs. This hypothesis was rejected. No statistically significant interaction was found between race/ethnicity and type of living-learning program on the measure of overall sense of belonging.

Campus racial climate perceptions. A 5 x 4 ANOVA was conducted to examine the relationships between race/ethnicity, type of LL program, and each of the two measures of perceptions of the campus racial climate: positive interactions with diverse peers, and perceptions of a positive campus racial climate. The means and standard deviations for the two measures of campus racial climate perceptions are presented in Table 7.

For the measure positive interactions with diverse peers, the ANOVA (Table 6) indicated a significant main effect for race/ethnicity, F (4, 1634) = 51.148, p = .001, with a large effect size, partial η^2 = .111. There was not a significant main effect for type of LL program, F (3, 1634) = .783, p = .503, nor was there a significant interaction effect, F (12, 1634) = .510, p = .910. Using the Tukey procedure, follow-up tests on the significant differences among racial/ethnic groups indicated that women of color reported more positive interactions with diverse peers than White/Caucasian women (Table 7).

Table 6
5 x 4 ANOVA for Effects of Race/Ethnicity and Type of LL Program on Positive Interactions with Diverse Peers

Source	*Sum of Squares*	*df*	*Mean Square*	*F*	*p*	*Partial Eta Squared*
Race/Ethnicity	8336.24	4	2084.059	51.148	.000	.111
LL Program Type	95.77	3	31.922	.783	.503	.001
Interaction	249.38	12	20.782	.510	.910	.004
Error	66578.62	1634	40.746			
Total	75267.43	1653				

*p < .05; **p < .01; ***p < .001

For the measure of perceptions of a positive campus racial climate, the assumption of equal variances was violated due to the unequal size of the groups; therefore, a more conservative alpha of .01 was used to determine significance. The ANOVA (Table 8) results indicated a significant main effect for race/ethnicity, F (4, 1607) = 4.013, p = .003, with a small effect size, partial η^2 = .010. There was not a significant main effect for type of LL program, F (3, 1607) = .884, p = .680, nor a significant interaction effect, F (12, 1607) = .562, p = .874. Using the Tukey procedure, follow-up tests on the significant differences among racial/ethnic groups indicated

Table 7

Mean Scores of Positive Interactions with Diverse Peers by Race/Ethnicity and Type of LL Program

	(1) Black/African American		(2) Asian Pacific American		(3) Latina		(4) Multiracial/ Multiethnic		(5) White/ Caucasian		Total			
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	Tukey's HSD for Race/ethnicity
LL Program Type														
Women-only STEM	22.67	4.84	21.70	7.63	23.67	1.53	23.00	4.24	18.98	5.48	19.58	5.66		
Co-ed STEM	24.17	6.88	23.83	2.32	25.00	6.13	22.33	6.95	19.08	6.39	20.08	6.50		
Other type of LL Program	20.77	4.71	25.01	6.77	24.67	6.51	25.33	7.00	19.20	6.37	20.56	6.82		
No type of LL Program	21.98	6.29	23.50	6.39	24.88	6.00	24.81	7.73	18.78	6.44	20.39	6.87		
Total by race/ethnicity	21.87	5.84	23.96	6.54	24.78	5.86	24.68	7.32	18.96	6.33	20.37	6.75	51.148 ***	5 < 1,2,3,4

Response scale index from 9-36, with 9 = not at all to 36 = all of the time

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

that Black/African American women perceived a less positive campus racial climate than Asian Pacific American, Multiracial/Multiethnic and White/Caucasian women (see Table 9).

Table 8
5 x 4 ANOVA for Effects of Race/Ethnicity and Type of LL Program on Perceptions of Positive Campus Racial Climate

Source	*Sum of Squares*	*df*	*Mean Square*	*F*	*p*	*Partial Eta Squared*
Race/Ethnicity	186.976	4	46.744	4.013	.003	.010
LL Program Type	30.891	3	10.297	.884	.449	.002
Interaction	78.533	12	6.544	.562	.874	.004
Error	18719.501	1607	11.649			
Total	19012.879	1627				

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

Hypothesis 2a. Differences in the two measures of campus racial climate perceptions will be found among women from different racial/ethnic groups. Women of color will report more positive interactions with diverse peers and perceive a less positive campus racial climate than White/Caucasian women and Black/African American women will perceive a less positive campus racial climate than women from other racial/ethnic groups.

This hypothesis was partially supported. There were significant differences among women from different racial/ethnic groups on the measure of positive interactions with diverse peers, with women of color reporting more positive interactions with individuals from other racial/ethnic groups than White/Caucasian women. On the measure of perceptions of a positive campus racial climate, Black/African American women perceived a less positive campus racial climate than women from all other racial/ethnic groups; there were no significant differences between other women of color and White/Caucasian women on this measure.

Table 9
Mean Scores of Perceptions of Positive Campus Racial Climate by Race/Ethnicity and Type of LL Program

	(1) Black/African American		(2) Asian Pacific American		(3) Latina		(4) Multiracial/ Multiethnic		(5) White/ Caucasian		Total			
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	Tukey's HSD for race/ethnicity
Type of LL Program														
Women-only STEM	16.33	3.20	16.80	3.77	16.00	1.73	17.50	2.12	17.42	3.26	17.27	3.24		
Co-ed STEM	16.63	5.50	18.86	2.79	18.50	3.83	17.33	4.13	18.00	3.43	17.95	3.59		
Other type of LL program	15.95	3.14	18.24	3.52	17.00	4.33	18.44	3.18	17.67	3.14	17.71	3.25		
No type of LL Program	16.54	3.85	17.48	3.69	17.00	4.23	17.88	4.64	17.89	3.28	17.69	3.52		
Total by race/ethnicity	16.39	3.77	17.75	3.62	17.11	4.06	17.97	4.13	17.78	3.24	17.69	3.42	4.013**	1< 2, 4, 5

Response scale index from 6-24, with 6 = little or none to 24 = a great deal.
* $p < .05$;** $p < .01$;*** $p < .001$

Hypothesis 2b. Women in STEM majors participating in living-learning programs will perceive a more positive campus racial climate and report more positive interactions with diverse peers than the comparison group who did not participate in living-learning programs. This hypothesis was rejected. There were no significant differences in perceptions of a positive campus racial climate or positive interactions with diverse peers among women in STEM majors in LL programs and those in the comparison group.

Hypothesis 2c. There will be significant differences on the two measures of campus racial climate perceptions among women from different racial/ethnic groups who participate in different types of STEM-related living-learning programs. This hypothesis was rejected. No statistically significant interaction between race/ethnicity and type of LL program was found on either positive interactions with diverse peers or perceptions of a positive campus racial climate.

Hierarchical Multiple Regression Analysis

A hierarchical multiple regression analysis was conducted to determine the utility of the conceptual framework developed for this study in explaining overall sense of belonging among undergraduate women in STEM majors. Procedures testing the assumptions of multiple regression indicated there was no multicollinearity among the independent variables. Bivariate correlations (Appendix D) indicated that the highest correlated variables were the measures of the residence hall as academically supportive and residence hall as socially supportive (r = .710). Tolerance levels were .451 (residence hall as academically supportive) and .486 (residence hall as socially supportive) and the VIF were 2.218 and 2.058 respectively. These diagnostics indicated that with tolerance

levels above zero and VIF statistics below 10 (Cohen, Cohen, West, & Aiken, 2003), the multicollinearity assumption was not violated.

The regression analysis examined the relationship of various student background characteristics and specified aspects of the college environment to overall sense of belonging among undergraduate women in STEM majors. The independent variables were entered into seven blocks to determine how each set of variables contributed to explaining the variance in overall sense of belonging. The overall results of the regression analysis indicated that this study's conceptual framework (as represented by the independent variables) explained a significant amount of the variance in overall sense of belonging, $R^2 = .291$, F (22, 1380) = 25.690, $p < .001$. Results for each block of the regression analysis are presented in Table 10.

The first block contained students' demographic characteristics. Among these variables, two were significant contributors to overall sense of belonging. The pre-test for sense of belonging had a strong relationship to overall sense of belonging, $\beta = .183$, $p < .001$. Race (being a woman of color) had a strong negative relationship to overall sense of belonging, $\beta = -.153$, $p < .001$. The other variables, including father's and mother's levels of education, average high school grades, combined SAT score, and socializing with friends from home were not significant. For this block, $R^2 = .067$, F (7, 1395) = 14.350, $p < .001$.

Block two added the variables measuring levels of confidence in math ability and academic self-confidence. The measure of academic self-confidence had a significant relationship to overall sense of belonging, $\beta = .136$, $p < .001$; level of confidence in math ability was not a significant predictor. The sense of belonging pre-test remained a

Table 10

Hierarchical Multiple Regression Analysis of Predictors of Sense of Belonging (N =1,505)

	Block 1			Block 2			Block 3		
Variable	B	SE	β	B	SE	β	B	SE	β
Race (Woman of Color)	-.990	.171	-.153***	-.933	.170	-.145***	-.901	.171	-.139***
Father's level of education	-.032	.058	-.017	-.042	.057	-.023	-.036	.057	-.020
Mother's level of education	.060	.063	.030	.058	.062	.029	.057	.062	.028
Average high school grades	-.179	.102	-.048	-.150	.101	-.041	-.158	.101	-.043
SAT combined score	-8.24	.001	-.004	-.001	.001	-.026	.000	.001	-.022
Socialize with friends from home	-.229	.156	-.038	-.206	.154	-.034	-.205	.154	-.034
Pre-test: sense of belonging	.679	.096	.183***	.557	.098	.150***	.564	.098	.152***
Math confidence			.076**	.113	.099	.033	.117	.099	.034
Academic self-confidence			.146***	.148	.030	.136***	.145	.030	.133***
Institutional Carnegie classification			.047			.038	.458	.313	.038
Academic class year			-.049			-.083**			-.085**
Course-related faculty interactions			.092***			.066*			.064*
Faculty mentoring			.059*			.035			.033
Women-only STEM LL program			-.010			-.009			-.006
Co-ed STEM LL program			-.008			-.013			-.013
Other type of LL program			.033			.038			.037
Residence hall academically supportive			.366***			.361***			.360***
Residence hall socially supportive			.397***			.391***			.391***
Peer discussion of academic/career issues			.106***			.087**			.086**
Peer discussion of socio-cultural issues			.108***			.091***			.091***
Positive peer diversity interactions			.133***			.122***			.127***
Positive campus racial climate			.300***			.290***			.289***
R^2	.067			.088			.089		
R^2 change	.067			.021			.001		
F change	14.350***			15.794***			2.144		

The shaded areas indicate variables entered into the regression model for each block.

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

Table 10 (continued)

	Block 4			Block 5			Block 6			Block 7		
Variable	B	SE	β	B	SE	β	B	SE	β	B	SE	β
Race (Woman of Color)	-.878	.171	-.136***	-.920	.155	-.142***	-.913	.156	-.141***	-.846	.164	-.131***
Father's level of education	-.037	.057	-.020	-.075	.052	-.041	-.076	.052	-.041	-.049	.051	-.027
Mother's level of education	.044	.062	.022	.052	.056	.026	.046	.056	.023	.050	.055	.025
Average high school grades	-.132	.101	-.036	-.088	.092	-.024	-.080	.092	-.022	-.031	.091	-.008
SAT combined score	.000	.001	-.008	-.001	.001	-.035	-.001	.001	-.037	-.001	.001	-.035
Socialize with friends from home	-.254	.154	-.042	-.258	.141	-.043	-.258	.141	-.043	-.305	.139	-.051*
Pre-test: sense of belonging	.528	.098	.142***	.444	.089	.120***	.439	.089	.118***	.440	.088	.118***
Math confidence	.138	.099	.040	.125	.089	.036	.129	.090	.037	.136	.088	.039
Academic self-confidence	.146	.031	.134***	.126	.028	.116***	.121	.029	.111***	.105	.028	.097***
Institutional Carnegie classification	.450	.312	.038	.250	.284	.021	.240	.284	.020	.216	.282	.018
Academic class year	-.318	.089	-.096***	-.248	.081	-.075**	-.245	.081	-.074**	-.211	.080	-.064**
Course-related faculty interactions	.076	.035	.064*	.061	.032	.051	.049	.032	.041	.042	.032	.036
Faculty mentoring	.029	.039	.022	.000	.036	.000	-.003	.036	-.002	.012	.035	.009
Women-only STEM LL program			-.011	-.773	.287	-.067**	-.772	.287	-.067**	-.670	.282	-.058*
Co-ed STEM LL program			-.020	-.552	.280	-.048*	-.569	.280	-.049*	-.559	.276	-.048*
Other type of LL program			.032	-.332	.161	-.053*	-.336	.161	-.054*	-.296	.158	-.047
Residence hall academically supportive			.355***	.162	.029	.192***	.161	.029	.191***	.170	.029	.201***
Residence hall socially supportive			.384***	.177	.023	.259***	.175	.023	.257***	.130	.023	.191***
Peer discussion of academic/career issues			.073**			.045	.052	.038	.039	.043	.038	.033
Peer discussion of socio-cultural issues			.077**			.031	.007	.020	.011	.005	.020	.007
Positive peer diversity interactions			.121***			.041			.034	-.007	.012	-.015
Positive campus racial climate			.284***			.174***			.172***	.152	.022	.176***
R^2	.101			.264			.266			.291		
R^2 change	.012			.162			.002			.025		
F change	6.264***			61.060***			1.759			24.191***		

The shaded areas indicate variables entered into the regression model for each block.
* $p < .05$; ** $p < .01$; *** $p < .001$

significant contributor, β = .150, $p < .001$, and being a woman of color continued to have a significant negative relationship, β = -.145, $p < .001$, to overall sense of belonging. This block was significant, $R^2 = .088$, R^2 change = .021, F change (2, 1393) = 15.794, $p < .001$.

The third block contained the variable institutional Carnegie classification. This was not a significant contributor to the variance in overall sense of belonging. The sense of belonging pre-test remained significant, β = .152, $p < .001$, as did being a woman of color, β = -.139, $p < .001$, and academic self-confidence, β = .133, $p < .001$. The contribution of the third block was not significant, $R^2 = .089$. R^2 change = .001, F change (1, 1392) = 2.144, $p = .143$.

Block four added three formal and informal academic environment variables to the model: academic class year, course-related interactions with faculty, and faculty mentoring. Academic class year had a significant negative relationship to overall sense of belonging, β = -.096, $p < .001$. Course-related interactions with faculty was also a significant predictor, β = .064, $p < .05$, while faculty mentoring was not significant. The variables that continued to significantly contribute to overall sense of belonging included the pre-test for sense of belonging, β = .142, $p < .001$; being a woman of color, β = -.136, $p < .001$; and academic self-confidence, β = .134, $p < .001$. The fourth block was significant, $R^2 = .101$, R^2 change = .012, F change (3, 1389) = 6.264, $p < .001$.

Five variables were added in the fifth block representing formal and informal social environments, including participation in women-only STEM LL program, participation in co-ed STEM LL program, participation in another type of LL program, and perceptions of the residence hall as academically and socially supportive. All of the

predictors added in this block were significant. Perception of the residence hall as socially supportive was the strongest predictor in this block, β = .259, $p < .001$, followed by perception of the residence hall as academically supportive, β = .192, $p < .001$. All of the LL program types were significant negative predictors: women-only STEM, β = -.067, $p < .01$; co-ed STEM, β = -.048, $p < .05$; and other type of LL program, β = -.053, $p < .05$. Being a woman of color continued to have a significant negative relationship with overall sense of belonging and gained strength when entered in this block, β = -.142, $p < .001$. The sense of belonging pre-test remained significant, β = .120, $p < .001$, as did academic self-confidence, β = .116, $p < .001$, and academic class year, β = -.075, $p < .01$. The fifth block was significant and the most powerful in the model, $R^2 = .264$, R^2 change = .162, F change (5, 1384) = 61.060, $p < .001$.

Two measures of peer interactions were added to block six: discussions of academic/career issues with peers and discussions of socio-cultural issues with peers. Neither predictor made a significant contribution to the model. Being a woman of color continued to have a significant negative relationship to overall sense of belonging, β = -.141, $p < .001$. The residence hall measures remained potently significant, with residence hall as socially supportive, β =.257, $p < .001$ and residence hall as academically supportive, β = .191, $p < .001$. The pre-test of sense of belonging remained significant, β = .118, $p < .001$, as did academic self confidence, β = .111, $p < .001$. Other predictors with a significant negative relationship included academic class year, β = -.074, $p < .01$; women-only STEM LL program, β = -.067, $p < .01$; co-ed STEM LL program, β = -.049, $p < .05$; and other type of LL program, β = -.054, $p < .05$. The contribution of the sixth

block was not significant, R^2 = .266, R^2 change = .002, F change (2, 1382) = 1.759, p = .173.

The final block contained two measures of the campus racial climate. Perceptions of a positive campus racial climate was significant, β = .176, p < .001, while the measure positive interactions with diverse peers was not significant. Interestingly, socialize with friends from home entered in the first block, became significant in this final block, β = -.051, p <.05. This is known as a suppressor effect, occurring when two independent variables share a positive relationship with each other but have opposite relationships with the dependent variable (Astin, 1991). In the case of the current study, socialize with friends from home had a positive relationship with perceptions of a positive campus racial climate. However, socialize with friends from home had a negative relationship with overall sense of belonging, while perceptions of a positive campus racial climate had a positive relationship with overall sense of belonging. Thus the relationship between socialize with friends from home and overall sense of belonging was suppressed until perceptions of a positive campus racial climate was entered into the regression model. Being a woman of color continued to have a significant negative relationship with overall sense of belonging, β = -.131, p < .001. The measures of the residence hall climate remained the strongest in the block, with residence hall climate as academically supportive gaining strength, β = .201, p < .001, and residence hall climate as socially supportive β = .191, p < .001. The sense of belonging pre-test continued to be significant, β = .118, p < .001, as did academic self-confidence, β = .097, p < .001, academic class year, β = -.064, p < .01, women-only STEM LL program, β = -.058, p < .05, and co-ed

STEM LL program, β = -.048, $p < .05$. This block was significant, $R^2 = .291$, R^2 change = .025, F (2, 1380) = 24.191, $p < .001$.

Hypothesis 3. The conceptual framework developed for this study will predict, successfully and significantly, overall sense of belonging among women for undergraduate women in STEM majors.

This hypothesis was supported because the conceptual framework explained 29.1% of the variance in overall sense of belonging. Key predictors of overall sense of belonging among undergraduate women in STEM majors identified by the conceptual framework include (a) racial/ethnic background, (b) socializing with friends from home, (c) the quasi pre-test measure of sense of belonging, (d) academic self-confidence, (e) academic class year, (f) women-only STEM LL program, (g) co-ed STEM LL program, (h) an academically supportive residence hall climate, (i) a socially supportive residence hall climate, and (j) perceptions of a positive campus racial climate.

Partial Correlation Analysis

After examining the results of the final block of the hierarchical multiple regression, the relationship between the measures of perceptions of the campus racial climate and overall sense of belonging was further assessed by partial correlation analysis. The bivariate correlations (see Appendix D) indicated that positive interactions with diverse peers was significantly correlated with overall sense of belonging ($r = .073$; $p < .001$) and perceptions of a positive campus racial climate was also significantly correlated with overall sense of belonging ($r = .311$; $p < .001$). Partial correlations indicated that after controlling for the effects of race/ethnicity, sense of belonging pre-test, socializing with friends, academic self-confidence, academic class year, the two

types of STEM LL programs, and the residence hall climate measures (all of the significant predictors from the regression analysis), and perceptions of a positive campus racial climate remained significantly correlated to overall sense of belonging (pr = .193, p < .001). The measure positive interactions with diverse peers was no longer significantly correlated with overall sense of belonging (pr = .042, p = .111).

Hypothesis 4. The two measures of campus racial climate perceptions will be significantly correlated to overall sense of belonging after controlling for the significant predictors from the conceptual framework, including background characteristics, confidence in academic and math abilities, faculty and peer interactions, type of living-learning program, and perceptions of the residence hall climate.

This hypothesis was partially supported because, after controlling for the significant predictors, perceptions of a positive campus racial climate was significantly correlated to overall sense of belonging, while positive interactions with diverse peers was not significantly correlated to overall sense of belonging.

Given that Black/African American women perceived a less positive campus racial climate than women from all the other racial/ethnic groups, one might wonder whether these perceptions of the campus racial climate continued to contribute to their overall sense of belonging, even after controlling for other background characteristics and college environments. Partial correlations were done for each racial/ethnic group, except for American Indian women because of the small sample size. For Black/African American women, the zero-order correlation indicated that perceptions of a positive campus racial climate was strongly correlated with overall sense of belonging (r = .509, p < .001). After controlling for the significant predictors from the regression analysis,

perceptions of a positive campus racial climate maintained a moderate significant correlation with overall sense of belonging (pr = .448, p < .001) for Black/African American women. The relationship between perceptions of a positive campus racial climate and overall sense of belonging also remained important for Multiracial/Multiethnic women after controlling for the significant predictors from the regression analysis. Zero-order correlations indicated a strong significant relationship between these measures (r = .614, p < .001), and the partial correlation indicated a moderate significant relationship (pr = .377, p < .01) for Multiracial/Multiethnic women.

For Asian Pacific American women, the relationship between perceptions of a positive campus racial climate and overall sense of belonging was significant but less strong. The bivariate correlation was small (r = .281, p < .001), and the partial correlation was even smaller (pr = .163, p < .05). The correlations for White/Caucasian women for these measures were also small (r = .275, p < .001; pr = .170, p < .001). For Latinas, perceptions of a positive campus racial climate were not significantly correlated with overall sense of belonging (r = .231, p = .110; pr = .171, p = .291).

Chapter Summary

This study examined the relationship between self-reported measures of campus racial climate perceptions and the overall sense of belonging among women from different racial/ethnic groups in undergraduate STEM fields. The results from the factorial analyses indicated significant differences among women from different racial/ethnic groups on overall sense of belonging and the measures of perceptions of the campus racial climate. Women of color (except Latinas) reported a less strong overall sense of belonging than White/Caucasian women; thus hypothesis 1a was supported.

However, there were no significant differences by LL program type, nor was there a significant interaction effect between race/ethnicity and type of LL program; thus hypotheses 1b and 1c were rejected. Women of color reported more positive interactions with diverse peers than White/Caucasian women. Significant differences in perceptions of a positive campus racial climate existed only between Black/African American women and women from other racial/ethnic groups, with Black/African American women perceiving a less positive campus racial climate than Asian Pacific American, Multiracial/Multiethnic, and White/Caucasian women. Thus hypothesis 2a was only partially supported. Hypotheses 2b and 2c were rejected because there were no significant differences by LL program type nor was there a significant interaction between race/ethnicity and type of LL program on the measures of campus racial climate perceptions.

In addition, the utility of the conceptual framework developed for this study was examined through hierarchical multiple regression analysis. Results from the final regression block indicated that the conceptual framework significantly explained 29.1% of the variance in overall sense of belonging, thus supporting the third hypothesis. Significant predictors from the final regression block that were powerful contributors to the model (as indicated by the standardized beta coefficient) included race/ethnicity (negative relationship), the measures of the residence hall climate as being academically and socially supportive, and perceptions of a positive campus racial climate. Additional significant factors were the sense of belonging pre-test, socializing with friends from home (negative relationship), academic self-confidence, academic class year (negative relationship), and both types of STEM LL programs (negative relationships). The most

potent block of the regression analysis contained the measures of the residence hall climate, contributing 16.2% to the variance in overall sense of belonging. The first block containing race and the sense of belonging pre-test explained 6.7% of the variance in overall sense of belonging. The block containing measures of campus racial climate perceptions contributed 2.5% to overall sense of belonging, and the block containing academic self-confidence explained 2.1% of the total variance. The block containing academic class year and interactions with faculty contributed 1.2% to the variance in overall sense of belonging.

Finally, this study examined the relationship between the two measures of campus racial climate perceptions and overall sense of belonging after accounting for the significant predictors from the regression analysis. The partial correlation analysis indicated that perceptions of a positive campus racial climate, but not positive interactions with diverse peers, remained significantly correlated with overall sense of belonging. Thus hypothesis 4 was partially supported. Additional partial correlation analyses indicated a moderate significant relationship between perceptions of a positive campus racial climate and overall sense of belonging for Black/African American and Multiracial/Multiethnic women. A small but significant correlation between perceptions of a positive campus racial climate and overall sense of belonging existed for Asian Pacific American and White/Caucasian women. There was not a significant correlation between perceptions of a positive campus racial climate and overall sense of belonging for Latina women.

Chapter 5: Discussion

This study examined the relationship between perceptions of the campus racial climate and overall sense of belonging among women of color in undergraduate STEM majors. Other factors of the collegiate environment were also examined in relation to overall sense of belonging, including (a) perceptions of academic self-confidence, (b) interactions with peers and faculty, (c) living-learning program participation, and (d) perceptions of the academic and social climates in the residence hall. This chapter begins with a discussion of the racial/ethnic group differences among the study's main constructs, overall sense of belonging and perceptions of the campus racial climate. Next, the utility of the conceptual framework in understanding overall sense of belonging is examined. Also discussed is the relationship of perceptions of the campus racial climate to overall sense of belonging among women of color in STEM after controlling for other college environments. The chapter continues with a discussion of the limitations associated with this study, and concludes with implications for practice and transforming STEM education, and future directions for research.

Racial/Ethnic Group Differences

Background characteristics. The descriptive analyses reveal that the sample used in this study had well educated parents, with 60.0% of fathers and 57.0% of mothers having completed a bachelors, masters, or professional degree. However, examination of differences by race and ethnicity indicate more women of color than White/Caucasian women had parents with education levels of some college or less. For example, Black/African American women reported that 45% of their mothers and fathers had some college or less. A large portion of Latinas also reported parents as having some college or

less (49% of fathers and 55% of mothers). These findings are consistent with Huang et al. (2000) and Grandy (1997) who found that students from under-represented racial/ethnic groups in STEM majors were more likely to have parents with less than a college education.

In terms of prior academic performance as indicated by self-reported high school grades, this sample performed well, with 89.8% reporting average grades of B+ or higher. Among racial/ethnic groups reporting grades of B+ or higher, 82.6% were Black/African American, 85.7% Latina, 86.9% Multiracial/Multiethnic, 89.6% Asian Pacific American, and 91.0% White/Caucasian. However, it is worth noting that a greater percentage of White/Caucasian women (60.9%) reported grades of A+ or A than women of color; this was also greater than those reporting grades of A+ or A in the entire sample (55.8%). Self-reported SAT scores indicate that 18.6% of the sample reported an SAT combined score of 1350 or higher, while 15.4% reported scores of 1140 or lower. More White/Caucasian (28.0%) and Asian Pacific American (27.2%) women reported SAT scores of 1350 or higher than women from other racial/ethnic groups, while 56.3% of Black/African American and 45.5% of Latina women reported SAT scores of 1140 or lower. These findings related to prior academic performance are consistent with research indicating that among STEM majors, under-represented students of color in general (Elliott et al., 1996; Grandy, 1997) and under-represented women of color in particular (Smyth & McArdle, 2004) had lower high school performances than their Asian Pacific American and White/Caucasian peers.

Living-learning program participation. Rates of LL program participation and racial/ethnic composition are findings of great interest. The sampling design of the larger

2004 NSLLP study was constructed so that approximately half of the sample would be participants in LL programs. From the overall 2004 NSLLP study 51% were LL program participants and 49% were the comparison group living in traditional residence hall arrangements (Inkelas & Associates, 2004). In the current study approximately 48% reported participation in some type of LL program. Given the sampling design of the 2004 NSLLP, one might assume that participation rates among women in STEM would also be around 50%; however, the analysis used in the current study show that women of color in STEM were significantly under-represented in LL programs.

Findings from the current study revealed that 7.0% of the sample participated in each type of STEM-related LL programs (women-only and co-ed) and approximately 34% of women participated in other types of LL programs (e.g., Honors, New Student Transition). However, women of color reported less participation in any type of LL program, ranging from 36.9% to 39.6%. Half of the sample of White/Caucasian women (50.8%) reported participation in a LL program. Women-only STEM LL programs were the least diverse, with 17.6% of participants being women of color, many of whom were Asian Pacific American (8.4%). This finding is consistent with the single-institution study done by Hathaway et al. (2001), who found that the women-only STEM program they examined was predominantly White. From the current study, co-ed STEM LL programs had 23.4% women of color and other types of LL programs had 25.8% women of color. Thus it appears that women of color are not accessing resources such as STEM LL programs that could facilitate their success in these majors. It may be that the recruitment efforts of these programs do not reach women of color or effectively describe to them the academic and social benefits of participating in LL programs. Some LL

programs have selective admission policies, which may preclude the participation of under-represented women of color, who generally have lower SAT scores. Finally, the overall lack of racial/ethnic diversity of STEM LL programs may make these programs unattractive to women of color.

It is important to note that despite the multiple institutions represented in the current study, the actual numbers of women participating in women-only STEM and co-ed STEM programs were quite small, with 7.0% of women in each type of program. Among the 34 institutions participating in the 2004 NSLLP, 10 offered women-only STEM programs, 11 offered co-ed STEM programs, and four offered both types of programs (Inkelas & Associates, 2004). Based on these data, it appears that STEM-related LL programs exist in small numbers, even among the many research universities represented in the sample. However, on the campuses where STEM LL programs existed, women in general, and women of color in particular, were more likely to not participate in these types of programs.

Sense of belonging. This study's hypothesis statements indicating differences by race/ethnicity and type of LL program on the overall sense of belonging among the sample were partially supported. Black/African American, Asian Pacific American, and Multiracial/Multiethnic women reported less strong overall sense of belonging than White/Caucasian women, thus supporting this portion of the hypothesis statement. This finding is consistent with other research (Gilliard, 1996; D. R. Johnson et al., 2007; Mandell et al., 1992; Reid & Radhakrishnan, 2003). The sample as a whole experienced a fairly strong overall sense of belonging (M =16.20, SD = 2.95, minimum value = 5 and

maximum value = 20), with the effect size indicating that the magnitude of the differences between racial/ethnic groups was small.

There was not a significant main effect for LL program type on overall sense of belonging, thus this portion of the hypothesis statement was rejected. This finding is not consistent with Hoffman et al. (2003) who found that participants in learning communities expressed greater sense of belonging than those who did not participate. This finding is also inconsistent with the overall results from the 2004 NSLLP study that found students in LL programs reported a stronger overall sense of belonging than students who did not participate in these programs (Inkelas & Associates, 2004). However, this finding is consistent with Inkelas et al. 2005, which examined women in STEM LL programs. In addition, there was not a significant interaction effect of race/ethnicity and LL program type on overall sense of belonging, and this portion of the hypothesis statement was also rejected. The finding that there were no differences in overall sense of belonging among women in STEM majors who participated in LL programs and those who did not is curious in light of the findings from the larger 2004 NSLLP study. Given that the measure of sense of belonging used in the current study assessed feelings of belonging to the larger campus, it may be that a STEM focused residential experience, combined with a demanding curriculum, limited the involvement in the larger campus community of women in STEM majors. Thus, the women in the current study would experience similar levels of belonging because of their common experiences in STEM.

Positive interactions with diverse peers. This study's hypothesis statements suggesting differences on the measures of campus racial climate perceptions among

women from different racial/ethnic groups and types of LL programs were partially supported. On the measure of positive interactions with diverse peers, women of color reported more positive interactions with diverse peers than White/Caucasian women, partially supporting the second hypothesis statement. This finding corroborates the early research of Hurtado et al. (1994) on cross-racial interactions. Additional research points to the necessary condition of compositional diversity (Milem et al., 2005) for students to have cross-race interactions (Chang, 1999, 2001; Chang, Astin, & Kim, 2004; Hurtado et al., 1994; Hurtado et al., 1999). Given the lack of diversity in STEM fields on the national level (see NSF, 2004b; Nelson, 2005), as well as in the current sample of women in STEM majors who participated in LL programs, White/Caucasian women in STEM appear to have fewer opportunities for cross-racial interactions with their peers. It is not surprising that White/Caucasian women would report having fewer positive cross-race interactions, given the fear, anxiety, and hesitation that often accompany the interactions many White people have with racial/ethnic minority groups (A. G. Johnson, 2006), and the privilege of being a member of the dominant racial group who does not have to interact with racial/ethnic minority groups (McIntosh, 1988).

The mean score of the sample (M = 20.39, SD = 6.75; response scale from 9-36, with a higher score indicating greater interactions) indicates that the women in this sample were engaged in limited amounts of cross-race interactions. Examining differences by racial/ethnic group, White/Caucasian women (M = 18.96) reported having limited amounts of positive cross-race interactions, while women of color, with mean scores ranging from 21.87 to 24.78, reported moderate amounts of positive cross-race

interactions (see Appendix B for a complete description of the variables used in the study).

The measure of interactions with diverse peers used in this study was characterized as positive for two reasons. First, the factor analysis conducted on the larger 2004 NSLLP dataset produced a scale in which nine items were grouped together with factor loadings that ranged from .495 to .857 (see Appendix C). Second, the nature of the items contained in the scale – attending social events, sharing meals, having intellectual discussions, sharing personal feelings and problems, studying together, discussing race relations, doing extracurricular activities together, rooming together, and dating - were construed as positive types of interactions. The characterization of such interactions as positive (i.e., sharing a meal with someone of a different race versus avoiding such opportunities) describes the kind of interaction but does not characterize the outcome or an individual's interpretation of the interaction (i.e., sharing a meal with someone from a different racial/ethnic group may be uncomfortable).

There was not a significant main effect for type of LL program on having positive interactions with diverse peers. This finding is not consistent with results from the larger 2004 NSLLP study (Inkelas & Associates, 2004) that found students in LL programs were more likely to report having positive interactions with diverse peers than students not in LL programs. Reviewing the mean scores of the LL program types in the current study indicate that all program types fostered limited amounts of interactions with diverse peers (see Table 6). This may be reflective of the lack of racial/ethnic diversity among the respondents in all types of LL programs. In addition, there was not a significant interaction effect of race/ethnicity and type of LL program on positive peer diversity

interactions. It may be that a significant interaction went undetected because of the small cell sizes used in the factorial analysis. These findings did not support the portion of the second hypothesis statement indicting differences would exist among type of LL program and an interaction effect.

Perceptions of a positive campus racial climate. On the measure of perceptions of a positive campus racial climate, Black/African American women had less positive perceptions than Asian Pacific American, Multiracial/Multiethnic, and White/Caucasian women. There were no other significant differences among other women of color, thus the second hypothesis statement was only partially supported. The finding that Black/African American women would perceive a less positive campus racial climate among other racial/ethnic minority and White/Caucasian women is consistent with prior research on students of color in general (see Ancis et al., 2000; Hurtado, 1992; Reid & Radhakrishnan, 2003; Smedley et al., 1993). However, the finding that other women of color did not perceive a less positive campus racial climate than White/Caucasian women is not consistent with prior research on students of color (see Ancis et al.; Hurtado; Nettles et al., 1986; Nora & Cabrera, 1996; Reid & Radhakrishnan). It may be that some women of color in STEM were isolated from the rest of the campus community because of the demanding nature of STEM to assess the campus racial climate. Among Asian Pacific American women, the over-representation of other Asian Pacific American students and faculty in STEM (NSF, 2007) may provide a supportive environment that positively shapes their experiences and perceptions of the campus racial climate. There may have been too few Latinas in the sample to detect any differences in their perceptions of the campus racial climate. Finally, little is known how

Multiracial/Multiethnic students perceive campus racial climates, so it is unknown if this finding represents their college experiences.

There was not a significant main effect for LL program type on perceptions of a positive campus racial climate. This has mixed consistency with findings from the larger 2004 NSLLP study. There were no differences reported in perceptions of a positive campus racial climate between LL program participants and non-participants. However, results did indicate differences in perception of a positive campus racial climate among the various LL program types. For example, students in health and wellness LL programs were more likely to perceive a less positive campus racial climate, compared to students in civic engagement LL programs who perceived a more positive campus racial climate (Inkelas & Associates, 2004). Finally, there was not an interaction effect of race/ethnicity and LL program type on perceptions of a positive campus racial climate. Thus, these portions of the second hypothesis statement were rejected. The lack of a significant main effect for LL program type may be related to the racial composition of the sample used in the current study, which was predominantly White. Given that White students generally have more favorable views of the campus racial climate than students of color (see Ancis et al. 2000; Hurtado, 1992; Nora & Cabrera, 1996; Reid & Radhakrishnan, 2003), it is plausible that no significant differences were found because of the large number of White/Caucasian women in the sample. The lack of a significant interaction effect may be attributed to cell sizes that may have been too small to detect an interaction between LL program type and racial/ethnic background.

Application of Conceptual Framework

The third research question addressed the utility of the conceptual framework for understanding overall sense of belonging among women in undergraduate STEM majors. Using Weidman's (1989) model of undergraduate socialization, along with Astin's I-E-O model (1991), the conceptual framework explained 29% of the variance in overall sense of belonging.

Background characteristics. The final block of the hierarchical multiple regression analysis identified several factors significantly related to overall sense of belonging. Among the demographic characteristics, being a woman of color had a negative relationship to overall sense of belonging. This factor was significant in all seven blocks, suggesting that even as aspects of the college environment are taken into account, being a woman of color has a strong negative relationship with overall sense of belonging. This supports the ANOVA results indicating that women of color reported a less strong overall sense of belonging than White/Caucasian women. Not surprisingly, the sense of belonging pre-test was a significant predictor of overall sense of belonging.

The extent to which participants socialized with friends from home had a significant negative relationship to overall sense of belonging. Weidman's (1989) theory acknowledged that ties to family and home community (a non-college reference group) are especially important to many students of color. For the women in the study it may be that these connections with their peers from home precluded a sense of belonging on campus, or conversely, connections with friends from home were strengthened because they experienced a less strong sense of belonging on campus.

Socializing with friends from home became a significant predictor when the measures of campus racial climate perceptions were entered into the regression, providing evidence of a suppressor effect. The correlation between socializing with friends from home and perception of a positive campus racial climate was positive (r = .050, $p < .05$). Thus, women in STEM who socialized with their friends from home perceived a positive campus racial climate. Perhaps they did not spend enough time on campus to observe interactions that would suggest that the campus racial climate was anything other than positive. Analysis of the item "socialize with friends from home" indicated that the women in this sample spent quite a bit of time with their friends from home, which related to their perceptions of a positive campus racial climate, but had a negative relationship to their overall sense of belonging. Women of color from Sosnowski's (2002) study indicated that the demanding nature of STEM majors left them little time to establish close friendships with other students, even other women. For the women in the current study who were mostly first-year students, the process of developing friendships may have taken longer; therefore, they may have relied more heavily upon their social networks from home, which inhibited their overall sense of belonging to their campus community.

There were several pre-college factors that did not have a significant relationship to overall sense of belonging. Father's and mother's educational levels were not significant predictors of overall sense of belonging. This finding is consistent with Gilliard (1996), and suggests that this aspect of Weidman's (1989) notion of parental socialization is not related to overall sense of belonging. Past academic performances, as indicated by self-reported average grades in high school and SAT combined score, and

confidence in math ability were also not significant predictors of overall sense of belonging.

Academic self-confidence. Academic self-confidence, which served as both an input and environment measure, or a bridge measure (Astin, 1991), had a significant relationship to overall sense of belonging from the point of entry in the second block. Academic self-confidence represents an aspect of the informal academic context in the Weidman model, who used Snyder's term "the hidden curriculum" (as cited in Weidman, 1989, p. 307) to characterize the unwritten rules of academic performance, behavior, and expectations, which have a socializing influence on students. The items included in the measure of academic self-confidence relate to aspects of the hidden curriculum because it includes ratings of confidence in the ability to do research, solve problems, work independently, use a computer, and use the library. The significant relationship of academic self-confidence to overall sense of belonging also supports Steele's (1997) notion that students who are able to perform an academic task confidently (that is, without the presence of stereotype threat) are better able to perform in and identify with their academic domain. It is notable that the measures of women's self-reported high school performance (high school grade average and standardized test scores) did not significantly contribute to their overall sense of belonging, but their academic self-confidence was a significant contributor. Thus, it may be that perceptions of one's academic ability may be more potent to overall sense of belonging than evidence of prior academic performance.

Institutional classification. Institutional Carnegie classification, representing the formal academic context (Weidman, 1989) and a between-institution measure (Astin,

1991), had no significant relationship to overall sense of belonging. It could be the similarity among the institutional classifications represented in the sample (25 were research universities) precluded any variation among the sample on this measure. The distal nature of this variable to students' campus experiences (Astin, 1991) may prohibit institutional type from having a significant relationship to sense of belonging.

Academic class year. Academic class year, representing an aspect of Weidman's (1989) formal academic context and a within-institution measure (Astin, 1991), had a significant negative relationship to overall sense of belonging upon entry into the regression analysis in block four. The majority of the sample (60.7%) were in their first-year of college when they completed the survey; thus, it appears that upper-level women in this sample expressed a less strong overall sense of belonging. This is not consistent with Mandell et al., (1992) who found that upper division students reported a greater sense of belonging to their academic department. First-year women expressed a stronger sense of belonging because they may have been optimistic about their experiences and had the expectation that they would feel as if they belonged to their campus. Although the first-year women in STEM were in academically demanding majors, they may have had more time to participate in activities that would facilitate their connection to the larger campus community, whereas upper-level women in STEM may have had less time for such pursuits because of greater academic demands placed on them, and thus reported a less strong overall sense of belonging.

Faculty interactions. Course-related interactions and faculty mentoring, measures of the informal academic context, had no significant relationship to overall sense of belonging. These findings were unexpected. Among the research examining students of

color and sense of belonging, several identified faculty interactions as a significant factor (Gilliard, 1996; Hurtado & Carter, 1997; Nora & Cabrera, 1996; Reid & Radhakrishan, 2003). Findings from qualitative research on women in STEM indicated that faculty interactions, although negative, had a relationship to their sense of belonging in these majors (Seymour & Hewitt, 1997). The Cronbach alpha coefficient for faculty mentoring for the sample of women in STEM was .665, compared to the Cronbach alpha for the overall 2004 NSLLP sample that was .746 (see Appendix C). It may be that the items in this measure describing faculty mentoring (working on an independent project or research, discussing personal problems, visiting informally, attending cultural events, or discussing career plans with an instructor) did not adequately capture the types of interactions the women in STEM from this sample had with their professors.

The measures of faculty interactions also represented aspects of the socialization process of the Weidman (1989) model, suggesting that among this sample, the socializing influence of faculty was not related to overall sense of belonging. Weidman noted that faculty become more important in the socialization process as students progress through college. Given that the sample for the current study consisted largely of women in their first year of college, it appears that faculty had not yet become an important socializing force in their overall sense of belonging. Examination of the means and standard deviations indicated that the women in the current study had few course-related faculty interactions (M = 8.52, SD = 2.50, response scale from 4 -16, with high values indicating greater frequency of interaction) and faculty mentoring experiences (M = 7.75, SD = 2.25, response scale from 6 -21, with high values indicating greater frequency of mentoring experiences). Seymour and Hewitt (1997) reported that few women in their

study had direct contact with faculty in their first two years of college. In addition, given that research universities are heavily represented in the current study, this sample of women were very likely in large introductory courses, which often hinder student-faculty interactions (The Boyer Commission, 1998).

The residence hall climate. The formal social context of the Weidman model was represented by the type of LL program. Both types of STEM-related LL programs had significant negative relationships with overall sense of belonging upon entry into the regression in the fifth block. This was somewhat unexpected, as previous research suggested that participation in LL programs and learning communities had either a positive significant relationship (Hoffman et al., 2003; Inkelas & Associates, 2004) or no significant relationship (D. R. Johnson et al., 2007; Inkelas et al., 2005) to sense of belonging.

Because the current study used a measure of overall sense of belonging, the findings may suggest that STEM LL programs, coupled with the demanding nature of STEM disciplines, may inadvertently isolate women from the larger campus community. Perhaps the women in this study who participated in STEM LL programs did not identify with these programs in some ways. Seymour and Hewitt (1997) found that some of the women in their study felt that participating in special programs to support women in STEM made it difficult to gain credibility among their male peers. Participation in such programs may be seen by some women students as calling more attention to the gender disparity in STEM, making them stand out even more. In addition, the predominantly White enrollments of these programs may have not facilitated an overall sense of belonging to the larger campus community for women of color.

The informal social context of Weidman's (1989) model was represented as students' perceptions of the climate in the residence hall as being academically and socially supportive. These variables were the most potent in the model upon entry into the regression in block five and had positive significant relationships with overall sense of belonging. Weidman noted the effects of the social climate in the residence halls on college outcomes, and research has positively linked the residence hall climate with sense of belonging (see Berger, 1997; D. R. Johnson et al., 2007). Based on these results, it appears that the residence hall climate is instrumental to the overall sense of belonging of women in STEM.

As an important context of the college experience, perceptions of an academically supportive residence hall climate can serve to reinforce women's interest in STEM fields. This measure of the climate was based on perceptions that others in their residence hall valued academic achievement and success, that it was easy to form study groups and find study spaces, and that residents spent a great deal of time studying. Not only is this type of climate conducive to the academic demands of STEM disciplines, it also helps women in STEM advance toward their academic goals and reinforces their career choices.

The socially supportive nature of the residence hall climate may be especially important for women of color in STEM. The items that comprised this measure of the residence hall included perceptions that residents appreciate differences related to race/ethnicity, religion, and sexual orientation, and residents help and support each other. These aspects of the climate may buffer the isolation women of color experience in their STEM major (A. Johnson, 2001; Ong, 2005; Sosnowski, 2002).The measure of the social climate in the residence hall also relates to students' academic lives, including

perceptions of the availability of peer academic support and whether the environment is intellectually stimulating. These aspects of the residence hall climate can serve to reinforce the career choices of women in STEM by providing an environment that supports their academic lives, and connect them to a peer group who share academic interests and understand the challenges of being women in traditionally male fields.

Given that the climate in the residence hall is an integral aspect of LL programs, it is curious that STEM-related LL program participation and perceptions of the residence hall climates had opposite relationships with overall sense of belonging. It may be that the women in the current study distinguish their STEM LL program from their residence hall experiences. It is plausible that the women in the current study viewed their STEM LL program as an academic experience that was distinct from the social context of the residence hall. In examining the organizational characteristics of the different LL programs in the NSLLP, in comparison to other types of LL programs, directors of women-only STEM LL programs were more likely to come from academic departments and co-ed STEM LL programs were more likely to have faculty involvement (Inkelas et al., 2005). Considering the research that suggests students' sense of belonging is derived in large part from the social aspects of college, including their residence hall experiences (Berger, 1997; Hurtado & Ponjuan, 2005; D. R. Johnson et al., 2007; Mandell et al., 1992), it is tenable that aspects of students' academic experiences could be negatively related to sense of belonging, particularly among first-year students.

Given that many of the women in the current study were in their first year of college, the residence hall climate may be critical to their overall sense of belonging because it constitutes one of their first reference or membership groups. In considering

Weidman's (1989) undergraduate socialization process, there may a temporal aspect associated with the salience of the residence hall climate for the women in this study. Weidman suggested that the relative importance of different settings within the college environment shifts during the course of students' undergraduate careers. Upcraft (1989) theorized that residence halls are particularly important to first-year students who are especially open to the influence of their peers as they develop independence, establish identity, and explore values, goals, and aspirations. Therefore, students living together in residence halls represent additional socializing agents in the college environment (Weidman) with profound influences over students' campus experiences. For example, Berger (1997) concluded that students' residence hall experiences helped to foster a sense of connection to the larger campus community, as evidenced in students' persistence decisions.

Interactions with peers. The measures of peer interactions as indicated by peer discussions of academic/social issues and socio-cultural issues were not significant predictors of overall sense of belonging. Prior research presents conflicting findings about the relationship of peer interactions with sense of belonging. Hurtado and Carter (1997) found that discussing course content with peers was positively related to sense of belonging for Latino students; however, Nora and Cabrera (1996) found that peer interactions were not significantly related to sense of belonging for students of color. It is not the case that the women in the current study were not having these types of peer interactions. Descriptive analyses indicated that the women in the current study were discussing academic or career issues with their peers (M = 14.70, SD = 4.28, minimum value = 6 and maximum value = 24), and discussing socio-cultural issues (M = 13.22, SD

= 2.23, and minimum value = 4 and maximum value = 16). In addition, prior to entry in block six, the measures of peer interactions would have been significant until the residence hall climate measures were entered into the model in block five (see Table 10). It appears that these types of peer interactions, in and of themselves, were important contributors to overall sense of belonging. However, the residence hall climate was powerful enough to overtake any relationship these peer interactions had with overall sense of belonging, suggesting the more proximal nature of the residence hall climate than even peer interactions to the experiences of women in STEM majors.

The campus racial climate. In the final block of the regression analysis, the two measures of campus racial climate perceptions had different relationships from each other to overall sense of belonging. Interactions with diverse peers had no significant relationship with overall sense of belonging. This contrasts with D. R. Johnson et al. (2007) who found (using a sub-sample of the 2004 NSLLP) that positive interactions with diverse peers was related to Hispanic/Latino first-year students' sense of belonging and with Velásquez (1999), who found that interactions with White students was positively related to Chicano students' sense of belonging. If STEM LL programs, and by extension, STEM majors, are predominantly White, there are fewer opportunities for White/Caucasian women to have cross-racial interactions. Therefore, these types of interactions may not contribute to their overall sense of belonging because they happen so infrequently. For women of color, it may be that the majority of their cross-race interactions are happening with White students, from whom they may not derive a sense of belonging (except perhaps for Latina women).

The other measure of the campus racial climate, perceptions of a positive campus racial climate, was significantly related to overall sense of belonging. This finding is consistent with the findings from Gilliard (1996), Hurtado and Carter (1997), D. R. Johnson et al. (2007), Nora and Cabrera (1996), and Reid and Radhakrishnan (2003). Although the measures entered into this block explained just 2.5% of the variance in overall sense of belonging, the magnitude of the beta coefficient indicated the importance of perception of a positive campus racial climate to overall sense of belonging. The broader campus racial climate may become critical to the experiences of women of color in STEM because of the lack of racial/ethnic diversity they encounter in their majors. Prior research indicates that women of color reported encounters with negative racial stereotypes and racist attitudes from their peers and faculty in STEM majors, and often experienced isolation from their racial/ethnic peers (A. Johnson, 2001; Ong, 2005; Sosnowski, 2002). As women of color in college negotiate multiple aspects of their identities (Jones & McEwen, 2000), it is likely that their racial and ethnic identities are salient for them, especially at predominantly White institutions (Jackson, 1998; Martínez Alemán, 2000). Thus, perceptions of the racial climate and the extent to which women of color feel welcomed and affirmed on campus are very important at this critical time in their identity development process (Torres, Howard-Hamilton, & Cooper, 2003).

The beta coefficients of the variables excluded from the regression model at various blocks offer more information as to how measures of campus racial climate perceptions interacted with other campus environments and related to students' overall sense of belonging (see Table 10). Prior to block four when the residence hall climate measures were entered into the model, positive interactions with diverse peers would

have been a significant contributor to overall sense of belonging had it entered the regression analysis. In addition, perceptions of a positive campus racial climate would have been a very powerful significant contributor to overall sense of belonging had it been included in the regression prior to the entry of the residence hall measures. However, once the residence hall environment is accounted for, positive interactions with diverse peers lost significance, while perceptions of a positive campus racial climate remained significant, but lost a great deal of power. This suggests that despite a supportive climate in the residence halls, which is a proximal aspect of students' college experiences, perceptions of the campus racial climate remain important to overall sense of belonging and may constitute a proximal environment for students of color.

The Process of Undergraduate Socialization

According to Weidman's (1989) model, the academic and social contexts of the college environment set the stage for the socialization of undergraduates. This socialization occurs through the quantity and quality of relationships students have with peers and faculty. Weidman identified three aspects of the socialization process as (a) interpersonal interactions, (b) intrapersonal processes, and (c) integration. Interpersonal interactions that are greater in frequency and intensity are presumed by Weidman as having a socializing influence. Weidman noted the importance of interactions with faculty, especially informal interactions outside of the classroom, in this aspect of the socialization process because such interactions are posited as some of the long-lasting effects of the college experience.

In the current study, the variables representing interpersonal interactions were course-related interactions with faculty, faculty mentoring, peer discussions of

academic/career and socio-cultural issues, and positive interactions with diverse peers. In the final regression model, these kinds of interpersonal interactions did not have any significant relationships to the overall sense of belonging for women in STEM majors. While inconsistent with prior research on sense of belonging (see Gilliard, 1996; Hurtado & Carter, 1997; D. R. Johnson et al., 2007; Velásquez, 1999), these findings suggest that peer and faculty interactions may operate differently within the STEM context. The literature on women's experiences in STEM indicated that the competitive nature of the environment strained their interactions with peers and faculty (see A. Johnson, 2001; Ong, 2005; Seymour & Hewitt; 1997; Sosnowski, 2002). Women had difficult interactions with their male peers, while women of color felt isolated from White students, including White women (A. Johnson). Women, including women of color, also reported difficult and tense relationships with faculty and felt faculty questioned their right to be in science (A. Johnson; Seymour & Hewitt; Sosnowski).

The results from the current study suggest that peer and faculty interactions appeared to neither inhibit nor facilitate overall sense of belonging among women in STEM majors. Such findings give evidence to the notion of the null environment, as described by Betz (2006). The null environment is one in which women in male dominated arenas are ignored rather than overtly discriminated against; they are neither discouraged nor encouraged in their career pursuits. The lack of active encouragement and engagement of women in STEM majors by faculty serves as yet another signal that women do not belong in these fields, and inhibits retention and success in male dominated areas (Betz). For college women in STEM, the lack of interactions with their faculty can eventually accrue into what Fassinger and Asay (2006) described as micro-

inequities – small biases that appear to be minor, isolated infractions, but ultimately accumulate to disadvantage women (relative to men) in their career development and mobility. Given that the sample for the current study contained a large percentage of first-year women, it appears that the conditions facilitating the null environment and the accumulation of micro-inequities may begin in the earliest and most critical stages of women's undergraduate STEM careers.

A second aspect of the socialization process, intrapersonal processes, is defined as an individual student's subjective assessment of the college experience (Weidman, 1989). In the current study, intrapersonal processes are represented by the measures of academic self-confidence, perceptions of academically and socially supportive climates in the residence hall, and perceptions of a positive campus racial climate. The findings from the final block of the hierarchical multiple regression model suggest that the intrapersonal aspects of the socialization process are the most powerful as it relates to the overall sense of belonging among women in STEM majors.

The intrapersonal processes appear to be salient to the outcome of overall sense of belonging for women in STEM majors. Sense of belonging is an individual's assessment of her self in relation to others, which produces an affective response related to feelings of identification and affiliation with a larger campus community (Hurtado & Carter, 1997). Given the psycho-social nature of sense of belonging, it is plausible that subjective assessments about the college environment (e.g., perceptions of the climate in the residence halls and of a positive campus racial climate) would play an important role as students determine whether the college environment affirms and supports them. In addition, academic self-confidence is important for women in STEM majors because

knowing they can compete in an academically demanding major may facilitate feelings of fitting in, reaffirm their "right" to be in these majors, and reinforce their career choices. For women of color in traditionally male fields at predominantly White institutions, these intrapersonal processes may have an even greater socializing influence given their gender and racial/ethnic minority statuses.

The final aspect of the socialization process identified by Weidman (1989) included integration, which occurs when students experience a sense of cohesion among other members of their peer group and faculty. In the current study, integration is represented by participation in one of the LL program types (women-only STEM, Co-ed STEM, or other type of LL program). Both of the STEM LL programs had negative relationships to overall sense of belonging. These findings may suggest that LL programs may not serve as a social integration function for women in STEM, perhaps because these women may be isolated from the larger campus community. These programs may make it especially difficult for some women of color to experience social integration because of the lack of racial/ethnic diversity among STEM LL program participants and the potential isolation from their racial/ethnic peer group in the larger, predominantly White campus community. It may also be the case that women in STEM LL programs perceive themselves as being different from most other students because of their academically demanding courses, and their LL program provides an environment of like-minded students among whom there is comfort and acceptance, thus they respond negatively to questions about their sense of belonging to the larger campus community.

Utility of Weidman's model. Seymour (1999) suggested that socialization processes are important lenses for explaining and understanding the experiences of

women in STEM majors. In this light, Weidman's (1989) model for undergraduate socialization was appropriate for use in the current study by calling attention to specific aspects of the college environment that relate to the extent to which women from different racial/ethnic groups felt an overall sense of belonging. A socialization framework allows for the consideration of how specific socialization contexts and processes facilitated or inhibited the overall sense of belonging of members of non-dominant groups in predominantly White and male environments.

The use of a socialization framework also draws attention to institutional forces, rather than individual student shortcomings, for considering the experiences of women from different racial/ethnic groups in STEM majors. Such a focus can take into account the power dynamics that exist in the social relations of majority and minority group members. It appears that key aspects related to the overall sense of belonging among women in STEM relate to various intrapersonal and integrative processes, rather than interpersonal interactions with peers and faculty. Use of this framework highlights that what may be more important in students' social relations are the perceptions of these interactions rather than their frequency, especially when such interactions occur between members of dominant and non-dominant groups.

Lastly, Weidman (1989) accounts for the influential role of people outside of the collegiate environment (non-college reference groups), whether family, friends, or community members, on students' experiences. The literature on women in STEM point to the influence of parents, teachers, and other pre-college associates on women's decisions to pursue these career fields (Huang et al., 2000; A. Johnson, 2001; Leslie at al., 1998; Seymour & Hewitt, 1997; Sosnowski, 2002). These non-college reference

groups are also important to the college experiences of students of color in general (Rendón et al., 2000; Tierney, 1992), and under-represented students in STEM (S. W. Brown, 2002; Russell & Atwater, 2005). Other college impact theories either do not include such groups as an integral part of the analysis (e.g., Astin, 1991) or suggest such ties are inherently harmful to students' college experiences without interrogating why these relationships exist and the function they serve in the lives of students (e.g., Tinto, 1993). The findings from this study indicated that socializing with friends from home was significantly related to overall sense of belonging for women in STEM majors; however, further research is needed to understand why women in STEM may be spending much time with their friends from home rather than connecting with their peers on campus.

Significance of the Campus Racial Climate to Sense of Belonging

The fourth research question addresses the relationship between measures of campus racial climate perceptions and overall sense of belonging, after controlling for significant predictors from the regression analysis. Because the measure of positive interactions with diverse peers was not a significant predictor in the regression model, partial correlation analysis was done only using the measure of perceptions of a positive campus racial climate. A comparison of the zero-order and partial correlation coefficients indicates that the relationship between perceptions of a positive campus racial climate and overall sense of belonging remained small but significant. Thus, for women in STEM majors, even after controlling for important aspects of the college environment, such as the residence hall climate, perceptions of a positive campus racial climate continue to play a role in their overall sense of belonging.

Differences among women of color. Sample size limitations prevented regression analyses by racial/ethnic group. However, using the significant predictors from the regression model, partial correlations were conducted among women from different racial/ethnic groups, offering further insight into the relationship between perceptions of a positive campus racial climate and overall sense of belonging. Partial correlation analyses for Black/African American and Multiracial/Multiethnic women indicated a significant moderate relationship between perceptions of a positive campus racial climate and overall sense of belonging. For Asian Pacific American and White/Caucasian women, the partial correlation analysis indicated a small but significant relationship between perceptions of a positive campus racial climate and overall sense of belonging. Among Latinas, there was not a significant partial correlation between perceptions of a positive campus racial climate and sense of belonging. Taken together, these findings support other research that suggests students from different racial/ethnic groups experience the campus racial climate differently (see Ancis et al., 2000; Cabrera et al., 1999; Hurtado, 1992; Reid & Radhakrishnan, 2003).

Findings from the ANOVA and partial correlation analysis suggested that the campus racial climate was quite important for Black/African American women in STEM. The salience of campus racial climate perceptions to the overall sense of belonging of Black/African American women can be understood from both psychological and sociological perspectives. Psychologically, African American women often experience or perceive a devaluation of who they are, while in comparison, White women are idealized and highly valued by the larger U.S. society (Greene, 1994). Such valuation operates on both individual and institutional levels. The Black/African American women in this study

were in majors where White/Caucasian women as the dominant racial group may have received preferred status as White women. Such status differential may have heightened Black/African American women's perceptions of the campus racial climate and contributed to the extent to which they experienced an overall sense of belonging.

Another way of understanding the salience of the campus racial climate for Black/African American women is through Collins' (1986) concept of an "outsider within." As outsiders within mainstream environments, Black women are not permitted full membership because of their race and gender status. Yet Black women's presence within these contexts allow them unique vantage points for understanding and making meaning of their environments. They are noticeable as Black women, yet remain invisible to others because they are not seen as fully belonging to the group. From this perspective, Black/African American women's status may give them unique insight into the campus racial climate, resulting in a less favorable assessment of both the climate and their place within the institution.

Results from the partial correlation analysis indicated that perception of a positive campus racial climate was also important to overall sense of belonging for Multiracial/Multiethnic women. Root (1994; 1996) described the racism that some Multiracial/Multiethnic women experience may relate, in part, to the difficulty others have in identifying their race or ethnicity, resulting in curious interactions with others who want to know "what are you?" and "where are you from?" Multiracial/Multiethnic women may experience pressure to choose which racial/ethnic group they identify and affiliate with or to prove or justify their racial or ethnic identity (Root, 1996). As racial categories are often viewed as distinct and mutually exclusive (Root, 1994), the pressure

of fitting in to one or another racial group or the desire to construct a multiracial identity may heighten perceptions of the campus racial climate for the Multiracial/Multiethnic women in the current study. Given the way the race/ethnicity question was structured on the 2004 NSLLP, the specific racial/ethnic backgrounds of participants choosing the Multiracial/Multiethnic identity category is unknown, and is a limitation of the current study.

The ANOVA findings related to Asian Pacific American women's perceptions of a positive campus racial climate and the small correlation with overall sense of belonging were curious. The lack of significant difference in Asian Pacific American women's perceptions of the campus racial climate, as compared to other women of color, may be related to the critical mass of Asian Pacific American students and faculty in STEM, which may offer a supportive racial climate. The lack of significant difference may also relate to the construction of the measure used in this study. Among the race-related experiences of Asian Pacific American women, concerns related to stereotypes and levels of assimilation and acculturation are prominent issues (Bradshaw, 1994; Hune, 1998). Racial and gender stereotypes persist of Asian Pacific American women as exotic and passive, model minority students who excel in math and science, and foreign-born with limited English language proficiency (Hune, 1998). In addition, the extent to which Asian Pacific American women are acculturated or assimilated into the dominant White culture adds another dimension to their experiences with discrimination (Bradshaw). It may be in the case of the current study, the measure used for campus racial climate perceptions did not capture dimensions of the campus racial climate that would be salient for Asian Pacific American women. Thus, it would be erroneous to conclude that the campus racial

climate is not important to the overall sense of belonging of Asian Pacific American women.

The findings that perceptions of the campus racial climate were not salient for Latinas should be interpreted with caution. Nieves-Squires (1991) suggested that Latinas face a number of race-related obstacles that contribute to their negative experiences on campus, including pressure to conform to the dominant White culture, perceptions of limited intelligence because of English language proficiency or speaking English with an accent, and cultural barriers. Stereotypes of Latinas as hot-tempered, sexual provocateurs or as maids and servants shape their interactions with the dominant group (Cofer, 2001) and relate to how they experience the racial climate on campus. It may be that for Latinas, the measure of the campus racial climate did not include items that address their unique experiences of racism, discrimination, and prejudice. It also may be that, with 57 Latinas in the study, there may have been too few in the sample to observe differences and make generalizations about their experiences.

In the literature on the campus racial climate, few scholars have examined gender differences among students of color. It may be that given the racialized gender experiences of women of color, an important aspect of the campus racial climate has yet to be accounted for and described in the literature. St. Jean and Feagin (1998) posited that women of color encounter "gendered racism," which are experiences of racism, sexism, and the "unique combinations of the two" (p. 16) and conspires to obstruct advancement and achievement. Gendered racism is the source of the isolation and tokenism women of color experience in certain education and work environments as they cope with negative stereotypes. As an aspect of internalized oppression, gendered racism leads women of

color to question their ability, competence, and presence within various settings. Thus, for women of color in STEM educational contexts that are dominated by White men both in structure and ideology (Seymour & Hewitt, 1997), gendered racism may be a more appropriate lens through which to describe and understand their experiences.

Limitations

Data limitations. There are several limitations associated with the current study, which was a secondary analysis of data obtained from the 2004 NSLLP. These data were collected for a purpose other than examining women in STEM fields; therefore, topic areas relevant to this study (e.g., prior achievement in math and science, levels of self-efficacy) were not included in the survey design. The 2004 NSLLP did not inquire about students' academic majors, but rather asked about their school/college of enrollment. Women who indicated their enrollment as being in a STEM-related school or college, such as School of Engineering, College of Agriculture and Life Sciences, or College of Information Science and Technology, were included in the current study. However, women in STEM fields subsumed within broader schools or colleges within a university system (e.g., Biology majors in a College of Arts & Sciences) could not be included in this study due to the design limitations described above. Thus, the number of women with an actual STEM major in the 2004 NSLLP dataset cannot accurately be determined. In addition, student participation in non-residential STEM co-curricular activities designed to support women and under-represented minority students was not included in the 2004 NSLLP; therefore the current study cannot account for the contribution of these types of co-curricular involvements to the overall sense of belonging of women in STEM majors.

Prior literature has described the contribution of the gender climate to women's experiences in STEM fields (see Ehrhart & Sandler, 1987; Fassinger & Assay, 2006; Ong, 2005; Seymour & Hewitt, 1997; C. Vogt, 2003; K. E. Vogt, 2005). However the 2004 NSLLP did not include constructs related to the gender climate in the design, and limited the extent to which the intersection of race/ethnicity and gender could be explored in the current study. In addition, although the inclusion of constructs related to campus racial climate perceptions adds an important dimension to understanding the experiences of women of color in STEM, there are limitations associated with the use of these measures in the current study. The measure of the racial climate used in this study was a gauge of respondents' perceptions of the overall campus climate and not the climate within their academic major; thus these two perceptions may be very different from each other. As previously mentioned, the measures of campus racial climate perceptions do not include gendered dimensions of the racism experienced by women of color and may not fully capture their perceptions of the campus racial climate. Also, the frequency of interactions with diverse peers does not equate with positive outcomes of such interactions. It may be that respondents were frequently engaged in interactions characterized as positive, but the outcomes of such interactions were not positive (e.g., sharing meals with students from different racial/ethnic groups may be an uncomfortable experience for some students).

The information on participants' average high school grades and SAT combined or ACT composite scores collected by the 2004 NSLLP were self-reported; therefore the current study cannot guarantee the accuracy of these items. The data for the current study were cross-sectional, rather than longitudinal, so it is unknown if the women in the study

persisted in their STEM major and whether their overall sense of belonging changed during their college career. The dependent variable, overall sense of belonging, was a measure of respondents' overall sense of belonging on campus and not specifically to their academic major. Therefore it may be that women of color in STEM construct and experience their sense of belonging to the larger campus community and their academic major in different ways.

Women of color were over-represented in this sample, ranging between 44.0% and 55.0% of the respondents to the 2004 NSLLP that indicated their enrollment in a STEM-related school/college; therefore the results may not be representative of the larger population of women of color in STEM majors. Despite their over-representation, the sample sizes of Black/African American, Latina, American Indian, and Multiracial/Multiethnic women prohibited the use of hierarchical multiple regression analysis for each of these groups. The result was that all women of color were grouped together for the regression analysis. This was simply an analytic technique, and although women of color share common experiences of racial and gender oppression, the ways in which these experiences are manifested in their lives are distinct (Andersen & Collins, 2001; Comas-Díaz & Greene, 1994). In addition, the small number of American Indian women in the sample did not permit descriptive analyses of their experiences. Although American Indian women were represented in the regression analysis, the choice to exclude them from descriptive analyses was a difficult one to accept because this practice is common in education research (Lowe, 2005), and contradicts my philosophy as a multicultural educator. The exclusion of American Indian women from the descriptive analyses used in this study reinforced their marginal status and is a powerful example of

the limitation of using quantitative methods to explore the experiences of under-represented groups. Finally, the current study did not account for other aspects of students' social identities, such as sexual orientation or socioeconomic status, which adds another dimension to women's experiences in STEM majors. Thus, it is unknown how these results apply to lesbian, bisexual, and transgender women, and women from different socioeconomic statuses.

The institutions in the sample of the current study primarily consisted of research universities. Participants in the current study included traditionally aged, residential college students, the majority of whom (60.7%) were in their first year of college at the time of the survey. Therefore, results may not be entirely applicable to older women students with higher academic class standings, who attend other types of institutions and live off-campus. A limitation of the analysis of the institutions that enrolled women in STEM majors and supported STEM LL programs was that only one institutional variable – Carnegie classification – was included in the design of this study. The inclusion of other institutional characteristics (e.g., geographic location, setting, and racial/ethnic composition of the student body) in the regression model as distal environments (Astin, 1991) would have provided a richer portrait of the institutions used in this study and offered insight on the relationship between institutional features and overall sense of belonging.

Theoretical limitations. There are two important limitations associated with using the Weidman (1989) model in this study. First, post hoc application of a model to existing data runs the risk of not fully incorporating all aspects of the model into a study. For example, although the parental socialization dimension of the model was represented

by level of education, having information related to parental careers could have added another dimension in understanding the role of parents in the development of sense of belonging of women in STEM majors. Also, non-college reference groups that are influential to the experiences of women in STEM (e.g., high school teachers, mentors, and various pre-college associations) could not be accounted for in the current study.

The other limitation relates to how the dynamics of power and privilege are unnamed and unspecified in Weidman's (1989) socialization process. For example, when considering the academic and social integration aspects of the model, Weidman acknowledged that "patterns of results are somewhat different for studies of minority students than they are for studies of [W]hite students" (p. 309). However, Weidman did not fully address which students are being integrated into which systems, whether integration is an outcome desired by all students, and some of the factors that might inhibit this process.

Power relations between dominant and non-dominant groups can and should be examined as part of an analysis of a socialization process. However, Weidman (1989) did not explicitly account for power issues in the model. Thus, the onus is on the individual researcher to consider who benefits from certain undergraduate socialization processes, how being a member of a non-dominant group relates to the extent to which socialization can have a positive relationship to outcomes, and whether the system to which students are being socialized is reflective of their cultural values and norms or is completely different from their own. Tanaka (2002) argued that college impact theories do not account for dominant institutional cultures and how it shapes the experiences of students from non-dominant social groups. He called upon higher education researchers to

interrogate how their social identities construct the development of theory and the meaning made from research findings, and to intentionally consider the dynamics of power in college environments and the intersections of identities in understanding students' college experiences.

Implications for Practice

The results of the current study point to several implications for practice related to the experiences of women in undergraduate STEM majors. The focus on overall sense of belonging offers another lens through which to understand and assess the quality of women's experiences in their STEM majors and the larger institution. The large number of first-year students in the sample of the current study sheds light on aspects of the college environment that shape the initial sense of belonging of women in STEM majors. The academic and social connections students make in their first year of college are critical to their persistence decisions (Tinto, 1993; Upcraft, Gardner, & Associates, 1989). The identification of some of the factors that contribute to the initial sense of belonging of women in STEM majors provide educators with additional information on how to facilitate the persistence of women, particularly women of color, in these disciplines.

Based on the participants in STEM LL programs from this study, it appears that these programs lack compositional diversity (Milem et al., 2005) as it relates to women of color. Although a by-product of the overall under-representation of certain racial/ethnic groups in STEM, there are consequences to the apparent lack of diversity in STEM LL programs; women of color are isolated from racial/ethnic group peers and White women lack opportunities for cross-racial peer interactions. To improve the educational

experiences and learning opportunities for all, STEM LL program directors should be vigilant in their quest to diversify their programs. Housing scholarships can be offered to women in STEM from low-income families to support living on campus and encourage STEM LL program participation. STEM LL program administrators can work with residence life staff to conduct assessments to examine the experiences and perceptions of women of color, both participants and non-participants in STEM LL programs, to learn how the programs might become more appealing to women from different racial/ethnic groups. Finally, STEM LL programs can offer diversity activities such as inter-group dialogues, cultural awareness workshops on the contributions of women and people of color to science, and informal peer support groups to help promote positive interactions among women from different racial/ethnic groups and create inclusive environments.

The results from this study also suggest that STEM LL program participation and time spent socializing with friends from home may interfere with overall sense of belonging to the campus community for women in STEM majors. STEM LL program staff, while mindful of the demanding nature of students' academic pursuits, should actively encourage and support connections to the larger campus community through various kinds of co-curricular involvement that are relevant to women's academic interests and racial/ethnic identities. Such involvement is particularly important for first-year students who are in the early stages of establishing their sense of belonging to their college community (see Hoffman et al., 2003; Hurtado & Carter, 1997; D. R. Johnson et al., 2007) .

The findings of this study revealed the importance of the residence hall climate to the overall sense of belonging of women in STEM majors. The academically and socially

supportive environments accommodate the demanding nature of STEM majors, while providing social support for students who may have little time to develop these networks. In addition, the residence hall climate appears to be critical for students in the early years of their college experiences as they establish their peer group affiliations. These findings underscore the important work done by residence life staff in creating living environments that support diverse students (Hughes, 1994).

As institutions address the retention of women in STEM, the residential program should not be overlooked as an important partner in these efforts. Residence life departments can intentionally recruit and hire women students in STEM to serve as resident advisors, locate (where possible) STEM LL programs in residence halls closest to STEM classroom buildings and labs, maintain and equip computer labs in the residence halls with the most common software applications used by students in STEM majors, and enforce quite study hours and make available group study spaces. In addition, residence life staff can encourage women in STEM to become socially involved in the residence hall and collaborate with other STEM LL programs and STEM co-curricular activities to develop social and academic programs. Finally, residence life departments can encourage and support the participation of women of color in STEM LL programs by offering professional development workshops on the issues faced by women in STEM, and by hiring women of color for professional staff positions.

Academic self-confidence was identified as a strong contributor to the overall sense of belonging among women in STEM majors. Given the racial and gender stereotypes about who is capable of doing math and science, helping women develop and maintain their confidence to compete in demanding majors is a critical element to their

success in STEM (see Steele, 1997). Student and academic affairs can collaborate to create opportunities for building the academic self-confidence among women in STEM by offering academic support services, peer tutoring, and peer mentoring in the residence halls. Prior research (see A. Johnson, 2001; Ong, 2005; Seymour & Hewitt, 1997; Sosnowski, 2002) demonstrated that supportive faculty interactions are important to the confidence of women in STEM. The lack of faculty interactions evidenced in the current study should be troubling to STEM educators and inspire them to create opportunities for both formal and informal interactions with women in these majors, even in the earliest stages of their college careers. Researchers knowledgeable about the importance of faculty interactions on the experiences of women in STEM can provide faculty development opportunities to discuss the critical role of faculty in creating a STEM culture that is inviting and supportive of all under-represented students.

Despite the potency of the residence hall climate, perception of a positive campus racial climate emerged as another critical element in the overall sense of belonging among women in STEM majors. The lack of racial/ethnic diversity in STEM departments located in predominantly White institutions may elevate the salience of the campus racial climate for women of color in STEM majors. An unsupportive campus racial climate adds another layer to the difficult STEM experiences faced by women of color, many of whom also struggle with feeling as though they are welcomed and belong in these majors (A. Johnson, 2001; Ong, 2002; Sosnowski, 2002).

Although increasing the number of students of color in STEM and in predominantly White institutions is an obvious way of addressing campus climate issues, Hurtado et al. (1999) remind us that increasing the racial/ethnic diversity is simply not

enough. The experiences of women of color in STEM majors relate to their history of inclusion or exclusion, and the psychological and behavioral dimensions of interactions with faculty and peers (Hurtado et al.). STEM faculty can play a critical role in creating a positive campus racial climate by making special efforts to involve women of color at all stages of their college careers in research and other academic activities, being willing to discuss pertinent issues of race and gender in courses, learning about the unique issues women of color face in STEM, and examining and unlearning their own biases about who is capable of doing science. These suggestions require a shift in STEM culture away from a White male centered paradigm to one that is inclusive of many perspectives about who scientists are and what they do. As campus officials attend to the climate for racial diversity, there must be a focus not only on the campus climate at large, but also on the climates of the many sub-environments within the campus community, including STEM departments.

Implications for Transforming STEM Education

One purpose for incorporating a transformative perspective into the conceptual framework of this study was to consider how undergraduate STEM education can be transformed into inclusive environments for women. Increasing the representation of women, African Americans, Latinos, and American Indians in the STEM pipeline remains an important issue for many colleges and universities, as evidenced in the awarding of federal funds from agencies such as the National Science Foundation for programs related to STEM access and retention, science and math curriculum reform, STEM teacher/faculty preparation and support, and partnerships with K-12 school communities (NSF, n.d.). However, such dedicated focus may not actually translate into

better learning environments for under-represented students as the numbers of undergraduate women in STEM have remained stagnant for several years (NSF, 2004a).

Given that the culture of STEM is identified with and centered on White men (Seymour & Hewitt, 1997), change must occur by challenging and transforming the dominant ideology in STEM. Based on the results of the current study, women's interactions with faculty emerged as an area where change and transformation are needed. Faculty can improve their interactions with women students, not just in quantity, but also in quality. The women in this study reported few course-related interactions with their faculty. As a result, the respondents may not have received any needed academic support from their instructors. Faculty truly interested in improving the climate for women in STEM can learn about women's learning styles and patterns (Belenky, Clinchy, Goldberger, & Tarule, 1986) and incorporate these into their classroom and interpersonal interactions with students. As faculty interact with undergraduate women, they should be mindful that many women take feedback on their work personally, seek to have personal relationships with their professors, and want positive reinforcement of their abilities (Seymour & Hewitt; A. Johnson, 2001; Sosnowski, 2002). Developing an awareness of what women need and value in their interactions with their professors can increase the quantity and improve the quality of such interactions and create a more welcoming climate.

Another area, faculty mentoring experiences, can also be improved by including activities that appeal to women and better demonstrate their interests and talents. The measure of faculty mentoring experiences used in this study included working with a professor on research or independent projects. It may be that women reported fewer

faculty mentoring experiences because few such opportunities were extended to them, or their professor's research projects were of little interest. Women in STEM have reported positive research experiences with faculty when they were engaged with projects that related to their motivations for pursuing science careers (A. Johnson, 2001; Sosowski, 2002). Faculty mentoring experiences in the current study also included various forms of informal social interactions with students. Previous research has documented women's reports of exclusion from the informal social activities STEM faculty have with male students (A. Johnson; Ong, 2005; Seymour & Hewitt, 1997; Sosnowski). To improve women's mentoring experiences, STEM faculty can support and encourage women's research interests (even if different from their own), make the extra effort to include women in informal social activities and genuinely welcome their involvement, engage in activities that might appeal to women, such as community service, and participate in STEM professional associations targeted at women and students of color to better understand these groups' involvement in STEM fields.

It is tempting to focus the direction of change on individual women in STEM by helping them adapt to the existing STEM culture as a way to succeed in an academic system in which they are not privileged members. Indeed, proponents of integration as the path to the successful retention of college students (e.g., Tinto, 1993) might agree with this tactic. However, to achieve lasting effects, change must be directed toward the institutional structures and dominant cultures that perpetuate women's under-representation in STEM fields. As higher education institutions continue to enroll students that are diverse in race, ethnicity, gender, language, sexual identity, ability status, and social class (El-Khawas, 2003), research on STEM educational experiences

and outcomes can use college impact theories to identify the structures that privilege some students in STEM, and incorporate a transformative perspective to dismantle and transform these structures so that all students can fully participate in STEM fields.

Future Directions for Research

The process of completing the current study, as well as its findings, offer new directions for research on the under-representation of women in STEM fields. Little of the current research on women in STEM accounts for race/ethnicity as a contributing factor to women's experiences. Scholars cannot think of women as a monolithic group, but rather recognize and understand that women's experiences in STEM are not shaped solely by their gender, but by their race, ethnicity, class, sexual orientation, and other dimensions of difference. Researchers should also interrogate how aspects of power and privilege, such as Whiteness and maleness, as well as different forms of oppression, operate together to construct the experiences of women in STEM from all racial and ethnic backgrounds. Such examinations are enhanced by, but not limited to, racially and ethnically diverse samples. Certainly, every possible effort must be made to involve women from diverse backgrounds; however, the lack of such diversity does not prohibit an analysis of the dynamics of power, privilege, and oppression in STEM fields.

Additional research is needed on how women in STEM experience sense of belonging, both to the overall campus and STEM communities. Further study would require directly querying the specific major to examine differences among STEM disciplines. For example, it may be that the sense of belonging differs for women enrolled in STEM majors with more women (e.g., biology) than in STEM majors with fewer women (e.g., computer science or physics). Longitudinal research can uncover how sense

of belonging develops over time and whether sense of belonging outcomes relate to persistence in STEM at the point of graduation and beyond. Further research could draw upon the work of Hoffman et al. (2003) who identified several dimensions of sense of belonging, including perceived support from faculty and peers, and the classroom environment.

Using qualitative research methods, future research can examine whether the findings from the current study are generalizable to local populations of undergraduate women in STEM majors at research universities. In addition, data collection methods such as in-depth interviews or focus groups can uncover the unique and similar ways women from different racial and ethnic groups construct their sense of belonging both to their campus community and STEM major, and what aspects of their campus experiences, and personal and social identities contribute to or inhibit their sense of belonging in predominantly White and male environments. A qualitative focus allows for the intersection of identities (e.g., race, gender, sexual orientation) to be explored, for women to connect with each other (via focus groups) to share their experiences and form support networks, and for discussions about how women from all racial/ethnic groups would transform STEM into more welcoming and supportive environments.

Further research on the concept of racial climate is needed in two areas. First, the racial climate in STEM departments ought to be examined directly. The current study was an initial examination of how women in STEM majors from different racial/ethnic groups experienced the campus racial climate, namely through interactions with diverse peers and perception of a positive campus racial climate. As a result, the extent to which these interactions and perceptions are descriptive of the experiences women have in their

STEM departments with faculty and peers is unknown. Second, measures of the racial climate, whether about the general campus or in STEM, should include items that pertain to racialized gender stereotypes and other forms of "gendered racism" (St. Jean & Feagin, 1998) experienced by women of color. Such a focus could identify the unique ways women of color experience the racial climate.

The conceptual framework for the current study explained 29% of the variance in overall sense of belonging among women in STEM majors, leaving 71% of the variance unaccounted for by the model. Future studies may include constructs related to STEM co-curricular activities, various social identity developmental processes, and self-efficacy to further understand sense of belonging among women in STEM. For example, prior research indicates that participation in STEM co-curricular activities that support women in STEM, (e.g., women in science and engineering (WISE) programs) (Hyde & Gess-Newsome, 2000), or under-represented students of color (e.g., minority engineering programs) (Grandy, 1998; Johnson, A., 2001; Sosnowski, 2002) is beneficial to students' STEM experiences by providing peer support, resources, mentors, access to faculty, and academic support. In addition, involvement in engineering professional societies such as Society of Women Engineers (SWE), National Society of Black Engineers (NSBE), Society of Hispanic Professional Engineers (SHPE), or American Indian Science and Engineering Society (AISES), can offer participants meaningful opportunities to connect with same gender or race/ethnic peers, develop leadership skills, engage with a larger community of STEM professionals, learn more about their intended professions, and connect with mentors interested in supporting under-represented students in STEM. Involvement in these types of campus activities may represent another dimension of

students' proximal environment that contribute to their sense of belonging (Hurtado & Carter, 1997).

The college years are a time when many students find themselves developing and negotiating various aspects of their social identities (e.g., race/ethnicity, sexual orientation, gender, social class, or disability) (McEwen, 2003). There is a dynamic interplay between where students are in this developmental process and the extent to which the campus environment challenges and supports their social identities (Torres et al., 2003). It may be that the extent to which students experience a sense of belonging to their campus community relates to where they are in their various social identity development processes. Students in the early stages of developing their racial/ethnic, gender, or sexual identities in which the respective dominant group is valued and emulated (McEwen) may experience a sense of belonging, while students in the developmental stages that devalue the dominant group and affirms one's own (McEwen) may experience less sense of belonging because the campus offers little in the way of support for these social identities. Given that STEM is dominated by cultures of Whiteness and maleness (Seymour & Hewitt, 1997), investigating how social identity development contributes to sense of belonging can help educators further understand under-represented students' experiences in STEM.

Finally, levels of self-efficacy among women in STEM has been studied in relation to major choice (Betz & Hackett, 1983; Hackett, 1983; Zeldin & Parajes, 2000) and academic achievement (Hackett et al., 1992; C. Vogt, 2003; K. E. Vogt, 2005). It may be that self-efficacy, defined as an individual's belief in their capacity to perform difficult tasks (Bandura, 1994), has a relationship to sense of belonging among women in

STEM because the extent to which they believe in their ability to successfully complete the academic tasks required of STEM majors may relate to their feelings of belonging in their major. Self-efficacy may also help to understand how women of color navigate some of the social challenges that may come with attending a predominantly White institution and experiencing membership in the campus community.

The future directions for research discussed here warrant the inclusion of critical research perspectives (e.g., feminist, critical race, and critical race feminist theories) and use of an interdisciplinary approach (i.e., using sociological, educational, and psychological theories) (Pascarella & Terenzini, 2005) to the scholarship on women in STEM fields. Such theoretical combinations make it possible to analyze academic domains that are centered on and identified with Whiteness and maleness, and examine how women's perceptions and understanding of themselves relate to their experiences in STEM. Using the tools of critical perspectives and interdisciplinary models, educators can deconstruct the dominant cultures within STEM, and begin to transform STEM environments into places where all talent is nurtured, all identities are affirmed, all perspectives are valued, and all students from all racial and ethnic backgrounds experience a sense of belonging.

Chapter Summary

The current study examined the relationship between perceptions of the campus racial climate and other key aspects of the college environment to the overall sense of belonging among undergraduate women of color in STEM majors. The conceptual framework developed for this study used Weidman's (1989) model of undergraduate socialization along with Astin's (1991) input-environment-outcome model. A

transformative perspective (Mertens, 2005) served as the backdrop for considering racial/ethnic group differences among the women in the sample and contextualizing the findings from this study within the dominant cultures of Whiteness and maleness that characterize STEM domains.

Results revealed significant differences by racial/ethnic group on the major constructs of this study; women of color reported a less strong overall sense of belonging and greater interactions with peers from different racial/ethnic groups than White/Caucasian women, and Black/African American women perceived a less positive campus racial climate than women from the other racial/ethnic groups. The conceptual framework developed for this study explained 29% of the variance in overall sense of belonging among undergraduate women in STEM majors. Several factors significantly contributed to overall sense of belonging, including race/ethnicity, perceptions of academically and socially supportive climates in the residence hall, perceptions of a positive campus racial climate, academic self-confidence, academic class year, socializing with friends from home, and participation in a STEM-related living-learning program. The inclusion of women of color and the campus racial climate constructs in this study created an opportunity to increase educators' knowledge of the race-related challenges faced by undergraduate women in STEM majors, and to continue efforts of building supportive environments that encourage the full participation of women of color in these fields.

Appendix A: Institutions in the Study

Name	Carnegie Classification	N in sample	N of women of color	N in women-only STEM programs	N in co-ed STEM programs	N in other type of LL programs	N in no type of LL program
Arizona State University	Research Extensive University	32	9	0	14	9	9
Bowling Green State University	Research Intensive University	9	4	0	0	0	9
University of Central Arkansas	Master's College/University	22	2	0	0	21	1
Central Washington University	Master's College/University	41	6	0	8	6	27
Clemson University	Research Extensive University	97	23	0	0	26	71
Colorado State University	Research Extensive University	135	11	0	6	59	70
Florida State University	Research Extensive University	9	1	4	0	2	3
Indiana University	Research Extensive University	1	0	0	0	1	0
Louisiana State University	Research Extensive University	100	29	0	3	21	76
North Carolina State University	Research Extensive University	77	7	13	0	30	34
Northeastern University	Research Extensive University	21	2	10	6	2	3
Northern Illinois University	Research Extensive University	3	0	0	1	0	2
Pennsylvania State University	Research Extensive University	214	34	14	57	66	77
Purdue University	Research Extensive University	75	11	32	15	9	19
San Jose State University	Master's College/University	2	1	0	0	1	1
Southern Illinois University	Research Extensive University	17	3	0	0	0	17
Syracuse University	Research Extensive University	12	6	3	0	0	9
University of California, Irvine	Research Extensive University	308	227	0	0	107	201
University of Florida	Research Extensive University	24	1	0	0	13	11
University of Illinois, Urbana-Champaign	Research Extensive University	41	15	19	0	9	13
University of Maryland, College Park	Research Extensive University	225	75	0	0	107	118
University of Michigan	Research Extensive University	3	1	0	0	1	2

Appendix A (continued)

Name	Carnegie Classification	N in sample	N of Women of color	N in women-only STEM programs	N in co-ed STEM programs	N in other type of LL programs	N in no type of LL program
University of Missouri	Research Extensive University	37	5	0	9	12	16
University of Northern Iowa	Master's College/University	38	4	0	0	11	27
University of South Carolina	Research Extensive University	15	4	0	0	0	15
University of Tennessee, Knoxville	Research Extensive University	5	0	0	1	1	3
University of Vermont	Research Extensive University	55	2	0	0	39	16
University of Wisconsin	Research Extensive University	95	13	25	0	24	46
Western Kentucky University	Master's College/University	9	0	0	0	1	8

Appendix B: Variables in the Study

Variable Name	*M*	*SD*	Coding
Student background characteristics			
Race/ethnicity	4.18	1.36	1 = Black/African American; 2 = Asian Pacific American; 3 = Latina; 4 = White/Caucasian; 5 = Multiracial/Multiethnic
Father's level of education	4.44	1.69	1 = Don't know; 2 = High school or less; 3 = Some college; 4 = Associates degree; 5 = Bachelors degree; 6 = Masters degree; 7 = Doctorate or professional degree
Mother's level of education	4.31	1.52	1 = Don't know; 2 = High school or less; 3 = Some college; 4 = Associates degree; 5 = Bachelors degree; 6 = Masters degree; 7 = Doctorate or professional degree
Average high school grades	1.58	0.76	1 = A+ or A; 2 = A- or B+; 3 = B; 4 = B- or C+; 5 = C or C-; 6 = D+ or lower; 7 = no high school GPA
SAT combined score	2.56	1.09	1 = 1140 or less; 2 = 1150-1250; 3 = 1260-1340; 4 = 1350 or higher
ACT composite score	2.66	1.10	1 = 1-23 or less; 2 = 24-26; 3 = 27-29; 4 = 30 or higher
Socialize with friends from home	0.59	0.49	0 = No; 1 = Yes
Sense of belonging pre-test	2.68	0.79	1 = Not at all confident; 2 = Somewhat confident; 3 = Confident; 4 = Very confident
Academic self-confidence	14.41	2.71	Scale index from 5-20, with high value indicating greater self-confidence
Confidence in math ability	2.82	0.85	1 = Not at all confident; 2 = Somewhat confident; 3 = Confident; 4 = Very confident
College/structural characteristics			
Institutional Carnegie classification	1.07	0.25	1 = Research extensive/intensive university; 2 = Master's college and university
Academic class standing	1.61	0.89	1 = First-year; 2 = Sophomore; 3 = Junior; 4 = Senior
Faculty interactions			
Course-related faculty interactions	8.52	2.50	Scale index from 4-16, with high value indicating greater faculty interaction
Faculty mentoring	7.75	2.25	Scale index from 6-24, with high value indicating greater faculty mentoring
Living-learning program participation			
Living-learning program type	3.32	0.88	1 = Women-only STEM; 2 = Co-educational STEM; 3 = Other type of LL program, non-STEM; 4 = No type of LL program

Appendix B (continued)

Variable Name	*M*	*SD*	Coding
Perceptions of the residence hall climate			
Residence hall academically supportive	16.68	3.49	Scale index from 6-24, with high value indicating greater academic support
Residence hall socially supportive	23.10	4.32	Scale index from 8-32, with high value indicating greater social support
Peer interactions			
Discussed socio-cultural issues with peers	14.70	4.28	Scale index from 6-24, with high value indicating more frequent discussions
Discussed academic/career issues with peers	13.22	2.23	Scale index from 4-16, with high value indicating more frequent discussions
Perceptions of the campus racial climate			
Positive interactions with diverse peers	20.40	6.75	Scale index from 9-36, with high value indicating greater interactions
Perceptions of positive campus racial climate	17.68	3.41	Scale index from 6-24, with high value indicating more positive perceptions
Dependent variable			
Overall sense of belonging	16.18	2.95	Scale index from 5-20, with high value indicating greater sense of belonging

Appendix C: Composite Measures in the Study

	2003 Pilot test Factor Loading	2004 NSLLP Cronbach Alpha	2007 Sample Cronbach Alpha
SELF CONFIDENCE			
Academic self-confidence		.748	.742
Research ability	.679		
Problem-solving ability	.625		
Working independently	.582		
Computer ability	.565		
Library skills	.463		
FACULTY INTERACTIONS			
Course-related faculty interactions		.767	.770
Visited informally with instructor before/after class	.692		
Made appointment to meet instructor in his/her office	.673		
Asked instructor for information related to course	.620		
Communicated with instructor via email	.591		
Faculty mentorship		.746	.665
Worked with instructor on independent project	.724		
Worked with instructor involving his/her research	.592		
Discussed personal problems or concerns with instructor	.534		
Visited informally with instructor on social occasion	.532		
Went to a cultural event with instructor or class	.531		
Discussed career plans and ambitions with instructor	.478		
PEER INTERACTIONS			
Discussed academic and career issues with peers		.737	.709
Discussed something learned in class	.743		
Shared concerns about classes and assignments	.725		
Talked about current news events	.672		
Talked about future plans and career ambitions	.497		
Discussed socio-cultural issues with peers		.864	.850
Discussed social issues such as peace, human rights, and justice	.760		
Discussions with students whose personal values different from own	.726		
Discussed views about multiculturalism and diversity	.721		
Held discussions with those with different religious beliefs	.703		
Talked about different lifestyles and customs	.702		
Discussions with students whose political opinions very different from own	.697		

Appendix C (continued)

	2003 Pilot test Factor Loading	2004 NSLLP Cronbach Alpha	2007 Sample Cronbach Alpha
RESIDENCE HALL CLIMATE			
Residence hall is academically supportive		.808	.825
Environment supports academic achievement	.706		
Most students study a lot	.612		
Most students value academic success	.555		
It's easy to form study groups	.529		
Adequate study space available	.513		
Staff helps with academics	.501		
Residence hall is socially supportive		.868	.877
Appreciate different races/ethnicities	.747		
Appreciate different religions	.705		
Help and support one another	.699		
Would recommend this residence hall	.584		
Intellectually stimulating environment	.548		
Different students interact with each other	.545		
Appreciation for different sexual orientation	.544		
Peer academic support	.481		
CAMPUS RACIAL CLIMATE			
Positive peer diversity interactions		.898	.900
Attending social events together	.857		
Sharing a meal together	.847		
Having intellectual discussions outside class	.832		
Sharing personal feelings and problems	.819		
Studying together	.766		
Discussing race relations outside class	.694		
Doing extracurricular activities together	.685		
Rooming together	.531		
Dating	.495		
Positive campus racial climate		.812	.813
Transracial student interaction	.738		
Transracial friendship	.723		
Transracial trust and respect	.674		
Campus commitment to success of students of color	.628		
Transracial dating	.585		
Professors respect students of color	.523		

Appendix C (continued)

	2003 Pilot test Factor Loading	2004 NSLLP Cronbach Alpha	2007 Sample Cronbach Alpha
SENSE OF BELONGING			
Overall sense of belonging		.898	.901
I feel a sense of belonging	.845		
I feel a member of the campus community	.826		
I feel comfortable on campus	.726		
I would choose the same college over again	.704		
My college is supportive of me	.692		

Appendix D: Correlation Matrix

Variable	SENSEBEL	RACE	FATHED	MOTHED	HSGPA	SAT	SOCIAL	PRESENSE	MATHABIL
Overall sense of belonging									
Race (Woman of color)	-.172***								
Father's level of education	.0025	-.080***							
Mother's level of education	.051*	-.142***	.546***						
Average high school grades	-.076	.134***	-.084***	-.054*					
SAT score (SAT + converted ACT score)	.037	-.159***	.268***	.210***	-.315***				
Socialize with friends from home	-.042*	.047*	-.067**	-.063**	.042*	-.073**			
Pre-test sense of belonging	.190	-.044*	.044*	.028	-.035	-.016	.031		
Math ability	.113	-.123***	.099***	.072**	-.202***	.300***	-.028	.092***	
Institutional Carnegie classification	.053*	-.104***	-.106***	-.048*	.075**	-.120***	.002	-.032	-.037
Academic self-confidence	.194***	-.083***	.087***	.068**	-.081***	.125***	-.035	.222***	.346***
Academic class standing	-.049*	.005	.026	-.018	-.042*	.114***	-.107***	-.030	.140***
Course-related faculty interactions	.113***	-.012	.019	.015	-.069**	-.049*	-.012	.090***	.074**
Faculty mentoring	.081**	-.055*	.073**	.069**	-.072**	.088***	-.034	-.034*	.056**
Women-only STEM LL program	.004	-.071**	.003	.036	-.018	.054*	-.071**	-.006	.035
Co-ed STEM LL program	.008	-.036	-.018	-.023	-.056*	-.009	-.085***	.026	.038
Other type of LL program	.042	-.058**	.145***	.089***	-.079***	.222***	-.024	-.011	.025
Residence hall academically supportive	.380***	-.024	.085***	.050*	-.076**	.119***	-.037	.079**	.060**
Residence hall socially supportive	.411***	-.044*	.075**	.048*	-.069**	.100***	-.016	.057*	.060**
Peer discussion of academic/career issues	.138***	-.079***	.074***	.093***	-.106***	.092***	-.008	.088***	.081***
Peer discussion of socio-cultural issues	.120***	-.001	.089***	.101***	-.049*	.087***	-.057*	.047*	.027
Positive interactions with diverse peers	.073**	.321***	.044*	.001	-.027	.020	-.010	.020	-.003
Positive perceptions of campus racial climate	.311***	-.045*	-.061**	-.035	-.092***	.008	.050*	.042*	.035

*p <. 05; ** p < .01; *** p < .001

Appendix D (continued)

Variable	CARNEGIE	ACADCON	CLASS	COURSEINT	FACMENT	WMSTEM	COEDSTEM	OTHERLL
Overall sense of belonging								
Race (Woman of color)								
Father's level of education								
Mother's level of education								
Average high school grades								
SAT score (SAT + converted ACT score)								
Socialize with friends from home								
Pre-test sense of belonging								
Math ability								
Institutional Carnegie classification								
Academic self-confidence	.044*							
Academic class standing	.036	.202***						
Course-related faculty interactions	.063**	.210***	.135***					
Faculty mentoring	.053*	.208***	.231***	.476***				
Women-only STEM LL program	-.072**	-.004	-.059**	-.026	-.002			
Co-ed STEM LL program	.002	.041*	-.030	.044*	.042*	-.075***		
Other type of LL program	.012	.008	.031	.043*	.105***	-.195***	-.195***	
Residence hall academically supportive	.029	.076**	-.011	.078**	.122***	.153***	.066**	.191***
Residence hall socially supportive	.005	.078**	-.031	.057*	.066**	.052*	.014	.138***
Peer discussion of academic/career issues	.035	.179***	.049*	.265***	.183***	.005	.049*	.047*
Peer discussion of socio-cultural issues	-.002	.165***	.032	.236***	.212***	-.012	.034	.088***
Positive interactions with diverse peers	-.136***	.073**	.042*	.112***	.105***	-.033	-.017	.023
Positive perceptions of campus racial climate	.017	.101***	-.061**	.054*	-.014	-.033	.016	.005

*p <. 05; ** p < .01; *** p < .001

Appendix D (continued)

Variable	RHACAD	RHSOC	PEERACAD	PEERSOC	POSDIVINT
Overall sense of belonging					
Race (Woman of color)					
Father's level of education					
Mother's level of education					
Average high school grades					
SAT score (SAT + converted ACT score)					
Socialize with friends from home					
Pre-test sense of belonging					
Math ability					
Institutional Carnegie classification					
Academic self-confidence					
Academic class standing					
Course-related faculty interactions					
Faculty mentoring					
Women-only STEM LL program					
Co-ed STEM LL program					
Other type of LL program					
Residence hall academically supportive					
Residence hall socially supportive	.710***				
Peer discussion of academic/career issues	.109***	.102***			
Peer discussion of socio-cultural issues	.131***	.145***	.569***		
Positive interactions with diverse peers	.135***	.188***	.175***	.348***	
Positive perceptions of campus racial climate	.206***	.349***	.104***	.110***	.281***

*p <. 05; ** p < .01; *** p < .001

Appendix E: Informed Consent Form and Survey Instrument

National Study of Living-Learning Programs (NSLLP)

2004 Residence Environment Survey

Please note:
Because this survey was fielded on the World Wide Web, the questions on this paper-and-pencil version of the questionnaire were altered in format to conform to the layout parameters of a Web survey. (For example, the questions that appeared on the actual Web survey did not spill over to the next column or page.) However, the content and order of the questions were the exact same as this version.

National Study of Living-Learning Programs
Informed Consent Form

The primary purpose of this study is to understand college students' perceptions of their residence environments and the impact of residence environments on students' academic and social development. This research will not help you personally. The researchers on this project believe that there are no short- or long-term effects associated with participation in this study.

Your participation in this study is voluntary, and you may skip any questions on the attached survey that you feel uncomfortable answering.

Please be assured that, to the extent permitted by law, personal information obtained for this project will remain confidential, and will not be shared with anyone not associated with this project. However, confidentiality is not absolute or perfect. There are some circumstances where the research staff might be required by law to share information that has been provided. For example, if the researchers have reason to believe that criminal or serious harm may have been done to an individual or individuals, the researchers are required by law to file a report with appropriate agencies.

For the purpose of understanding your collegiate experiences as a whole, some of your demographic records will be obtained from your registrar and merged with your responses to this survey. Any publications of the study will be based on grouped data and will not reveal your identity or your individual records.

We know how busy, and sometimes stressful, college life can be. In fact, some of the questions on the survey may trigger some personal and social emotions that you may like to discuss with someone who can assist you. In these circumstances, please call the Counseling Center at 301-314-7651, where you can schedule an appointment to visit with a counselor. For concerns about alcohol use or the effects of alcohol use on others, please call either the Counseling Center (301-314-7651) or the University Health Center Substance Abuse Program at 301-314-8128, or consult the following website: http://www.inform.umd.edu/UHC/Library/subsabuse.html.

If you have any questions about this study, please feel free to contact:

Karen Kurotsuchi Inkelas, PhD
3214 Benjamin Building
University of Maryland
College Park, MD 20742

Phone: 301-405-0682
Email: info@liveearnstudy.net

I state that I am 18 years of age or older and wish to participate in this study:

☐ Yes ☐ No

2003-04 Residential Environment Study

YOUR PERCEPTIONS BEFORE ENROLLING IN COLLEGE

1. Thinking back to *before you started college*, what activities did you *think* were going to be very important to you during college? (Circle one response for each.)

1 = Not at all important 2 = Somewhat important 3 = Important 4 = Very important

Participating in extra-curricular activities.....	1	2	3	4
Participating in volunteer or community service activities.....	1	2	3	4
Getting to know people from backgrounds different than your own	1	2	3	4
Learning about cultures different from your own.....	1	2	3	4
Discussing ideas and intellectual topics with other students.....	1	2	3	4
Getting to know your professors outside of class.....	1	2	3	4
Learning more about yourself.....	1	2	3	4
Finding your residence hall to be academically supportive.....	1	2	3	4
Finding your residence hall to be socially supportive…….....	1	2	3	4
Drinking alcohol during social occasions.....	1	2	3	4

2. Looking back to *before you started college*, how confident were you that you would be successful at the following: (Circle one response for each.)

1 = Not at all confident 2 = Somewhat confident 3 = Confident 4 = Very confident

Handling the challenge of college-level work……..…	1	2	3	4
Feeling as though you belong on campus…….	1	2	3	4
Analyzing new ideas and concepts.....	1	2	3	4
Applying something learned in class to the "real world".....	1	2	3	4
Enjoying the challenge of learning new material.....	1	2	3	4
Appreciating new and different ideas, beliefs……..	1	2	3	4
Developing your own values and beliefs……..	1	2	3	4
Gaining skills in working with others.....	1	2	3	4
Growing and developing academically.....	1	2	3	4
Making a difference in the community in which you live.....	1	2	3	4
Being satisfied with your college experience.....	1	2	3	4

YOUR EXPERIENCES IN COLLEGE

3. Using a continuum of 1 = very difficult to 6 = very easy, please indicate how you felt the following activities to be during your first year in college. (Circle one response for each.)

	Very Difficult					**Very Easy**
Amount or difficulty of coursework.....……..	1	2	3	4	5	6
Using computers for coursework.....	1	2	3	4	5	6
Seeking academic or personal help when you needed it.....	1	2	3	4	5	6
Becoming familiar with the campus.....	1	2	3	4	5	6
Learning to use e-mail.....	1	2	3	4	5	6
Making new friends.....	1	2	3	4	5	6
Managing your time effectively.....	1	2	3	4	5	6
Managing money effectively.....	1	2	3	4	5	6
Communicating with instructors outside of class.....	1	2	3	4	5	6
Being separated from your family.....	1	2	3	4	5	6
Forming study groups	1	2	3	4	5	6

3. (continued)

Getting along with your roommate(s).....	1	2	3	4	5	6
Getting to know other people in your residence hall.....	1	2	3	4	5	6

4. During the past year, how much time did you spend during a typical week doing the following activities? (Circle one response for each.)

	None	1 to 5 hrs	6 to 10 hrs	11 to 15 hrs	16 to 20 hrs	21+ hrs
Attending classes.....	1	2	3	4	5	6
Studying/doing homework.....	1	2	3	4	5	6
Socializing with friends.....	1	2	3	4	5	6
Exercising/sports.....	1	2	3	4	5	6
Partying.....	1	2	3	4	5	6
Working (for pay).....	1	2	3	4	5	6
Volunteer work.....	1	2	3	4	5	6
Student clubs/groups.....	1	2	3	4	5	6
Watching TV alone.....	1	2	3	4	5	6
E-mail or instant messaging.....	1	2	3	4	5	6
Playing video/computer games……..	1	2	3	4	5	6

5. During the past year, how involved are/were you in any of the following activities? (Circle one response for each.)

1 = Not at all involved 2 = Somewhat involved 3 = Involved 4 = Very involved

a. Fraternity/sorority.....	1	2	3	4
b. Service fraternity/sorority.....	1	2	3	4
c. Marching band.....	1	2	3	4
d. Arts/music performances & activities.....	1	2	3	4
e. Intramural or club sports.....	1	2	3	4
f. Varsity sports.....	1	2	3	4
g. Student government.....	1	2	3	4
h. Political or social activism.....	1	2	3	4
i. Religious clubs and activities.....	1	2	3	4
j. Ethnic/cross-cultural activities, clubs.....	1	2	3	4
k. Media activities (e.g., newspaper, radio).....	1	2	3	4
l. Work-study or work on-campus.....	1	2	3	4
m. Work off-campus.....	1	2	3	4
n. Armed Services ROTC.....	1	2	3	4
o. One-time community service activity.....	1	2	3	4
p. Ongoing community service activity.....	1	2	3	4
q. Other (specify: _____).....	1	2	3	4

6. Who did you primarily socialize with during the *current* school year? (Circle all that apply.)

1. People you work with
2. People in social clubs/activities
3. People you attend class with
4. People in your major or intended major
5. People in a living-learning (L/L) program
6. People in your residence hall (not in L/L program)
7. Friends from home
8. Other: _____

7. During interactions with other students outside of class, how often have you done each of the following during the *current* school year? (Circle one response for each.)

1 = Never 2 = A few times a semester 3 = A few times a month 4 = Once or more a week

Discussed something learned in class.....	1	2	3	4
Talked about current news events.....	1	2	3	4
Talked about different lifestyles/customs……...	1	2	3	4
Shared your concerns about classes and assignments……	1	2	3	4
Held discussions with students whose personal values were very different from your own.....	1	2	3	4
Discussed major social issues such as peace, human rights, and justice.....	1	2	3	4
Talked about your future plans and career ambitions	1	2	3	4
Held discussions with students whose religious beliefs were very different from your own.....	1	2	3	4
Discussed your views about multiculturalism and diversity.....	1	2	3	4
Studied in groups.....	1	2	3	4
Held discussions with students whose political opinions were very different from your own.....	1	2	3	4

8. About how often have you done each of the following during the *current* school year? (Circle one for each.)

1 = Never 2 = Once to a few times a semester 3 = A few times a month 4 = Once or more a week

Asked your instructor for information related to a course you were taking.....	1	2	3	4
Visited informally with an instructor before or after class.....	1	2	3	4
Made an appointment to meet with an instructor in his/her office	1	2	3	4
Communicated with your instructor using e-mail.....	1	2	3	4
Visited informally with an instructor during a social occasion (e.g., over coffee or lunch).....	1	2	3	4
Discussed your career plans and ambitions with an instructor…….	1	2	3	4
Discussed personal problems or concerns with an instructor……	1	2	3	4
Went to a cultural event (e.g., concert or play) with an instructor or class	1	2	3	4
Worked with an instructor on an independent project.....	1	2	3	4
Worked with an instructor involving his/her research.....	1	2	3	4

9. Please indicate the level to which you agree with the following statements. (Circle one response for each.)

1 = Strongly disagree 2 = Disagree 3 = Agree 4 = Strongly agree

I frequently question or challenge professors' statements and ideas before I accept them as "right"..	1	2	3	4
I prefer courses in which the material helps me understand something about myself	1	2	3	4
I prefer courses requiring me to organize and interpret ideas over courses that ask me only to remember facts or information..	1	2	3	4
There have been times when I have disagreed with the author of a book or article that I was reading.	1	2	3	4
I consider the best teachers to be those who can tie things learned in class to things that are important to me in my personal life.....	1	2	3	4

9. (continued)

I enjoy discussing issues with people who don't agree with me.....	1	2	3	4
I try to explore the meaning and interpretations of the facts when I am introduced to a new idea.....	1	2	3	4
A good way to develop my own opinions is to critically analyze the strengths and limitations of different points of view.....	1	2	3	4
I have become excited about a specific field or academic major as a result of taking a course in that field.....	1	2	3	4
When I discover new ways of understanding things, I feel even more motivated to learn.....	1	2	3	4
When I don't understand something in a course, I work at it until I do.	1	2	3	4
Something I learned in one class helped me understand something from another class.....	1	2	3	4
I try to look at everybody's side of a disagreement before I make a decision.....	1	2	3	4
I enjoy the challenge of learning complicated new material.....	1	2	3	4
I prefer reading things that are relevant to my personal experiences..	1	2	3	4
I often have discussions with other students about ideas or concepts presented in classes.....	1	2	3	4
Learning is important to me because it will give me greater control over my life.....	1	2	3	4
For me, one of the most important benefits of a college education is a better understanding of myself and my values.....	1	2	3	4
I enjoy courses that are intellectually challenging.....	1	2	3	4
I have applied material learned in a class to other areas in my life, such as in my job, internship, interactions with others	1	2	3	4

10. In thinking about how you have changed during college, to what extent do you feel you have grown in the following areas? (Circle <u>one</u> response for each.)

1 = Not grown at all 2 = Grown somewhat 3 = Grown 4 = Very much grown

Becoming more aware of different philosophies, lifestyles, and cultures	1	2	3	4
Developing your own values and ethical standards.....	1	2	3	4
Understanding yourself and your abilities, interests, and personality	1	2	3	4
Improving your ability to get along with people different than yourself	1	2	3	4
Ability to put ideas together and to see relationships between ideas	1	2	3	4
Ability to learn on your own, pursue ideas, and find information you need.....	1	2	3	4
Appreciation of racial/ethnic differences..	1	2	3	4
Ability to critically analyze ideas and information.....	1	2	3	4
Learning more about things that are new to you.....	1	2	3	4
Appreciation of art, music, and drama.....	1	2	3	4
Gaining a broad general education about different fields of knowledge	1	2	3	4
Openness to views that you oppose.....	1	2	3	4
Ability to discuss controversial issues.....	1	2	3	4
Motivation to further explore ideas presented in class.....1	2	3	4	

11. Now that you have been in college for a while, how confident do you feel in the following areas? (Circle one response for each.)

1 = Not at all confident 2 = Somewhat confident 3 = Confident 4 = Very confident

Writing ability.....	1	2	3	4
Math ability.....	1	2	3	4
Working independently.....	1	2	3	4
Research ability.....	1	2	3	4
Computer ability.....	1	2	3	4
Problem-solving ability.....	1	2	3	4
Library skills.....	1	2	3	4
Expressing ideas orally.....	1	2	3	4
Working as part of a team.....	1	2	3	4
Time management skills.....	1	2	3	4
Leadership ability.....	1	2	3	4

YOUR RESIDENCE HALL ENVIRONMENT

12. How often do you utilize the following resources or participate in the following activities *inside your residence hall*? (Circle one response for each.)

1 = Never 2 = A few times a semester 3 = A few times a month 4 = Once or more a week
9 = Not available in my residence hall

(Utilized in your residence hall…)					
Computer labs.....	1	2	3	4	9
Academic advisors.....	1	2	3	4	9
Peer counselors.....	1	2	3	4	9
Interactions with professors.....	1	2	3	4	9
Seminars and lectures.....	1	2	3	4	9
Peer study groups.....	1	2	3	4	9
Social activities.....	1	2	3	4	9
Career workshops.....	1	2	3	4	9
Community service projects.....	1	2	3	4	9

13. Consider how well each of the following statements describes your residence hall environment. (Circle one response for each.)

1 = Strongly disagree 2 = Disagree 3 = Agree 4 = Strongly agree

I can find adequate quiet study space available in my residence environment.....	1	2	3	4
I find that students in my residence environment have an appreciation for people from different races or ethnic groups.....	1	2	3	4
Students in my residence environment are concerned with helping and supporting one another.....	1	2	3	4
Life in my residence environment is intellectually stimulating.....	1	2	3	4
I find that students in my residence environment have an appreciation for people with different sexual orientations.....	1	2	3	4
I would recommend this residence environment to a friend.....	1	2	3	4
I find that students in my residence environment have an appreciation for people from different religions.....	1	2	3	4
I see students with different backgrounds having a lot of interaction with one another in my residence environment..... .	1	2	3	4

13. (continued)

I have enough peer support in my residence environment to do well academically.....	1	2	3	4
Most students in my residence environment study a lot.....	1	2	3	4
I think the majority of students in my residence environment think academic success is important.....	1	2	3	4
My residence environment clearly supports my academic achievement.	1	2	3	4
I think the staff in my residence environment spend a great deal of time helping students succeed academically	1	2	3	4
I think it's easy for students to form study groups in my residence environment.....	1	2	3	4

PERCEPTIONS OF DIVERSITY

14. To what extent have you done the following with *students from a racial/ethnic group that is different from your own*? (Circle one response for each.)

1 = Not at all 2 = A little 3 = A lot 4 = All of the time

Studied together.....	1	2	3	4
Shared a meal together.....	1	2	3	4
Were roommates.....	1	2	3	4
Attended social events together.....	1	2	3	4
Had intellectual discussions out of class...	1	2	3	4
Dated someone.....	1	2	3	4
Shared personal feelings and problems.....	1	2	3	4
Participated in extracurricular activities together (e.g., clubs)..	1	2	3	4
Had meaningful discussions about race relations outside of class.....	1	2	3	4
Had guarded, cautious interactions.....	1	2	3	4
Had tense, or even hostile interactions.....	1	2	3	4

15. Please rate the extent to which each of the following is descriptive of your college campus. (Circle one response for each.)

1 = Little or none 2 = Some 3 = Quite a bit 4 = A great deal

Respect by white professors for students of color.....	1	2	3	4
Dating between students of color and white students on campus.....	1	2	3	4
Inter-racial tension in the residence halls.....	1	2	3	4
Friendship between students of color and white students.....	1	2	3	4
Campus commitment to develop an environment that is conducive to the success of students of color.....	1	2	3	4
Separation among students from different racial/ethnic backgrounds on campus.....	1	2	3	4
Trust and respect between students from different racial/ethnic backgrounds....	1	2	3	4
Interaction between students of color and white students.....	1	2	3	4
Racial conflict on campus.....	1	2	3	4

16. Please indicate the extent to which you agree or disagree with the following statements. (Circle one response for each.)

1 = Strongly disagree 2 = Disagree 3 = Agree 4 = Strongly agree
9 = Don't know/Never thought about this

Since coming to college, I have learned a great deal about other racial/ethnic groups.....	1	2	3	4	9

16. (continued)

I have gained a greater commitment to my racial/ethnic identity since coming to college.....	1	2	3	4	9
My campus's commitment to diversity fosters more division among racial/ethnic groups than inter-group understanding..	1	2	3	4	9
Since coming to college, I have become aware of the complexities of inter-group understanding.....	1	2	3	4	9
My relationships with students from different racial/ethnic backgrounds during college have been positive.....	1	2	3	4	9
I think this campus's focus on diversity puts too much emphasis on the differences between racial/ethnic groups..	1	2	3	4	9
My social interactions on this campus are largely confined to students of my race/ethnicity.....	1	2	3	4	9
At times, it is important to be with people of my own racial/ethnic group for the chance to be myself...	1	2	3	4	9

CITIZENSHIP PERCEPTIONS

17. Please indicate your agreement or disagreement with the following items. (Circle <u>one</u> response for each.)

1 = Strongly disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly agree

For the items that refer to a "community," please refer to the community to which you feel the most affiliated, whatever that may be.

I understand the extent to which the groups I participate in contribute to the larger community.....	1	2	3	4	5
It is important to me that I play an active role in my communities.....	1	2	3	4	5
I volunteer my time to the community.....	1	2	3	4	5
I believe my work has a greater purpose for the larger community.....	1	2	3	4	5
There is little I can do that makes a difference for others.....	1	2	3	4	5
I believe I have responsibilities to my community.....	1	2	3	4	5
I give time to making a difference for someone else.....	1	2	3	4	5
Ordinary people can make a difference in their community.....	1	2	3	4	5
I work with others to make my communities better places.....	1	2	3	4	5
I have the power to make a difference in my community.....	1	2	3	4	5
I am willing to act for the rights of others.....	1	2	3	4	5
I participate in activities that contribute to the common good.....	1	2	3	4	5
I believe I have a civic responsibility to the greater public.....	1	2	3	4	5
I value opportunities that allow me to contribute to my community.....	1	2	3	4	5

EXPERIENCE WITH ALCOHOL

18. How did your drinking habits change from high school to college? (Circle <u>one</u>.)

1. I don't drink alcohol and I never have *(skip to question 22)*
2. I started drinking in college
3. I am drinking less in college
4. I am drinking more in college
5. I stopped drinking in college
6. No change

19. Think back over last semester. During a typical two week period, how many times did you have *5 or more drinks(men) or 4 or more drinks (women)* in a row? (Circle one.)

0. None
1. Once
2. Twice
3. 3 - 5 times
4. 6 - 9 times
5. 10 or more times

20. What factors influence how much you drink on a given occasion? (Circle all that apply.)

1. As a reward for working hard
2. To fit in
3. To feel more comfortable in social situations
4. If everyone else is drinking
5. If it is free or cheap
6. If it is a special occasion
7. If I'm having a bad day or got a bad grade
8. To lower my inhibitions about having sex
9. To get away from my problems and troubles
10 To get drunk
11 None of the above

21. Since the beginning of the school year, how many times have any of the following happened to you as a result of your own alcohol use? (Circle one response for each.)

1 = Not at all 2 = Once 3 = Twice or more

I have missed or performed poorly in class.....	1	2	3
I have been confronted by a residence hall staff member.....	1	2	3
I have had a hangover.....	1	2	3
I have become sick or vomited.....	1	2	3
I have passed out.....	1	2	3
I have had memory loss or blackouts.....	1	2	3
I have physically harmed myself or another person.....	1	2	3
I have caused a disturbance (i.e., been noisy).....	1	2	3
I have damaged property.....	1	2	3
I have had unprotected sex.....	1	2	3
I have received a citation or been arrested.....	1	2	3
I have regretted getting sexually involved with someone.....	1	2	3
I have coerced another person into being sexual with me.....	1	2	3
I have been ashamed by my behavior.....	1	2	3
I have had a conflict with my roommate or another person.....	1	2	3
I have fallen behind in my studies.....	1	2	3
I have regretted losing control of my senses.....	1	2	3

22. Since the beginning of the school year, how often have you experienced any of the following because of *others'* drinking? (Circle one response for each.)

1 = Not at all 2 = Once 3 = Twice or more

I have been harassed, insulted, or humiliated.....	1	2	3
I have had a serious argument or quarrel.....	1	2	3
I have been pushed, hit, or assaulted.....	1	2	3
I have had my property damaged.....	1	2	3
I have had to "babysit" or take care of another student.....	1	2	3
I have had my studying or sleep interrupted.....	1	2	3
I have experienced an unwanted sexual advance...	1	2	3

22. (continued)

I have been the victim of sexual assault or date rape.....	1	2	3
I have been inconvenienced from vomit in the hallway or bathroom.....	1	2	3
I have been affected by the behavior of guests who are drinking.....	1	2	3

FUTURE ACTIVITIES

23. Which of the following activities do you plan to participate in while in college that you have not participated in yet? (Circle all that apply.)

1. Practicum, internship, field experience, co-op experience, or clinical assignment
2. Community service, volunteer work, or service learning
3. Research with a professor
4. Taking a leadership position
5. Study abroad
6. Independent research
7. Self-designed major
8. Culminating senior experience (e.g., capstone course, thesis project, comprehensive exam, etc.)
9. None of the above

OVERALL SATISFACTION WITH COLLEGE

24. Indicate the extent to which you agree or disagree with the following statements. (Circle one response for each.)

1 = Strongly disagree 2 = Disagree 3 = Agree 4 = Strongly agree
9 = Don't know/Never thought about this

I feel comfortable on campus.....	1	2	3	4	9
My college/university is supportive of me.	1	2	3	4	9
If I had to do it over again, I would choose the same college or university....	1	2	3	4	9
I feel that I am a member of the campus community.....	1	2	3	4	9
I feel a sense of belonging to the campus community.....	1	2	3	4	9

25. How satisfied have you been with each of the following aspects of your academic experience at your college or university? (Circle one response for each.)

1 = Very dissatisfied 2 = Dissatisfied 3 = Satisfied 4 = Very satisfied

The intellectual quality and challenge of the classes I have taken.....	1	2	3	4
The size of my classes.....	1	2	3	4
The relevance of the course material to issues that are important to me.	1	2	3	4
The opportunity to get into classes that I really want to take.....	1	2	3	4
The amount of effort I am putting into my courses.....	1	2	3	4
The amount of interaction between instructors and students.....	1	2	3	4
The quality of relationships with my instructors.....	1	2	3	4
The quality of relationships with college/university staff members.....	1	2	3	4
Your overall satisfaction with this college/university.....	1	2	3	4

26. Do you plan to return to the same college or university next fall? (Circle one.)

1. Yes
2. No, I am graduating this year

26. (continued)
3. No, I am enrolling at a different college or university
4. No, I will not be pursuing any form of education next fall
5. Undecided

BACKGROUND INFORMATION

27. What is your gender? (Circle one.)

1. Male 2. Female 3. Transgendered

28. Please indicate your sexual orientation. (Circle one.)

1. Bisexual 2. Gay or Lesbian 3. Heterosexual

29. Please circle the one response that you think best applies to your race/ethnicity. (Circle one.)

1. African American/Black (not of Hispanic origin)
2. Asian or Pacific Islander (includes the Indian sub-continent)
3. American Indian or Alaskan Native
4. Hispanic/Latino (Spanish culture or origin)
5. White/Caucasian (Persons not of Hispanic origin, having origins in any of the original peoples of Europe, North Africa, or the Middle East)
6. Multi-racial or multi-ethnic
7. Race/ethnicity not included above

30. Please indicate your citizenship and/or generation status. (Circle one.)

1. Your grandparents, parents, and you were born in the U.S.
2. Either or both your parents and yourself were born in the U.S.
3. You were born in the U.S., but at least one of your parents was not
4. You are a foreign born, naturalized citizen
5. You are a foreign born, resident alien/permanent resident
6. You are on a student visa

31. What is your current religious affiliation? (Circle one.)

0. None
1. Buddhist
2. Christian (e.g., Catholic, Protestant, etc.)
3. Hindu
4. Jewish
5. Muslim
6. Other: _____

32. What is the highest level of education completed by one or both of your parent(s) or guardian(s)? (Circle one in each column, if applicable.)

	Father or Male Guardian	**Mother or Female Guardian**
Don't know.....	0	0
High school or less.....	1	1
Some college.....	2	2
Associates degree.....	3	3
Bachelors degree.....	4	4
Masters degree.....	5	5
Doctorate or professional degree (JD, MD, PhD)	6	6

33. What is your best estimate of your parents' total income last year? Consider income from all sources before taxes. (Circle one.)

1. Less than $6,000
2. $6,000 to $9,999
3. $10,000 to $14,999
4. $15,000 to $19,999
5. $20,000 to $24,999
6. $25,000 to $29,999
7. $30,000 to $39,999
8. $40,000 to $49,999
9. $50,000 to $59,999
10. $60,000 to $74,999
11. $75,000 1to $99,999
12. $100,000 to $149,999
13. $150,000 to $199,999
14. $200,000 or more

HIGH SCHOOL INFORMATION

34. What were your average grades in high school? (Circle one.)

1. A+ or A
2. A- or B+
3. B
4. B- or C+
5. C or C-
6. D+ or lower
7. No high school GPA

35. Please write your combined SAT and/or ACT score on the blanks provided. (e.g., 1 2 0 0)

SAT Composite ___ ___ ___ ___

ACT Composite ___ ___

COLLEGE INFORMATION

36. What is your current class level? (Circle one.)

1. First year
2. Sophomore
3. Junior
4. Senior
5. Graduate student
6. Other

37. What is your best estimate of your grades so far in college? (Circle one.)

1. 3.50 – 4.00
2. 3.00 – 3.49
3. 2.50 – 2.99
4. 2.00 – 2.49
5. 1.99 or less
6. No college GPA

38 Did you receive financial aid in 2003-2004 in the form of: (Circle all that apply.)

0. Not receiving financial aid
1. Loans
2. Need-based scholarships or grants
3. Non-need-based scholarships or grants
4. Work-study
5. Athletic scholarship
6. Other: _____

39. Is there anything else you would like to share about your residence experiences?

The next 4 questions will be customized for each institution.

Custom #1: What is your current school/college of enrollment ?

Custom #2: What is the name of the residence hall you are currently living in?

Custom #3: Please specify which living-learning program(s) you have *ever* participated in while in college.

Custom #4: Which living-learning program are you currently participating in? (Circle one response only.)

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