

ABSTRACT

Title of Dissertation: ASIAN AMERICAN WOMEN IN SCIENCE,
ENGINEERING, AND MATHEMATICS:
BACKGROUND CONTEXTUAL AND COLLEGE
ENVIRONMENT INFLUENCES ON SELF-
EFFICACY AND ACADEMIC ACHIEVEMENT

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The purpose of this research study was to examine, for undergraduate women of various Asian American ethnic backgrounds, the influence of background contextual and college environment factors on their sense of academic self-efficacy and achievement in science, technology, engineering, and mathematics (STEM) majors. Social cognitive career theory and its critiques provided a theoretical foundation for relationships from past performance, socioeconomic status, acculturation, and college environment variables (compositional diversity, racial climate, gendered climate, academic peer support), to academic self-efficacy and achievement.

Data were collected through an online survey. Instrumentation included the scales of Language, Identity, and Behavioral Acculturation; Gender Discrimination; Faculty and Classroom Behavior; Interactions with Peers; and Academic Milestones Self-efficacy. The participants were 228 Asian American undergraduate women in STEM at a large

public, doctoral research extensive university on the east coast; the response rate was 51%. In three MANOVAs for nine social cognitive career variables, four ethnic groups (East, South, Southeast, and Multi-ethnic Asian American) significantly differed only on socioeconomic status. In path analysis, the initial model was not a good fit and was rejected. The model was respecified through statistical and theoretical evaluation, tested in exploratory analysis, and considered a good fit. The respecified model explained 36% of semester GPA (achievement) and 28% of academic self-efficacy.

The academic achievement of Asian American women in STEM was related to past performance, background contextual factors, academic self-efficacy, academic peer support, and gendered climate. The strongest direct influence on achievement was academic self-efficacy followed by past performance. The total effect of Asian acculturation on achievement was negative and the total effect of American acculturation on achievement was not significant; academic self-efficacy mediated these complex relationships. The total effects of racial and gendered compositional diversity and racial climate on both academic self-efficacy and achievement were not significant. Students in majors with more female peers reported less academic peer support.

In this study, when culturally specific variables embellished social cognitive career theory, the theory exhibited cultural validity for undergraduate Asian American women in STEM. The nature of the relationships among culturally specific variables and college environment variables, however, requires further study.

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MATHEMATICS: BACKGROUND CONTEXTUAL AND COLLEGE
ENVIRONMENT INFLUENCES ON SELF-EFFICACY AND ACADEMIC
ACHIEVEMENT

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2005

DEDICATION

In memory of my father, Arthur Vogt

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Chapter I: Introduction

Issues of racism and sexism pervade U.S. college campuses and have been identified in science, technology, engineering, and mathematics (STEM) fields in particular (Eisenhart, Finkel, Behm, Lawrence, & Tonso, 1998; Sandler, 1999; Seymour & Hewitt, 1997; U.S. Commission on Civil Rights, 1992). Asian Americans, U.S. citizens or permanent residents of Asian ancestry (Nomura, 2003), are in a precarious position within the racial dynamics on campus (Hune, 1998). They often are not perceived as a minority, yet they are not part of the White majority (Espiritu, 1997; Hune). As a result, their needs often are ignored in the competition for limited resources on campus (Espiritu; Hune). In part, this dynamic is reflective of a racial stereotype, Asian Americans as the “model minority.” The model minority stereotype invokes a perspective that Asian Americans have successfully overcome historical discrimination and achieved socioeconomic success (Suzuki, 2002; Woo, 2001). As a result, Asian American students may be encouraged to take stereotyped coursework, such as math and science, and at the same time ignored for academic assistance (Hune; Suzuki). The lack of support combined with pressure to succeed academically may increase Asian American students’ sense of isolation and stress (Suzuki, 1989, 2002).

Furthermore, Asian American women may experience racialized sexual harassment on college campuses (Espiritu, 2001a; Hune, 1998). The exotic and demure stereotypes of Asian American women alongside neuter-gender and non-sensual stereotypes are connected to sexual objectification, a chilly campus climate, and achievement barriers (Espiritu; Hune). Recent events at and near a large public research

university, the site of the current research study, serve as examples of both sexism and racism faced by Asian American women. An example of domestic violence occurred in the spring of 2003, when a female student was shot in an attempted murder-suicide by her ex-boyfriend, whom she met at their Korean Presbyterian church; the two recently had ended a three-year relationship before the confrontation in a campus parking garage (Slusark & Cribbs, 2003). Later that same year, a popular dance club located near the same campus hosted an “Asian pimp ‘n’ ho” costume theme party on Halloween. These graphic examples are extreme indicators of oppression. Less overt forms of discrimination exist as well (Espiritu; Hune). In a report on the status of Asian American women in higher education, one student described her experience with discrimination by stating, “it’s hard to know if it’s because I’m a woman, or because I’m Asian, or both” (Hune, p. 11).

Asian American ethnic groups historically have been perceived, stereotyped and treated as a single racial group within the U.S. and are exposed to similar racial dynamics in the U.S. despite their distinct cultures, diverse histories, and heterogeneity (Espiritu, 1992; Helms & Cook, 1999; Nomura, 2003; Shah, 1997). Asian American women with different experiences and unique stories are part of the same power hierarchy of race and gender. Their lives are “all monumentally shaped by three major driving forces in U.S. society: racism and patriarchy...and ultimately, imperial aggression against Asia as well” (Shah, p. xiii). A panethnic Asian American female identity is created and essentialized through the existence of this power hierarchy (Shah).

STEM disciplines (the natural sciences, engineering, and mathematics, but not social sciences and psychology) in U.S. colleges and universities exist within a social

system as well as a culture of science that are both dominated by Western patriarchy (Eisenhart et al., 1998). This context filters students' interactions with their institutions and helps to shape the institutional elements that influence the success of all students, including Asian American undergraduate women (Eisenhart et al.; Hune, 1998; Hurtado, Milem, Clayton-Pedersen, & Allen, 1999). Some cultural, racial, and gender issues that may shape the experiences of undergraduate Asian American women in STEM include alienation, invisibility, and silence; language and English-speaking proficiency; gender role socialization regarding education, marriage, and family duty; and stereotypes from lotus blossom exotics to perpetual foreigners and model minority myths (Andersen & Collins, 2001; Espiritu, 2001a; Hune).

It is important to understand the experiences of Asian American women in STEM education because of evidence that Asian American women are negatively impacted by the overall racial and gendered climate on college campuses (Greenstein, 2000; Hune, 1998; Vogt, 2003). Asian American students often are considered *over-represented* in STEM (Betz, 1997; *Land of Plenty*, 2000), but Asian American women and some Asian American ethnic groups participate in STEM at lower rates than Asian American men and other Asian American ethnic groups (Chinn, 1999; Huang, Taddese, & Walter, 2000; National Science Foundation, 2004). The climate in higher education is influenced not only by participation rates but also by other psychological and behavioral climate factors (Hurtado et al., 1999). An abundance of research details the influence of the college environment on students' learning, development, and achievement (Astin, 1993; Pascarella & Terenzini, 1991). There is also evidence of the influence of racial and gendered climates (Hall & Sandler, 1982; Hurtado et al.) and academic peer support

(Astin, 1993; Pascarella & Terenzini, 1980, 1991) on students' learning, development, and achievement. The absence of an empirical study of the degree to which the educational environment experienced by Asian American women in STEM is positive, supportive, or beneficial in their academic and career development is a glaring oversight in the research literature. Thus, the purpose of this research study was to examine, for undergraduate women of various Asian American ethnic backgrounds, the influence of background contextual and college environment factors on their sense of academic self-efficacy and achievement in STEM majors.

In this introductory chapter, the issues presented thus far are expanded upon to highlight the context within which undergraduate Asian American women experience their STEM studies. This includes a historical context of Asian Americans in the U.S. as well as the empirical knowledge currently available regarding Asian American women in STEM and the within-group diversity of this population of students. The literature regarding issues of the college environment, self-efficacy, and academic outcomes are presented to highlight the current empirical understanding of the academic development processes for Asian American women in STEM. After defining terms related to the study, a section on the purpose of the study and the research design details the theoretical framework and data collection and analysis methods. A philosophical discussion of Asian American feminism, which guided this research endeavor, follows, and the chapter concludes with the significance of this research study in terms of theory, research, practice, and policy.

Historical Context

The history of Asian Americans and Pacific Islanders, since the mid-nineteenth century, has been a racialized as well as a gendered history (Espiritu, 2001a; Nomura, 2003). The historical relations of Asian Americans and dominant U.S. society illuminate distorted perceptions of both Asian American men and women. Asian American history is predominantly an immigrant history and relates to U.S. policies regulating immigration and citizenship. People first emigrated to the U.S. from Asia during the mid-1800s in response to recruitment of cheap male labor for farming and railroad construction. Men first came to the U.S. intending to work and return home, a pattern reinforced by two U.S. policies. Chinese men were excluded from citizenship, and Chinese women were excluded from immigration (Espiritu, 1997). This led to a gender imbalance in some immigrant communities, where women and children lived in China while their husbands, fathers, and brothers lived in the U.S.

The popular image of Asian American communities in the U.S. was that of bachelor societies, prostitutes, and picture brides, but many men maintained “transnational” family units with their wives and children (Hune, 2000). Families of laborers were denied immigration, but some Asian merchants in the U.S. were permitted to bring their families. These racist and gendered U.S. immigration policies initiated changes in the gender relationships within Asian and Asian American families. For example, picture brides, a modified version of arranged marriages, served as a means to an end for many women. They were able to immigrate, support their families financially, get an education, leave troubling conditions in Asia, and experience religious freedom and other personal or gender-role freedoms (Hune, 2000). Additionally, family

reunification rules in the early part of the 20th century allowed children to be united with their fathers, but wives were not permitted to enter the U.S. until the 1965 Immigration Act ended the exclusion laws (Espiritu, 1997).

In ending exclusion, the 1965 Immigration Act aimed to reunite families and increase the number of skilled workers. The result was an influx of Asian immigrants, mostly women; the Asian American population doubled from 1.5 million in 1970 to 3.7 million in 1980 (Espiritu, 1997). In the 1970s, more than half of immigrants from many Asian and Pacific island nations were women. Women married U.S. men engaged in military action in Asia, joined their relatives in the U.S., or came to work in either professional or low-wage positions (Hune, 2000). Currently approximately 12 million Asian Americans live in the U.S (Hune, 2002; U.S. Census Bureau, 2002). About half of the 12 million Asian Americans counted in the 2000 Census were women (U.S. Census Bureau). The immigration and naturalization laws also structured the socioeconomic patterns that exist for this population today. Immigrants after 1965 included many individuals with higher educational, economic, and occupational status than their predecessors, and most immigrants arrived as family units. Changing economic conditions in the U.S. increased the number of low-wage positions in the service sector and decreased occupational opportunities for educated professionals. These two conditions have created a contemporary bimodal economic situation, with both high income and low income Asian American families (Espiritu; Hune, 2002; Reeves & Bennett, 2004).

The changing policies had cumulative effects, spurring new family formations, reconstructing families, altering gender roles, and creating new family-community

relationships. Most Asian American women historically have worked outside the home, whether in their family business, in the wage system (e.g., domestic service, factories, nursing, and other professional positions), or informally (e.g., laundry service, taking in boarders, and sewing) (Hune, 2000). Asian American women today are often co-providers in their families, enjoying access to social capital, informal and formal networks, increased self-worth, less dependence on men for survival, and increased decision-making in their family (Hune, 2000). Asian American women today also experience domestic violence, divorce, or restructured patriarchal family dynamics (Kibria, 1990).

The changing policies also contributed to the myth of the model minority, the image of a minority group overcoming racism to reach educational and economic success (Suzuki, 2002; Woo, 2001). Indeed, statistics show that Asian American women are more highly educated and work in the labor force at a higher rate than any other group of women (Espiritu, 1997; Reeves & Bennett, 2004; Woo, 2001). For example, in 2000, 41% of Asian American women over 25 earned at least a bachelor's degree, whereas only 26% of White women over 25 did so (*The Wage Gap*, 2002).

This image of a successful minority group became popular during the civil rights era of racial tensions, serving as a political justification for reducing governmental assistance for any racial group. The assumption was that all minorities could achieve success with hard work, just like Asian Americans (Suzuki, 2002; Woo, 2001). However, as noted above, aggregate educational attainment statistics indicating success are influenced by immigration laws that preference professionals from East Asian countries (China, Japan, and Korea), who represent the largest proportion of the Asian American

category (Espiritu, 1997; Hune, 2002; Reeves & Bennett, 2004). Immigrants comprise at least 66% of the highly educated Asian American population (Espiritu, 1997). Refugees from Southeast Asia (e.g., Vietnam, Cambodia, and Laos) and immigrants from some Pacific islands have not achieved the same level of attainment (Hune, 1998, 2002; Reeves & Bennett). In 1990, only 3% of Hmong women received a bachelor's degree, yet 49% of Asian Indian women did (Espiritu). Even among Asian Indian women, however, 51% did not receive a bachelor's degree (Espiritu).

Furthermore, high income levels are influenced by the high rate of multiple-earner incomes in Asian American families and the concentration of Asian American populations in cities where the cost of living is well above average (Suzuki, 2002). In addition, Asian American women and men earn less than White men with the same level of education, and Asian American women earn less than Asian American men but more than White women (Hune, 2002; Reeves & Bennett, *The Wage Gap*, 2002; Woo, 2001). Although these statistics demonstrate the inaccuracies of a model minority status for Asian Americans, the myth prevails. In the education realm, Asian American students are assumed to be "good" students: smart, able to do well in math and science, and hard working students who do not want or need academic or social support (Hune, 1998; Suzuki).

Status of Asian American Women in STEM

The experiences of Asian American women in STEM education are unclear as empirical information is scarce. The limited knowledge base arises from a discourse on diversity in STEM that centers on under-representation of particular social groups (Rosser, 1997). Under-representation is an issue of percentages, or compositional

diversity (Hurtado et al., 1999), which exposes great disparities in STEM participation between women and men and between African American, Latino, and Native American students in comparison to White and Asian American students (Babco, 2001; Chubin & Pearson, 2001; Hill, 2002, *Land of Plenty*, 2000; National Science Foundation, 2000, 2004). Asian American women and men in STEM, like White students, are considered *over-represented* in these fields (Betz, 1997, *Land of Plenty*). The National Science Foundation's Louis Stokes Alliances for Minority Participation program has acknowledged Pacific Islanders as a group with distinct experiences and needs from other Asian American groups and has considered Pacific Islanders as an *under-represented* (minority) group in STEM (National Science Foundation, 2003a).

Statistics from the National Science Board in 1996 revealed that Asian Americans were 2% of the total labor force and 5% of the science and engineering labor force (Betz, 1997). In 2000, Asian Americans were 3.6% of the U.S. population and received 11.8% of all engineering bachelor's degrees (Babco, 2001). Again, these group statistics are misleading. Disaggregated data reveal that Southeast Asian, Filipino and Pacific Islander students are under-represented in STEM environments (Chinn, 1999). Furthermore, Asian American participation rates by gender are not consistent across STEM fields, and gender differences among Asian American students in major choice, participation rates, and graduation rates parallel the differences of White women and men (Huang et al., 2000). For example, in 2001, Asian American and Pacific Islander women received only 24% of the engineering bachelor's degrees received by Asian Americans, 32% of computer science, 47% of mathematics, 49% of physical science, 57% of biological science, and 64% of agricultural sciences bachelor's degrees (National Science

Foundation, 2004). At the university site of the current research study, spring 2005 participation rates for Asian American women of all Asian American students were: 20% in the School of Engineering; 22% in the College of Computer, Mathematical, and Physical Sciences; 58% in the College of Life Sciences; and 74% in the College of Agriculture and Natural Resources (Office of Institutional Research & Planning, 2005).

The under-representation of Asian American women and some Asian American ethnic groups from many STEM fields has numerous negative consequences. Since the number of White men choosing science has been declining and the number of jobs in STEM has been growing (Barton, 2002, *Land of Plenty*, 2000), under-representation has the potential to create a shortage of workers, limiting the international competitiveness of the U.S. (Barton, *Land of Plenty*). The pervasiveness of under-representation across race and gender despite numerous efforts to recruit a diverse population, as demonstrated by a cataloging of projects funded by the National Science Foundation, highlights the disparity in educational opportunities and social privileges between groups (Betz, 1997; Rosser, 1997). This reality violates the national ideal of equality and also affects the quality of science, engineering, and mathematical research and products that are produced. The 2004 program solicitation from the National Science Foundation's Program for Research on Gender in Science and Engineering stated:

Optimal performance of science and engineering in the service of society requires that inquiry, discovery, and design be informed by diverse points of view and diverse research questions. If significant populations are not represented, the results are often inadequate. (National Science Foundation, 2003b, p. 20)

Chronic under-representation of Asian American women and some Asian American ethnic groups not only has implications for society but also for individuals. STEM fields offer low unemployment rates and competitive salaries (Bonous-Hammarth,

2000; Bowen & Bok, 1998). The number of jobs available in STEM fields has been growing rapidly and currently there is a shortage of workers in information technology. Since the overwhelming majority of technology careers require at least a bachelor's degree, educational attainment is critical (*Land of Plenty*, 2000). Bowen and Bok's study of racial groups at selective colleges revealed that majoring in STEM had significant earnings advantages for women in all racial groups; that is, majoring in STEM brought greater earning potential for women than if they majored in other fields. For other students, regardless of gender or race, a STEM career simply fulfills an intrinsic interest in these fields (Bowen & Bok).

Diversity Among Asian American Women in STEM

Conclusions about Asian American women cannot confidently be drawn simply by adding evidence about Asian Americans and additional evidence about women. Women as a group receive a smaller proportion of degrees in STEM than men as a group, but Asian American students as a group receive a larger proportion of degrees in STEM than White students (National Science Foundation, 2000). This evidence is inconclusive regarding the proportion of degrees in STEM received by Asian American women in comparison to the proportion received by Asian American men. The role of race and gender in Asian American women's STEM experience, therefore, is not additive, but interactive and interlocking in a matrix of systemic racism and sexism (Andersen & Collins, 2001; Weber, 1998). Ultimately, a focused study on the specific experiences, outcomes, and needs of Asian American women is necessary to understand the environment for Asian American women in STEM.

Race and gender are salient factors for understanding STEM student experiences and outcomes, but other aspects of identity also may be central. Evidence of different rates of participation in education among Asian American ethnic groups (Espiritu, 1997; Hune, 1998, 2002; Reeves & Bennett, 2004) suggests that their participation, experiences, and outcomes in STEM education may vary as well. Disparity among Asian American subpopulations in terms of socioeconomic status, generational status, and educational attainment warrant breaking down the Asian American category, particularly by ethnicity, to better understand the complexity of issues for this population overall (Bagasao, 1989; Hune, 1998; Suzuki, 2002).

In a report on the status of Asian American women in higher education, Hune (1998) argued that treating Asian Americans as an over-represented minority:

is a sweeping and unsubstantiated generalization that hinders their progress in academe. It ignores inequalities within and among Asian American groups and by gender, restricts their access to fields of study and employment areas where they are under-represented, and denies opportunities to economically disadvantaged Asian Americans. (p. 27)

This conclusion raises the need to study the Asian American population using a more complex view of their identities that includes gender, socioeconomic status, generation in the U.S. and in college, acculturation, and ethnicity. Socioeconomic status is an individual's or family's level of available financial, human, and social resources (Ensminger et al., 2000), and acculturation is the process of change in adherence to Asian ethnic and dominant American cultures by Asian Americans (Kim, Atkinson, & Yang, 1999; Suinn, Rickard-Figueroa, Lew, & Vigil, 1987). Hune's conclusion also raises the need to study Asian American college experiences and outcomes using a more complex view of higher education by exploring sub-environments such as institution types,

divisions, departments, and even interpersonal interactions to assess more proximal environmental influences on the experiences of Asian American women.

Because of the evidence that Asian American women confront institutional and cultural oppression in college environments (Hune, 1998; Suzuki, 2002), the lack of attention to the experiences of Asian American women in STEM majors in particular is troubling. The National Asian Pacific American Women's Forum (NAPAWF), an activist group seeking to support the needs of Asian American women at a national level, has written a platform paper on educational access in response to the invisibility of issues related to Asian American women's education (Chen et al., 1999). Educational issues for Asian American women are invisible because information is derived from data that ignore the intersection of race and gender and that use an umbrella Asian and Pacific Islander (API) category, which hides women of specific ethnicities, socioeconomic statuses, and other social identities. One of two goals in the educational platform is "to improve the availability of information necessary to analyze the diverse needs and status of API women and girls" (Chen et al., p. 2). The platform objective, "to promote awareness within and beyond the API community about the issues that affect API girls and women and that hinder their full participation and development in school and in their jobs," provides a call for empirical research informing these issues (Chen et al., p. 2). In response, this research study explores the relationships between college environment factors, academic self-efficacy, and achievement for Asian American undergraduate women in STEM fields by ethnic group and other background contextual factors.

Beyond Representation: College Environment, Self-Efficacy, and Academic Outcomes

In studies on major choice, persistence, and achievement in STEM fields, gender and race often are recognized as salient aspects of participants' social identities, although independently explored. Studies related to the influence of both gender and race tend to conduct two separate analyses, one by race and another by gender (e.g., Grandy, 1997; Hackett, Betz, Casas, & Rocha-Singh, 1992; Hathaway, Sharp, & Davis, 2001). In the research literature, Asian American women may be subsumed under a larger aggregated category or overlooked altogether (e.g., Bonous-Hammarth, 2000). For instance, when conducting comparative racial analyses, Asian American students may be grouped with White students, in an attempt to compare under-represented groups with over-represented groups. Since White students in these studies greatly outnumber Asian American students, the results related to a *White/Asian American* category are heavily weighted toward the White student experience. An example is Hathaway et al.'s study where Asian American students comprised only 16% of the *White/Asian American* category of students.

At the same time, gender studies of barriers and facilitative factors related to the retention and success of women in STEM may not describe female participants' race (e.g., Brainard & Carlin, 1998; Civian & Schley, 1996). When Asian American women are identified as a distinct group in a particular study, however, the sample size may be too small to include the group in statistical analyses or to make legitimate interpretations of results regarding the group (e.g., Hackett et al., 1992). Important exceptions to this trend are three qualitative studies of career development, including Park's (2002) study on the intersection of racism and sexism in the career experiences of Asian American

professional women, Prosser's (2001) research on career experiences of prominent women of Asian descent, and Chinn's (2002) study of the response of Asian and Pacific Islander women scientists and engineers to racial and gendered STEM stereotypes. However, the unique socialization experiences of Asian American women as undergraduate STEM majors generally are overlooked.

Consistent with the need to study diversity in STEM beyond indicators of participation rates and level of representation, this research study addresses the quality of students' experiences as STEM majors. Quality of experience is indicated by students' sense of academic self-efficacy as they experience the college environment and by their learning, as evidenced by academic achievement. A study that collects empirical evidence of academic achievement challenges the assumptions of the model minority stereotype, avoiding a presumption of success for all Asian Americans.

Self-efficacy is theorized to predict career/major choice, persistence, and achievement (Byars & Hackett, 1998; Hackett & Betz, 1981; Lent, Brown, & Hackett, 1994). Academic self-efficacy, confidence in one's ability to perform tasks essential to academic success in STEM fields (Hackett et al., 1992; Lent, Brown, & Larkin, 1986), has been found to play an important role in the academic and career development of women in STEM (Betz & Hackett, 1997; Hackett et al., 1992; Hackett & Betz; Vogt, 2003). However, women tend to underestimate their abilities in math and science, which then influences lower perceptions of self-efficacy (Betz, 1997). Lack of self-confidence and low math self-efficacy are internal barriers to career choice for women (Betz & Hackett; Fassinger, 1996; Hackett & Betz). Women's confidence in math ability starts to decrease in 6th grade (Eccles, 1997) and continues to deteriorate during college. Several

studies document a disintegration over time of women's self-confidence as a result of participation in a science major, particularly during the first year of college (Astin & Astin, 1992; Seymour, 1995; Sonnert, 1999).

Self-efficacy is the personal expectation for successfully performing the necessary behaviors to produce an outcome (Bandura, 1977). In Bandura's social cognitive theory of human behavior, self-efficacy influences three behaviors: choice, effort, and persistence. Self-efficacy is more predictive of tasks when it is measured as specific to those tasks and when contextual factors, such as social, situational, and temporal issues, are considered (Bandura). Self-efficacy theory was extended to career development outcomes, including persistence and academic success in a college major, by Hackett and Betz (1981). Hackett and Betz hypothesized that self-efficacy expectations mediated the relationship between gender role socialization and career choice and achievement and helped to explain the weak relationship between women's ability and interests with their career choices and successes. Social cognitive career theory (Lent et al., 1994) is an extension of Bandura's and Hackett and Betz's theoretical work. It unifies the empirical findings that link self-efficacy and achievement, while also considering other social cognitive factors and environmental and personal influences, to describe the processes involved in academic and career development (Lent et al., 1994).

Vogt (2003), Hackett et al. (1992), and Lent, Brown, and Larkin (1984, 1986) found statistically significant and positive relationships between academic-related self-efficacy and grades for undergraduate students in STEM majors. In Hackett et al.'s and Lent et al.'s (1984, 1986) studies, self-efficacy scores did not differ by gender. In a study of the social cognitive development of engineering undergraduates, Vogt did not find

differences in grade point averages by students' gender, but did find that women had lower engineering self-efficacy, lower academic self-confidence, and greater perceived gender discrimination. About 50% of the sample identified as Asian American, but race was not included as a variable in Vogt's study. The environment variables of gender discrimination (negative) and academic integration (positive) were significantly related to engineering self-efficacy and academic self-confidence, which were significantly and positively related to grade point average (Vogt).

Self-efficacy of Asian American undergraduates has been studied by Greenstein (2000) and Tang, Fouad and Smith (1999). In these studies, self-efficacy was significantly and positively related to academic and intellectual development and career choice. Greenstein did not find the presence of gender differences in the relationship between self-efficacy and academic development but did find that the relationship between academic self-efficacy and academic and intellectual development was strong for Asian American students, consistent with the results for the total sample of all racial groups. Tang et al. found that acculturation, or level of comfort with dominant U.S. culture, language, and attitudes, was significantly but negatively related to Asian American students' career self-efficacy.

Two studies of pre-college academic achievement offer evidence of the predictors of achievement relevant for Asian American adolescent women. Muller, Stage, and Kinzie (2001) found that socioeconomic status, prior grades, and internal locus of control were significant positive predictors of Asian American girls' 8th grade science achievement. An interaction effect between gender and race and large subgroup variance indicated a need for separate analyses by subgroup to assess within-group differences

(Muller et al.). Indeed, Kim, Rendon, and Valadez (1998) found differences in 10th grade math performance and educational aspirations among six Asian American ethnic groups. South Asians (Asian Indian and Pakistani) were more likely to have the highest scores and Southeast Asians (Vietnamese, Laotian, Cambodian, and Thai) were more likely to have the lowest scores of the two outcomes. Furthermore, positive self-concept was a statistically significant positive predictor for Chinese, Filipino, and Southeast Asian students' educational aspirations. Gender was significant only for Chinese students, such that boys had higher educational aspirations than girls (Kim et al.).

Pre-college academic experiences of Asian American women also include aspects of the K-12 educational environment. For example, the number of science courses significantly predicted the rate of growth in science achievement from 8th to 12th grade for Asian American girls, as did academic track (Muller et al., 2001). School-related predictors of 10th grade educational aspirations for Asian American students included attending a low-socioeconomic status school (negative for Southeast Asian, Japanese, and Filipino Americans), attending an urban school (negative for Japanese Americans), and a competitive academic climate (positive for Chinese Americans) (Kim et al., 1998). Furthermore, the U.S. Commission on Civil Rights (1992) reported widespread anti-Asian violence and discrimination, racial tension, and unsupportive and hostile environments for Asian American children in the nation's schools, particularly for immigrants and students with limited English proficiency. The report concluded that the negative racial climate creates barriers to educational attainment.

The influence of context, both background contextual factors and proximal college environment factors, on the relationship between self-efficacy and academic

outcomes is the least studied aspect of social cognitive career theory (Lent, Brown, & Hackett, 2000). Recent research (Greenstein, 2000; Hackett et al., 1992; Lent et al., 2003; Vogt, 2003) indicates that self-efficacy at least partially mediates the influence of context on persistence, career choice, academic and intellectual development, and grades, but Tang et al. (1999) and Flores and O'Brien (2002) suggested that background contextual factors may have more direct influences on outcomes for students of color than hypothesized by social cognitive career theory.

Definitions of Terms

The term *Asian American students* was defined in this research study to include undergraduate students enrolled in U.S. institutions of higher education who were U.S. citizens or permanent residents of Asian ancestry. *Asian ethnicities* include Chinese, Japanese, Korean, Filipino, Asian Indian, Pakistani, Bangladeshi, Sri Lankan, Nepalese, Vietnamese, Hmong, Lao, Cambodian, Indonesian, Thai, Malaysian, Singaporean, and others (Nomura, 2003). Although often grouped with Asian Americans, individuals of Pacific Island ancestry and indigenous people of Pacific islands colonized by the U.S. (Nomura) were not included in the current definition. The tension in defining a panethnic group such as Asian American, Asian Pacific American, or Asian/Pacific Islander American is sociopolitical in nature and scholars follow different guidelines (Helms & Cook, 1999; Kochiyama, 1997; McEwen, Kodama, Alvarez, Lee, & Liang, 2002; Nomura). The sheer number of ethnicities forming this constructed category of Asian Americans and Pacific Islanders – at least 57 – speaks to the heterogeneity of this group (Hune, 2002). Pacific Islanders have distinct histories of oppression with the U.S. (Kochiyama) as indigenous people in U.S. territories rather than as immigrants, which is

more characteristic of people of Asian ancestry (Hirschman, 1994). In addition, the relative numbers of Pacific Islanders at the institution where the current research study occurred are extremely small in comparison to other Asian American groups (Counseling Center, 2004). Encompassing Pacific Islanders in a larger category often further marginalizes their experience by masking their differences (Nomura). The term Asian American, as used in this research study, does not subsume Pacific Islanders, and when literature and data regarding Pacific Islanders are available, they are provided and identified as such. However, individuals who identified as Pacific Islander were not excluded from participation in this research study.

The term *academic and career development* refers to the process in which an individual grows in one's academic and career interests, choice, and performance. Social cognitive career theory (Lent et al., 1994) provides the theoretical perspective for academic and career development in the current research study. In this theory, past performance, background contextual factors, college environment factors, and social cognitive variables such as academic self-efficacy are hypothesized to influence academic and career interests, choice, and performance, including academic achievement.

In this research study, the term *background contextual factors* was used to reference both socioeconomic status and acculturation. *Socioeconomic status* was defined as the level of financial, human, and social resources available to an individual or family through educational attainment, occupational status, and sources of income and wealth (Ensminger et al., 2000). Socioeconomic status was measured in this research study using a SES index that included indicators of parents' educational attainment, parents' occupational status, and participants' perceived family socioeconomic status.

Acculturation was defined as the complex process of change in adherence to values, beliefs, attitudes, and behaviors by Asian Americans as they are exposed to the dominant U.S. culture (Kim et al., 1999; Suinn et al., 1987). Adherence to dominant U.S. culture may be independent of retention of an Asian ethnic culture along any one dimension (Birman & Trickett, 2001). In the current research study, acculturation was measured by the American Acculturation Index and the Asian Acculturation Index of the Language, Identity, and Behavioral Acculturation Scale (LIB; Birman & Trickett, 2001).

STEM fields consisted of areas of study in the natural sciences (physics, chemistry, biology, agriculture), engineering (including computer science), and mathematics, all of which were offered as majors in four science and engineering colleges at the university site of the research study. The social sciences and psychology were not included in this definition of STEM fields due to distinct differences in gendered history; laboratory, project, and problem based work; and mandatory prerequisite courses (Elliott, Strenta, Adair, Matier, & Scott, 1996).

In this research study, *college environment factors* was a term that encompassed racial climate, gendered climate, compositional diversity, and academic peer support. The *racial climate* perceived by Asian American undergraduate women in STEM majors was defined as perceptions of faculty-student interactions and racial sensitivity in the classroom, measured by the Faculty and Classroom Behavior scale (Neal, 1992). The *gendered climate* perceived by Asian American undergraduate women in STEM majors was defined as perceptions of direct or vicarious discouragement or discrimination by faculty or peers based on gender, measured by the Gender Discrimination scale (Vogt, 2003). *Compositional diversity* is the numerical representation of racial and gender

groups (J. F. Milem, personal communication, November 22, 2004), referred to as structural diversity by Hurtado et al. (1999). In this research study, compositional diversity was operationalized as the percent of undergraduate women in a STEM major and the percent of Asian American undergraduate students in a STEM major. *Academic peer support* was defined as the quality of a student's peer-group interactions (Pascarella & Terenzini, 1980). This variable was measured by the Interactions with Peers scale (Pascarella & Terenzini).

Academic self-efficacy, measured by the Academic Milestones Self-Efficacy scale (Lent et al., 1986), was defined as confidence in one's ability to perform tasks essential to academic success in STEM fields (Hackett et al., 1992; Lent et al.).

In this research study, *academic achievement* was defined as a student's semester grade point average, and *past performance* was defined as high school grade point average. Career choice, degree aspirations, grade point average, degree attainment, and graduation with honors are all indicators of college achievement (Astin, 1993), but grades and grade point average predict bachelor's degree attainment and enrollment in graduate programs, even after controlling for other factors (Pascarella & Terenzini, 1991, 2005).

Purpose of the Study and Research Design

The purpose of this research study was to examine, for undergraduate women of various Asian American ethnic backgrounds, the influence of background contextual and college environment factors on their sense of academic self-efficacy and achievement in STEM majors. Three research questions guided the study. For Asian American undergraduate women in STEM majors,

1. Do Asian American ethnic groups significantly differ on social cognitive career variables of past performance, socioeconomic status, acculturation, academic peer support, racial climate, gendered climate, academic self-efficacy, and achievement?

2. How do the social cognitive career variables of past performance, socioeconomic status, acculturation, academic peer support, racial climate, and gendered climate contribute to explaining academic self-efficacy and achievement?

3. Does academic self-efficacy mediate the relationships from past performance, socioeconomic status, acculturation, racial climate, gendered climate, and academic peer support to achievement?

The design of this research study involved cross-sectional, single-institution, survey research. Data were collected through an online survey and analyzed through quantitative statistical procedures of multivariate analysis of variance and path analysis. The sample was a full population sample of Asian American undergraduate women majoring in the natural sciences (physics, chemistry, biology, agriculture), engineering (including computer science), and mathematics in one of four science or engineering colleges at a large public, doctoral research extensive university on the east coast.

Social cognitive career theory (Lent et al., 1994) provided the theoretical foundation for the research design by delineating the relationships from college environment factors to academic self-efficacy and achievement including the influences of past performance, socioeconomic status, and acculturation for Asian American undergraduate women majoring in STEM, as depicted in the theoretical path model in Figure 1. This research study first explored the presence of differences among Asian American ethnic groups in the social cognitive career model's variables. The design

further involved an analysis of the relationships among the social cognitive career variables.

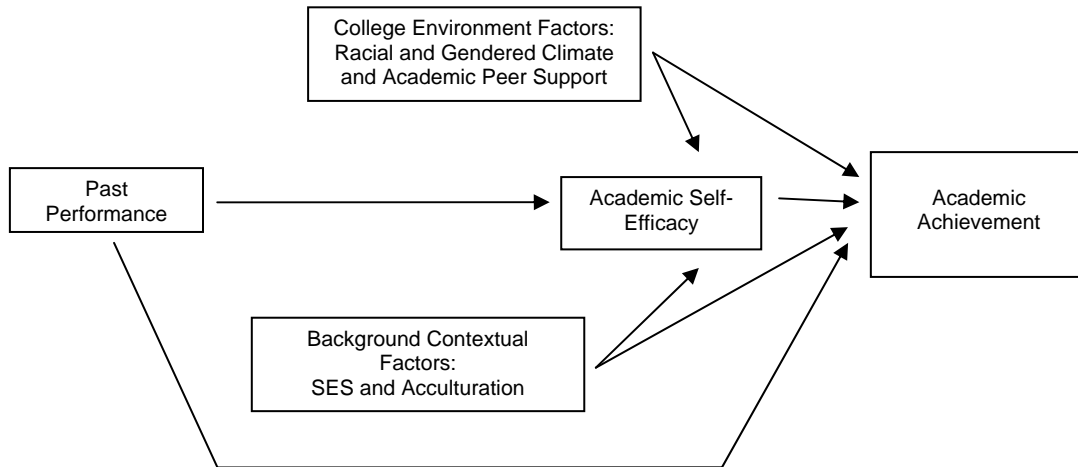


Figure 1. Theoretical model of academic and career development.

The data for this study were collected at a large public, doctoral research-intensive university on the east coast, where the Asian American population comprised 14% of the undergraduate student body (Office of University Communications, 2004), and 36% of Asian American students in STEM majors at this institution were women (Office of Institutional Research & Planning, 2005). Data on past performance, academic level, compositional diversity of STEM major, and achievement were obtained from institutional sources. Data for background contextual factors (socioeconomic status and acculturation), college environment factors (academic peer support and climate), and academic self-efficacy were collected from several measures on a single survey instrument available via the Internet.

The research design involved two phases of data analysis. First, ethnic group differences in social cognitive career variables were assessed through multivariate analysis of variance (MANOVA) procedures. The nine variables included in the three MANOVA tests were (a) socioeconomic status index, Asian acculturation index, and American acculturation index; (b) racial climate, gendered climate, and academic peer support; and (c) high school grade point average, academic self-efficacy, and semester grade point average. MANOVA tested for statistically significant differences among four ethnic groups of East Asian American, South Asian American, Southeast Asian American, and multi-ethnic Asian American participants. Results from the MANOVA tests determined if ethnic groups were considered separately or if they were aggregated in the second phase of analysis: examining relationships among the variables through path analysis. It was determined in the first phase of analysis that ethnic groups could be aggregated in the second phase of analysis.

In the second phase, path analysis procedures were implemented to test relationships among the variables hypothesized by the application of social cognitive career theory (Lent et al., 1994) to Asian American undergraduate women majoring in STEM (Byars & Hackett, 1998; Hackett et al., 1992; Leong & Chou, 1994; Tang et al., 1999). In addition to the nine variables from the first phase of analysis, academic level, the total number of college credits earned by a student, was included in the path diagram as a control variable, and two compositional diversity variables were included. Path analysis provided a robust picture of the complex processes involved in academic and career development, aligning with critical feminist inquiry that advocates an interactional

view of gender, recognizing individual agency within a social context of power and domination (Riger, 1998).

Statistical data analysis, using maximum likelihood estimation in EQS 6.1 (Bentler & Wu, 2000), examined overall model fit. If the theoretically derived model was not a good fit, the model was respecified based upon theoretical support for model changes (Byrne, 2001). Respecifying a model is exploratory in nature because it is dependent upon the data collected (Byrne; Klem, 2000). The collective influence of background contextual factors and college environment factors was assessed by identifying their direct, indirect, and total effects on academic self-efficacy and achievement.

Some limitations to the research design should be considered. Since ethnicity of participants was not known prior to data collection, the size of each ethnic group may have limited the proposed Asian American ethnic group analyses. In addition, although path analysis addressed the complexity of psychosocial processes, it could not confirm the model (Klem, 2000). The cross-sectional design of this study prevented determination of causality among background contextual factors, college environment factors, and academic self-efficacy proposed in the social cognitive career model.

The limitations were offset by some of the benefits of this particular research design. For example, the intricacy of relationships among complex social constructs was maintained in path analysis, enabling an analysis of both internal psychological processes and external contextual process in academic and career development. This study provided new data to support the scholarly knowledge base regarding the academic and career development of Asian American women in STEM majors. However, conclusions and

decisions should be made only when the findings from this study are combined with other evidence to provide a robust picture of the experience of Asian American women in undergraduate STEM majors.

Asian American Feminism

Asian American feminism served as the philosophical grounding of this research study, guiding interpretation of social cognitive career theory, decisions regarding the research design, and interpretations of findings. This section describes the issues that Asian American feminists identify as important and demonstrates how this research study fits into the Asian American feminist action agenda, further supporting the need for and significance of this study.

Asian American feminism is an “articulation of the necessary overlap of many social and historical processes of hierarchy and injustice” (Aguilar-San Juan, 1997, p. x). Because Asian American women share a common space in the system of power and hierarchy, feminism must be concerned with more than the experiences of the diverse Asian American female population (Shah, 1997). It must represent their interests in order to uncover the forces of racism and patriarchy, and to expose how they counter these forces (Shah, 1997). For example, Espiritu (2001a) detailed the gendered and sexualized racist stereotypes assigned to Asian Americans and Asian American women in particular, in order to emphasize how race and gender are not parallel, but “intersect and confirm each other” (p. 199).

Asian American feminism is not an addendum to either the Asian American movement or Western feminism. Asian American feminism critiques the Asian American movement for ignoring internal tensions related to gender hierarchies in the name of

racial solidarity (Aguilar-San Juan, 1997; Hune, 2000). The need to sustain an image of success and respect has pervaded the Asian American community and its organizations, with a disproportionate impact on its women and the social issues relevant to women. Asian American women often are held to a standard of a model image as loyal, chaste, passive, modest, and obedient. Many Asian American women are aware of sexism but loyalty to their Asian American community and concern for issues of racism take precedence (Chow, 1998). As a result, Asian American women feminists may feel they must choose between loyalties to their communities or their political beliefs and values (Das Dasgupta & DasGupta, 1997).

Asian American feminism critiques Western feminism as well. Western feminism often promotes perspectives that tend to obscure the social conditions that marginalize different groups of women in different ways. As such, these perspectives do not help to address issues of social justice relevant to the lives of Asian American women (Aguilar, 1997). In contrast to Western feminism, Asian American feminists call for a feminism that is viewed in collective (rather than individualistic) and global (rather than local) terms (Das Dasgupta & DasGupta, 1997). Recommendations for working to create an Asian American feminism include questioning from within the community; building upon the history of feminist activism in Asia and the “Third World”; relying upon the empowering components of Asian heritage; and developing a deep understanding of race, class, sexuality, and nationality (Das Dasgupta & DasGupta).

Organizing among Asian American women has occurred around local issues for decades. Some of the lasting outcomes of Asian American feminist movements include a focus on gender in college Asian American studies departments, attention to health needs

in health and mental health centers, and Asian American women's writer's groups (Chow, 1998). In addition, the NAPAWF, National Asian Pacific American Women's Forum, was formally established in 1995.

The NAPAWF platform paper on educational access, described above, adds education issues to the Asian American feminist agenda (Chen et al., 1999). A recent action related to higher education is lobbying for the passing of HR 333, a proposed amendment to the Higher Education Act of 1965. In August 2003, 102 Asian American organizations, including NAPAWF, signed their support for HR 333, which would have established a designation of *Asian American and Pacific Islander Serving Institution (AAPISI) of Higher Education*, accompanied by federal support, for any college with an Asian/Pacific Islander American population of 10% or more. This designation would parallel those of Historically Black Colleges and Universities, Alaskan Native/Native Hawaiian Serving Institutions, Tribal Colleges, and Hispanic Serving Institutions (Cayabyab, 2003). The bill was not passed during the 108th Congress and was removed from the books (GovTrack, 2005).

Asian American feminism offers an approach for philosophically understanding the roles of oppression and agency in the experience of Asian American undergraduate women in STEM (Hune, 1998). As a foundation, Asian American feminist philosophy provides a richer and more informed perspective of the need for this research study. It also raises the importance of understanding how ethnicity, background contextual factors, and college environment factors influence Asian American women's self-efficacy, academic achievement, and overall career development.

Significance of this Study

This study has strong theoretical and research based implications as it contributes to the body of research literature regarding gender and race, academic self-efficacy and achievement, and climate within the STEM college environment. Furthermore, a clear understanding of Asian American women's issues, enhanced by the results from this study, can inform better educational practice and enable institutions to address the needs of Asian American women in STEM.

The analysis of climate in social cognitive career theory makes a much needed contribution to the research regarding social cognitive career theory, as contextual factors have not been considered to the extent that other aspects of social cognitive career theory have been addressed in the research literature (Byars & Hackett, 1998; Hackett, 1997; Lent et al., 2000). Furthermore, this research study assessed the relevance and utility of social cognitive career theory in explaining the processes of academic and career development for Asian American women. This study tested hypothesized relationships between variables in social cognitive career theory for Asian American women that were proposed by Byars and Hackett (1998) but had not been empirically researched. Tang et al. (1999) used social cognitive career theory to study the career choices of Asian American women and men, but did not conduct a gender analysis of their data. Vogt (2003) analyzed social cognitive models by gender, but did not consider race as a variable in the study's research design even though the sample had a sufficient number of Asian American and White men and women. The current research study acknowledged that individuals experience their race and gender simultaneously (Weber, 1998).

This study can serve practitioners in higher education and in STEM support services in particular by describing both the strengths and needs of a group of students that often are obscured (Chen et al., 1999). Close attention to the description of the population under study and the climate at this institution are important for determining the applicability of the findings to similar populations at similar institutions. However, educators responsible for support services, specialized programs, and instruction may use the results regarding climate, self-efficacy, and achievement to inform a needs assessment and evaluation of their respective units. In particular, Women in Engineering programs, Women in Science and Engineering residential learning communities, racial/ethnic student associations, and discipline-based student associations may consider ways that they can positively influence the climate experienced by undergraduate Asian American women majoring in STEM disciplines. For example, a support services unit may work to create a mentorship program connecting Asian American women to other Asian American female peers or recruit Asian American women to programs or organizations that currently exist.

Furthermore, highlighting the hidden diversity of experience within the Asian American population and attending to the quality of students' experience can bring Asian American women's issues into the center of policy decisions. By questioning how person and environment together relate to achievement of Asian American women, this study averts the model minority myth and recognizes that the great diversity within this racial group may lead to differences in perceptions of the climate, peer support, sense of self-efficacy, and academic achievement in STEM. Currently the experiences of Asian American women in STEM are invisible because the misleading phrase *over-represented*

is applied as a label, defining their rate of participation but also marginalizing their position in the discourse surrounding diversity (Rosser, 1997). This study attempts to break the silence, challenge the pervasiveness of racial and gender stereotypes, and begin to make visible what has been hidden. Any increase in knowledge, however small, reduces the likelihood that Asian American women will continue to be overlooked.

The results from this study may address missing pieces in the literature and may encourage more diversity research within the STEM educational domain that is not related to the level of *representation* of a group of students. Although Asian American women earn a smaller proportion of all undergraduate degrees awarded to Asian American students in some STEM fields, and some Asian American ethnic groups are under-represented (Chinn, 1999; Huang et al., 2000; National Science Foundation, 2004), the spirit of this study surrounds the *experience* of a marginalized group. This challenges scholars and STEM educators to reconceptualize issues of diversity as more than representation and persistence. Asian American feminists have an agenda to uncover the forces of racism and sexism present in the lives of Asian American women (Chen et al., 1999; Chow, 1998; Shah, 1997); this study may provide insight into how some of these forces operate within a specific context.

Chapter II: Literature Review

The purpose of this research study was to examine, for undergraduate women of various Asian American ethnic backgrounds, the influence of background contextual and college environment factors on their sense of academic self-efficacy and achievement in science, technology, engineering, and mathematics (STEM) majors. The theoretical base for this study came from social cognitive career theory (Lent et al., 1994). This theory has been customized to incorporate variables important to the academic and career development for Asian American women (Byars & Hackett, 1998; Leong & Chou, 1994; Prosser, 2001). In addition, the conceptual frameworks of climates for diversity in higher education (Hurtado et al., 1999; Sandler, 1999) were used to identify specific elements related to the college environment experienced by Asian American women in STEM. This chapter introduces social cognitive career theory, its critiques, and recommended modifications, followed by a comprehensive examination of the empirical evidence available regarding major constructs of social cognitive career theory – achievement, academic self-efficacy, background contextual factors, and proximal environment. The conceptual framework of institutional climate for diversity is presented to provide a lens for understanding the proximal environment. Research studies that tested relationships among these constructs are then presented, and the chapter concludes with recommendations for the theoretical model tested in the current research study.

The research literature throughout this chapter considered either gender or race as primary categories of analysis. A limited number of relevant studies addressed the interaction of gender and race or included Asian American women as a distinct group in

their samples. Therefore, literature presented in this chapter that did not pertain directly to this population of students was included because it addressed either race or gender issues relevant to essential aspects of the theoretical framework of the current research study, such as relationships among variables in the model, the research design, or the research methodology. This chapter describes the accumulation of knowledge regarding the academic and career development of Asian American women in STEM and recommendations for the design of the current research study offered by the research literature.

Social Cognitive Career Theory

Social cognitive career theory (Lent et al., 1994) was informed by research, such as Hackett et al. (1992) and Lent et al. (1984, 1986), that relied upon social cognitive theory of human behavior (Bandura, 1977, 1986) to study the academic achievement of science and engineering undergraduate students. Bandura's social cognitive theory provided the base for social cognitive career theory by delineating self-efficacy and prescribing the link between self-efficacy and behavior change. Bandura (1977) defined self-efficacy as the personal expectation that an individual could successfully perform a behavior that was needed to produce an outcome (Bandura, 1977). By focusing on performance, self-efficacy is distinct from outcome expectations, which are beliefs regarding the consequences of a behavior. Bandura (1977) proposed that self-efficacy influences the choice of engaging in a behavior, the level of effort expended, and the length of time spent on an action in a particular situation, and consistently predicted performance for individual actions. Adequate skills and motivation are also important to behavior choice, effort, and persistence, but self-efficacy exerts a major force on these

actions. Furthermore, self-efficacy expectations differ in magnitude, generality, and strength and are based on four sources of information: performance accomplishments, vicarious experience, verbal persuasion, and emotional arousal (Bandura, 1977).

With respect to performance accomplishments, prior success increases expectations about future successful performance (Bandura, 1977). Vicarious experience, or role modeling, is another source of efficacy information, although observing another's successful actions had a weaker relationship with self-efficacy than one's own experience with success. Verbal persuasion is another weak source of self-efficacy information, but it tends to strengthen the effects of performance accomplishments and vicarious experience. The fourth source of efficacy information is emotional arousal. People use their level of arousal to identify their level of anxiety and stress, and cognitive appraisal of the arousal informs their sense of self-efficacy. High anxiety tends to reduce expectations of success, but emotional arousal might also be energizing. Cognitive appraisal of information applies to the other three processes as well (Bandura, 1977).

The relationship between self-efficacy and task accomplishment is stronger when contextual factors, such as social, situational, and temporal issues, were considered (Bandura, 1977). Sociostructural contextual factors shape the psychological processes of human development, such as self-efficacy, which in turn produce actions. Individuals are considered agentic within overlapping social contexts, and are generative, creative, proactive and reactive with respect to those contexts (Bandura, 2001). Self-efficacy information is localized to a behavior, and is more predictive of tasks when it is measured as specific to those tasks. Cognitive appraisal of the level of safety in a situation, the attribution of outcomes to skill or situation, the difficulty of the task, the risk of negative

consequences, and the frequency of success, all influence the predictive ability of self-efficacy on performance (Bandura, 1986).

Hackett and Betz (1981) first introduced social cognitive theory to career development theory and research to aid in understanding women's career development. Social cognitive theory was proposed to explain the process by which gender role socialization (manifested in both internal/psychological barriers and external/environmental barriers) related to women's career behavior and ultimately explained the weak relationship between women's ability and interests with their career choices and successes. Hackett and Betz described the cognitive processes of self-efficacy expectations that mediated the relationship between socialization and career choice and achievement behaviors. They proposed that internal barriers, such as fear of success, reduce women's expectations of self-efficacy, and external barriers, such as discrimination or lack of support, are obstacles requiring strong self-efficacy to overcome, if possible. Specifically, Hackett and Betz hypothesized that women's self-efficacy was lower and weaker than men's self-efficacy in career-related behaviors due to differential access to and different socialization experiences with the four sources of efficacy information (performance accomplishments, vicarious experience, verbal persuasion, and emotional arousal) identified by Bandura (1977). Hackett and Betz further hypothesized that interventions or alterations in these sources of efficacy would increase women's sense of self-efficacy, and a stronger sense of self-efficacy would subsequently increase women's career choices, satisfaction, persistence, and performance. Betz and Hackett (1997) documented the accumulation of research evidence demonstrating that women and men differed in their levels of occupational self-

efficacy, self-efficacy for scientific-technical careers, mathematics self-efficacy, and self-efficacy related to Holland types (i.e., Realistic, Investigative, Artistic, Social, Enterprising, Conventional). Betz and Hackett proposed that gender differences in these specific forms of self-efficacy derived from differences in gender role socialization and resulted in differences in career interests, in general, and participation levels in traditionally male career fields (such as science and engineering), in particular.

Based upon social cognitive theory of human behavior (Bandura, 1977, 1986) and extending the subsequent theoretical and research applications to career development initiated by Hackett and Betz (1981), Lent et al. (1994) developed social cognitive career theory to describe the interactions between background characteristics and the environment with cognitive-person factors (e.g., self-efficacy), and the influence of these constructs on academic and career development. The three academic and career development outcomes explained by social cognitive career theory are career and academic interest, choice, and performance (i.e., achievement). The theory incorporates three interlocking models to describe the elements and processes involved in explaining these three outcomes. Hypotheses related specifically to the performance model are presented below.

Social cognitive career theory (Lent et al., 1994) conceptualizes performance as level of accomplishment and persistence in career and academic realms. In the performance model of social cognitive career theory, self-efficacy influences performance both directly and indirectly through outcome expectations and performance goals. Outcome expectations, defined by Bandura (1977) as beliefs regarding the consequences of a behavior, influence academic and career performance only indirectly

through performance goals. Performance goals are defined by Lent et al. as an individual's desires regarding level or quality of performance. Furthermore, in social cognitive career theory, ability or past performance influence performance both directly and indirectly through both self-efficacy and outcome expectations (Lent et al.). Past performance was viewed as a source of efficacy information, as described in Bandura (1977). Lent et al. hypothesized that accurate or slightly inflated estimates of self-efficacy (compared to current ability) are most effective in an individual's academic and career development. Both over-estimating and under-estimating expectations to accomplish a behavior could have negative consequences regarding outcomes.

Consistent with Hackett and Betz's (1981) conceptualization of the influence of gender on social cognitive theory, social cognitive career theory postulates that person factors of gender and race/ethnicity influence performance indirectly through access to sources of information (here, past performance) and through environmental forces, such as socialization processes and opportunity structure (Lent et al., 1994). Environmental factors are both perceived and observed. Background contextual factors of emotional support, financial support, cultural socialization, gender-role socialization, and vicarious experience are more distal environmental influences that impact performance indirectly through past performance. More proximal elements of the environment, such as current discriminatory experiences and perceptions of supports and barriers, exert influence on performance indirectly through performance goals (Lent et al., 2003). According to social cognitive career theory, gender and racial differences in career actions arise primarily from differences in access to opportunities, supports, and socialization processes. Furthermore, gender and racial differences in self-efficacy are mediated by differences in

access to sources of efficacy information and different forms of reinforcement (Lent et al., 1994).

Race and Gender in Social Cognitive Career Theory

In a review of the literature on the academic and career development of women of color through the lens of social cognitive career theory, Byars and Hackett (1998) described the processes through which race/ethnicity, gender, and cultural factors influence social cognitive factors and career outcomes. The social identity variables identified by Byars and Hackett as influencing self-efficacy included socioeconomic status along with gender and race/ethnicity. Byars and Hackett also identified stress and coping efficacy as two psychological variables that measured the ability of women of color to address negative aspects of their environments. Furthermore, racism and sexism influenced the environmental factors of perceived and encountered barriers, social support, and opportunity structure (Byars & Hackett; Flores & O'Brien, 2002; Hackett et al., 1992; Lent et al., 1994). In a theoretical discussion of race, gender, sexual orientation, and social class and the utility of career development theories, Fitzgerald and Betz (1994) highlighted additional factors that influence career development for White women, women of color, and men of color. Structural and cultural factors relevant to women's career development are discrimination, a "null" environment (indifference), sexual harassment, attitudes towards the relationship between home and work, and gender-role socialization. Fitzgerald and Betz identified the need for career development theory to account for racial occupational stereotyping, college degree attainment, and collectivist values when considering race-related influences.

The environment is the least studied aspect of social cognitive career theory; most research has focused on cognitive-person variables, particularly self-efficacy (Lent et al., 2000). As a result, several career theorists and researchers (Byars & Hackett, 1998; Flores & O'Brien, 2002; Hackett & Betz, 1981; Lent et al., 2000) have recommended research that focuses on the context within which career development occurs, particularly for women of color. Lending support for a study in career development that includes college environment factors, Lent et al. (2000) provided theoretical foundations for studies of environmental factors involved in career decisions, particularly contextual supports and barriers to career choice. Operationalizing the barriers constructs within social cognitive career theory requires differentiation between perceived and objective environments, proximal and distal factors, and career barriers and coping efficacy. The interplay between objective barriers, subjective perceptions, and personal locus of control influences whether barriers would be perceived as insurmountable, mere obstacles, or strong motivators to succeed (Lent et al., 2000). Additionally, critical analysis of social cognitive career theory reinforced the need to empirically explore career supports, missing from much of the general career development research literature (Fitzgerald & Betz, 1994; Lent et al., 2000).

Lent et al. (2003) studied the role of contextual variables in engineering persistence by comparing two theoretically derived models. Using path analysis of data collected from 287 undergraduate engineering students, the authors found that the first model, derived from social cognitive career theory, was not a good fit, but the general self-efficacy model (social cognitive theory) from Bandura (1977) was a good fit for predicting persistence. The difference between the two models was in the relationship

between contextual variables and career actions, where the Lent et al. (1994) model predicted both a direct relationship to persistence and an indirect relationship through performance goals. On the other hand, the Bandura (1999) model predicted only an indirect relationship to persistence through self-efficacy. Lent et al. (2003) found that the paths between contextual supports and barriers (environment measures) to self-efficacy were significant, accounting for 56% of the variance in self-efficacy. However, the paths between supports and barriers to performance goals were not significant. The data provided stronger support for the Bandura model by indicating that the relationship between environmental variables and persistence was predominantly, if not exclusively, indirect through self-efficacy (Lent et al., 2003). The results of this study of *persistence* suggest that social cognitive career theory's hypothesis of direct effects of the environment on performance is inaccurate, but the association between environment and *performance* (as opposed to persistence) has not been tested.

The cross-sectional nature of the Lent et al. (2003) study (except for collection of persistence data) prohibited determination of the causal ordering that was proposed by the theoretical path models. Furthermore, the skewed nature of students' characteristics and responses limited generalizability to theoretical applications for all students. First, most students (93%) identified strong goals to continue in engineering, and most (79%) persisted over the three semesters of the study. Second, students perceived their environmental context positively, citing many supports and few barriers (Lent et al., 2003). And third, the sample consisted of 80% men and 63% European American students. Asian American students comprised 18% of the sample, but gender representation was not available by racial group. Therefore, results found in this study

may not be replicated in another study of a sample with more variance in goals, persistence, gender, and race. Lent et al. (2003) recommended future exploration of the social cognitive career relationships among variables (a) for different student groups, particularly those that are under-represented in engineering; (b) in more collectivistic cultural contexts where family may have more direct effects on career choice and actions; and (c) for more specific types of barriers and supports, such as gender-related barriers, teacher support, and student competition, instead of aggregate measures (Lent et al., 2003).

Asian American Women's Career Development

The theoretical exploration, elaboration, and critique presented above influenced the evolution of social cognitive theory in the realm of academic and career development. It initiated additional theory-generating work and empirical research findings that utilized a more diverse perspective on the individuals in question and the environmental influences within which those individuals developed. This section references additional theoretical considerations by Byars and Hackett (1998), Leong and Chou (1994), and Prosser (2001) to describe the academic and career development of Asian American women. By expanding upon Lent et al.'s (1994) hypotheses related to gender and racial differences in self-efficacy and career actions, Byars and Hackett (1998) reviewed the literature on the academic and career development of women of color to propose relationships between culturally-based background contextual factors and social cognitive career processes. The hypotheses for African American women, Latinas, Asian American women, and American Indian women were organized around the four sources of efficacy information: performance accomplishments, vicarious learning, physiological and

affective states, and verbal persuasion (Bandura, 1977). This discussion focuses on the hypotheses related to Asian American women.

Within prior performance accomplishments, Byars and Hackett (1998) hypothesized that extrinsic values combined with a pragmatic and collective approach to career choice are important in Asian American women's career development because personal experiences with racism or sexism may influence Asian American women's prior performance accomplishments. As a result, education becomes more functional for economic and career attainment as social forces resulting from racism and sexism block other paths to economic attainment. Extrinsic values, encouraged by experiences with racism, therefore are important to career choice. Byars and Hackett also hypothesized that Asian American women are more likely to choose a career for pragmatic reasons, such as income, stability, and prestige, than to make a choice based on self-actualization goals or personal interests. Furthermore, Byars and Hackett hypothesized that Asian American women are more likely to defer their career choice to parents than to make choices independently, and may have strong levels of efficacy for math and science, supported by positive experiences in math.

Vicarious learning occurs through interactions with role models (Bandura, 1986). Byars and Hackett (1998) hypothesized that within-group role models are important influences on the self-efficacy of Asian American women with a collectivist orientation. Due to occupational segregation of Asian Americans in technical fields, it may be easier to find Asian American role models in STEM than in other fields, thereby enhancing self-efficacy (Byars & Hackett). The relatively small proportion of Asian American STEM professionals combined with the gender gap among Asian Americans in STEM (Hill,

2002; Huang et al., 2000, 2000) indicates that it may be easier to find a female role model who is White or an Asian American role model who is male than to find a role model who is both Asian American and female.

With respect to affective states, Asian American women are more likely to express an external locus of control and low tolerance for ambiguity, with implications for their career development (Leong, 1985). Byars and Hackett (1998) hypothesized that external locus of control and low tolerance for ambiguity provide motivation to perform well and an increase in personal efficacy. Since social anxiety is impacted by acculturation and assimilation, actions to reduce anxiety, such as majoring in STEM in order to increase in-group status, were hypothesized to increase self-efficacy and coping strategies. Furthermore, an Asian value of respect for older relatives may increase the salience of verbal messages from parents of Asian American women. These messages may be encouraging or discouraging, and therefore verbal persuasion may have both positive and negative impacts on self-efficacy (Byars & Hackett).

The hypothesized links between the four sources of efficacy information and social cognitive career outcomes, specifically self-efficacy and achievement, are influenced by Asian American students' racial identity and level of acculturation (Byars & Hackett, 1998). Leong and Chou (1994) observed a lack of research connecting acculturation and career-related outcomes and offered several hypotheses that could be tested. Acculturation is a complex process of cultural change for an individual resulting from contact with another culture and can be expressed in terms of language, behaviors, interpersonal interactions, attitudes, and values (Leong & Chou). Leong and Chou connected acculturation of Asian Americans to work attitudes, occupational choice, and

career expectations and to the impact of occupational segregation, occupational stereotyping, and discrimination. Specifically, Leong and Chou proposed that less acculturated Asian Americans (those who maintain and uphold primarily Asian cultural values and behaviors) are more likely to choose stereotyped occupations, such as science and engineering fields, whereas more acculturated individuals (those who adopt mostly Western cultural values and behaviors) are less likely to be influenced by occupational segregation in their career choice. In addition, greater acculturation to dominant American culture may result in greater emphasis on self-actualization in career choice, as opposed to more pragmatic choices influenced by parental expectations and financial security (Leong & Chou). Acculturation impacts the processes identified in social cognitive career theory in that collectivist orientation, family financial needs, and parental pressure might be more important than self-concept (a construct related to self-efficacy and interests) for Asian Americans in general and less acculturated Asian Americans in particular. Leong and Chou hypothesized that less acculturated Asian Americans demonstrate lower career-related self-efficacy because they are more likely to adhere to the Asian cultural value of respect for parental authority. Therefore, choice may be more closely tied to family decisions than personal interests and may increase stress and reduce job satisfaction. Notably, gender was not considered by Leong and Chou in their theoretical piece.

A grounded theory study by Prosser (2001) offered a gender perspective to the career development of Asian American women. Prosser's study resulted in the creation of a grounded theoretical framework for understanding the career development of successful Asian American women across a variety of careers. In the grounded theory, identity

factors of culture and gender, multiple roles, personality, life values, and belief in self were strong influences on women's professional career development. The influence of culture was broad and tended to be episodic. Family of origin, education experiences, and sociopolitical factors were the background variables that influenced Asian American women's career development. The women in Prosser's study influenced their environments which reciprocally influenced them, particularly through challenges/limitations and resources/support systems. Managing family and work, coping with stress, addressing racism and sexism, and engaging in leadership were common behaviors. Furthermore, career paths tended to be unplanned. A common career goal for the women in this study was to enjoy their careers as they worked to positively impact others' lives (Prosser).

Although not specifically asked in interviews about their experiences of racism and sexism, 24 of 25 participants in Prosser's (2001) study identified personal experiences with discrimination and the role of racism and sexism in their personal and professional lives. They discussed gender-specific experiences, such as unequal pay, and culture-specific experiences, such as choice of traditional career fields. Many participants noted that their discriminatory experiences were related to both racism and sexism. They also discussed the presence of sexism within their own culture (i.e., Asian/Asian American patriarchy). These acts of discrimination were present throughout their careers but tended to shift from overt to more covert forms. The Asian American women tended to see race as more salient to their identities and racism as more prominent in creating stress at work, but they viewed sexism as a greater challenge to their career development than racism (Prosser).

Discrimination from racism and sexism, in terms of a non-supportive environment, lack of networking, death threats, and sexual harassment, increased participants' work-related stress (Prosser, 2001). As a result, participants felt they needed to continually re-establish credibility, they faced increased demands to "do more" with respect to race and gender issues, and they experienced health problems. The effects were feelings of inadequacy, reduced sense of self-worth, and limited opportunities and hindered advancement when they decided to enact advocacy-based career decisions (Prosser). Career-related barriers encouraged the women to work harder, to push themselves to do their best, and to do what they most enjoyed. They viewed their success, defined in terms of both personal *and* professional achievement, as the result of a combination of personal and external factors, including a team effort (Prosser).

The influence of Prosser's (2001) participants' high levels of self-confidence, self-knowledge, and self-assessment of strength on their career development was related to the notion of career self-efficacy identified in the social cognitive career literature (Byars & Hackett, 1998; Hackett & Betz, 1981; Lent et al., 1994). Furthermore, most participants reported that traditional gendered/patriarchal values were not espoused by their parents, highlighting the role of gender role socialization in women's career development. The role of acculturation, manifested as levels of cultural identity, pride in heritage, and connection with a cultural community, also was salient in shaping the women's career goals and related actions (Prosser). This grounded theory study enhanced the career development literature in several ways. First, Prosser found that participants' career interests and enjoyments were congruent with their career choices and with their parents' support and values. The study uncovered that the participant reports of support

they received from their families of origin regarding career choice ranged from support for independent or non-traditional choices to pressure for prestigious or traditional choices. However, most of the high-achieving women viewed their parents' high expectations for educational and career attainment as an accepted assumption rather than pressure. Therefore, Prosser concluded that parent support was the most critical factor in family involvement on career choice and career self-efficacy.

Additionally, participants in Prosser's (2001) study did not report major influences of socioeconomic status on their career interests or achievement, but Prosser did note that the sample was skewed towards both high-socioeconomic status and high professional achievement and that the notion of "Asian SES" was complex (p. 197). Finally, Prosser's work expanded understanding of the intersections of gender, ethnicity, and race in career development processes, particularly with respect to experiences of discrimination, career-related supports and barriers, work-related stress, personal and professional identity, and background factors.

Summary

By applying the features of social cognitive career theory to the academic and career development of Asian American women, the following processes become apparent. Cultural factors, such as socioeconomic status, acculturation, collectivist values, and gender-role socialization, are important to Asian American women's career actions and academic performance (Betz & Hackett, 1997; Byars & Hackett, 1998; Lent et al., 2000; Leong & Chou, 1994; Prosser, 2001). Cultural factors influence career outcomes indirectly through self-efficacy and outcome expectations (Byars & Hackett; Lent et al., 1994, 2000; Leong & Chou). Academic self-efficacy is positively and directly

related to academic achievement; academic self-efficacy is also indirectly related to achievement through performance goals (Lent et al., 1994). Although social cognitive career theory models a direct path between proximal environment factors and career outcomes, empirical evidence indicates that the path may be indirect through self-efficacy (Lent et al., 2003). Important elements of the proximal environment are barriers, supports, and opportunity structures (Byars & Hackett; Fitzgerald & Betz, 1994; Lent et al., 1994, 2000). A pragmatic orientation to career choice, availability of role models, external locus of control/collectivist orientation, and family roles and expectations are hypothesized to positively influence self-efficacy and therefore achievement (Byars & Hackett; Leong & Chou; Prosser).

Some background contextual variables (within-group differences), other than level of acculturation and socioeconomic status, that also may influence career development were not considered in social cognitive career theory or its critiques. In particular, ethnicity, generational status, and generation in college may influence students' achievement above and beyond elements described in social cognitive career theory (Chinn, 1999; Hune, 1998; Suzuki, 2002). In addition, proximal environment variables related to stereotypes and discrimination also may influence the career development of Asian American women in STEM. Specifically, Hune and Suzuki (1989, 2002) suggested that "model minority" expectations around performance in STEM may increase stress and lower self-efficacy, particularly for collectivist oriented students. The status of over-represented minority may lead to a lack of attention to students' needs; if true, then it might negatively impact Asian American students' self-efficacy and achievement (Hune; Suzuki, 2002).

The primary constructs in social cognitive career theory – achievement, self-efficacy, background context, and proximal environment – and hypotheses regarding relationships among them are explored in detail in the following sections. Since the research literature on social cognitive career theory did not provide specific information on the academic and career development of Asian American women, research studies related to specific constructs in the model were analyzed, offering greater understanding of the factors involved in Asian American women’s academic achievement. Research studies that relied upon social cognitive theory and social cognitive career theory to examine achievement, race and gender, or STEM educational experiences are then examined.

Achievement

Indicators of undergraduate achievement include career choice, degree aspirations, grade point average, persistence, degree attainment, and graduation with honors (Astin, 1993). Astin reasoned that grades are not a good measure of intellectual growth because rather than measuring growth from a students’ own baseline, grades are determined in relation to other students’ achievement. However, Astin noted the importance of grades as externally evaluated measures, as opposed to self-reported measures, that are valued in employment decisions and graduate school admissions. Indeed, grades have predicted college persistence, bachelor’s degree attainment, graduate school attendance, and graduate degree attainment, even after controlling for other potentially confounding factors, including but not limited to academic ability, motivation, aspirations, high school grades, institutional selectivity, college major, and social involvement (Pascarella & Terenzini, 1991, 2005). Leslie, McClure, and Oaxaca (1998),

using pre-college through employment data from the 1971 and 1980 Cooperative Institutional Research Program data sets and the National Longitudinal Survey of Youth in 1979, found that the influence of undergraduate grades on bachelor's and master's degree attainment was stronger for White women than for White men in the physical sciences, biological sciences, and engineering. Pascarella and Terenzini (2005) also found that grades predicted career choice, job status/prestige, and earnings. For example, meta-analysis results demonstrated that after controlling for background characteristics, college experiences, and college major, an increase of one grade point was related to a net total increase of 8-9% in earnings (Pascarella & Terenzini, 2005). The influence of grades on earnings was stronger for women and students in science, mathematics, business, and education majors. In fact, the effect of grades on earnings for women was 130% of the effect for men (Pascarella & Terenzini, 2005).

Predictors of College Achievement

Several background characteristics are significantly related to college grades. Specifically, high school GPA and SAT scores are consistently the strongest predictors of college GPA (Astin, 1993; Pascarella & Terenzini, 1991; Robbins et al., 2004). Other background characteristics that have positive relationships with college grades include socioeconomic status, gender (being female), race (being White), and citizenship status (being a citizen; Astin; Robbins et al.).

In a meta-analysis of the relationship of psychosocial factors with academic outcomes, Robbins et al. (2004) combined college impact and psychological theories to explore the predictors of academic achievement and retention. The constructs in the study included three traditional predictors of high school GPA, ACT/SAT scores, and

socioeconomic status; eight psychosocial and study skills factors (achievement motivation, academic goals, institutional commitment, perceived social support, social involvement, academic self-efficacy, general self-concept, and academic-related skills); and the contextual influences of financial aid/support, institutional size, and institutional selectivity. The sample of 109 published studies included 279 correlations with cumulative GPA using samples ranging from 24 to 4,805 students. Robbins et al. found true score correlations of .50 between self-efficacy and cumulative GPA, and .45 between high school GPA and cumulative college GPA. These predictors had the largest estimated true correlations. A multiple regression model based on the meta-analysis results tested the predictive ability of psychosocial factors on GPA after controlling for the traditional predictors of high school GPA, SAT/ACT score, and socioeconomic status. The three psychosocial factors of achievement motivation, academic goals, and academic self-efficacy were selected for the regression because their correlations with GPA were the same as or greater than the correlations of the traditional predictors with GPA. The combined model accounted for 26.2% of the variance, and the three psychosocial factors contributed 4.3% above that of the traditional predictors (Robbins et al.). However, Robbins et al. did not include information about participants' race or gender and did not test for the moderating effects of contextual factors on the relationships between psychosocial and study skills factors with academic achievement/GPA.

Pascarella and Terenzini (1991, 2005), in their meta-analyses of the college impact literature, found evidence supporting the influence of the following college environment factors on student grades: institutional type and selectivity, coursework and course-taking, majoring in engineering, science, and mathematics (but most likely

reflecting academic aptitude of students in different majors), teacher behavior (instructor skill, course organization, clarity), faculty cognitive style and attitudes towards grading, student-faculty informal interaction, student academic effort, student stress and workload, and student involvement in personal and social experiences. Student involvement in social and interpersonal experiences has consistently been linked to learning and development (Astin, 1993; Pascarella & Terenzini, 1991, 2005). From results of the Cooperative Institutional Research Program 1985 freshman survey and 1989 follow-up questionnaire, Astin concluded that students' peer groups were the strongest influence on learning and development in college. With respect to college grades, Astin found that the following aspects of the college environment had the strongest significant positive influences on GPA: merit-based aid or scholarships, majoring in education or arts and humanities, faculty diversity orientation, percent of Catholic students, percent of Jewish students, and percent of students in biological science majors. Negative environment predictors of GPA are peers' intellectual self-esteem (related to more stringent grading at more selective institutions), need-based aid, majoring in engineering, and attending a public institution. Several student involvement variables were significantly related to GPA after controlling for background and environmental characteristics, such as the positive predictors of hours per week studying, participating in an internship or study abroad, and talking with faculty outside of class and the negative predictors of hours per week partying, working full-time, hours reading for pleasure, and social fraternity/sorority membership (Astin).

In a study of the influence of institutional characteristics on self-reported gains in learning using a stratified random sample drawn from the College Student Experiences

Questionnaire (CSEQ), Pike, Kuh, and Gonyea (2003) found that after controlling for background characteristics, there were no differences in the college experiences and learning gains of students at different types of colleges and universities, based on institutions' Carnegie classifications (e.g., Doctoral/Research-Extensive and Baccalaureate Liberal Arts). However, more proximal elements of the college environment did influence gains in learning over and above background characteristics. Students with the greatest gains in learning tended to have greater levels of academic and social involvement and more positive perceptions of the academic and interpersonal environments. Women, students of color, and students who wanted more education beyond a bachelor's degree tended to have more positive perceptions of the environment and be more involved on campus; as a result of indirect effects, these students were more likely to have greater gains in learning (Pike et al.).

One study that explored the cognitive and noncognitive predictors of academic achievement of Asian American college students was conducted by Fuertes, Sedlacek, and Liu (1994). Fuertes et al. used stepwise multiple regression to predict grades in the first, third, fifth, and seventh semesters from SAT Verbal, SAT Math, and eight noncognitive variables from the NonCognitive Questionnaire (NCQ): self-concept, realistic self-appraisal, ability to identify and cope with racism, preference for long-term goals, availability of a strong support person, demonstrated leadership experience, demonstrated community service, and acquired knowledge in a nontraditional area. The random sample included 431 Asian American entering freshmen attending orientation between 1979 and 1988 at a large, predominantly White institution located in the northeastern U.S. About 42% of the students were women and the sample was 25%

Korean American, 22% Chinese American, 16% Vietnamese American, 8% Filipino/a, 6% Japanese American, and 23% other Asian American. Gender and ethnicity were not considered in the analyses. SAT Math scores were found to have the strongest relationship to GPA in each semester. Self-concept, nontraditional knowledge, realistic self-appraisal, and community service were consistently positive and significant predictors of GPA until semester 7 when the only noncognitive variable that was a statistically significant predictor was handling racism. The results suggest that both cognitive and noncognitive factors are important in the academic achievement of Asian American students (Fuertes et al.).

Racial Group Patterns of Gender Differences

A 2001 report from the Educational Testing Service explored some of the similarities and differences among racial/ethnic groups in their achievement patterns, specifically how gender differences in educational test scores and other indicators of achievement varied by race/ethnicity from 4th grade through work experience (Coley, 2001). Data sources included the National Assessment of Educational Progress (NAEP) tests of science and math, high school courses taken by SAT test takers, Advanced Placement exam participation and scores, SAT, GRE, and Graduate Management Admission Test (GMAT). Graduation rates, employment rates, and salary and wage information for graduates from high school and college also were reported, but these data were not available for Asian/Pacific Islander/Asian American students (Coley). The report only examined differences in gender gaps and did not compare absolute values of these indicators by racial/ethnic group. Each data source used different labels and

groupings for racial/ethnic categories; the original labels are used here, but only data from the categories that include Asian Americans are presented.

Coley (2001) reported that there were no significant gender differences in NAEP science scores for Asian/Pacific Islander students at ages 9, 13, and 17 in any of the years of collected data (1986, 1990, 1992, 1994, and 1996). Also, there were no significant gender differences in NAEP mathematics scores for Asian/Pacific Islander students in grades 4, 8, and 12 in any of the years of collected data (1990, 1992, and 1996). Between 1990 and 1999, the gender gap favoring men on the number of SAT takers who completed four or more years of high school mathematics and four or more years of high school natural science disappeared for Asian/Pacific Islander groups. However, Asian/Asian American male students were more likely to score a 3, 4, or 5 on the Advanced Placement (AP) Biology and Calculus AB exams than Asian/Asian American female students (Coley).

On the SAT I Mathematics test, Asian/Pacific Islander male students scored significantly higher (about 40 points) than Asian/Pacific Islander female students, a consistent trend between 1990 and 1999 (Coley, 2001). The Asian/Pacific Islander gender gap on the verbal GRE shifted between 1988 and 1998 from favoring women by 16 points to favoring men by 8 points. On the quantitative section of the GRE, men had stronger scores than women in all racial/ethnic groups. Scores on the analytical section of the GRE were similar for Asian/Pacific Islander men and women, about a 10 point advantage for men. Asian/Asian American men scored on average 35 points higher than Asian/Asian American women on the GMAT, the smallest difference of all racial/ethnic groups. Coley's report demonstrates that although some of the gender gaps in educational

achievement measures decreased between 1990 and 1999, significant gaps in math and science achievement indicators between Asian American men and women persist. The report did not explore racial/ethnic group differences among men or among women, only gender differences within racial/ethnic groups.

Achievement for Asian American Youth

Three research studies used data from the National Educational Longitudinal Study (NELS:88) to understand the achievement of Asian American youth in 8th through 12th grade. Given that Asian American youth, as a group, demonstrated higher achievement scores, higher rates of college attendance, and lower rates of dropping out of school than other racial/ethnic groups, Peng and Wright (1994) explored the home environments and extracurricular academic activities that predicted academic achievement for 8th grade student participants in the NELS:88 database and whether differences in these factors accounted for differences in achievement by racial/ethnic group. The sample consisted of 24,599 eighth grade students (in 1988) with 1,527 Asian American students. Independent variables in the study included living with both parents, parent educational level, family income, time doing homework, time watching television, parents helping with homework, parents talking to their children about school related issues, parent expectations for amount of schooling completed, taking lessons outside of school, and total number of educational activities outside of school. Student achievement was a combined score of reading and mathematics tests (Peng & Wright).

Results of racial/ethnic differences compared Asian American students to each of the other student groups (Peng & Wright, 1994). Asian American students had higher achievement scores than Hispanic, Black, and Native American students, but scores were

not different between White students and Asian American students. Asian American students were more likely than all other racial/ethnic groups, including White students, to live in a two-parent family, have parents with an advanced college degree, spend more time doing homework and less time watching television, have higher parental expectations for years of schooling, and participate in more educational activities outside of school. Race/ethnicity accounted for 10% of the variance in achievement scores; school type (private or public), home environment, and educational activities explained 30% of the achievement outcome. The multiple regression equation with all variables found that race/ethnicity added 3% over these home factors. Differences in achievement scores between Asian American students and other racial/ethnic groups decreased after controlling for school type, home environment, and educational activities. In fact, after controlling for these factors, White students had higher achievement scores than Asian American students. This suggests that Asian American students underperformed in comparison to White students in similar socioeconomic and home educational environments (Peng & Wright).

Both 8th grade science achievement and the rate of growth in science achievement from 8th to 12th grade by subgroups of race and gender, including Asian American males and Asian American females, were analyzed by Muller, Stage, and Kinzie (2001) using data from NELS:88. Individual factors explored in the hierarchical linear modeling analysis included socioeconomic status, prior grades, attitudes toward science, attitudes toward mathematics, 8th grade locus of control, 10th grade locus of control, high school track placement, number of science courses, and science class behaviors (such as paying attention in class). For all subgroups, socioeconomic status and prior grades had

significant positive relationships with 8th grade achievement, and locus of control was important for all subgroups except Asian American males. Math and science attitudes were not significant. Quantity of science courses was a significant factor of science achievement growth rates for all subgroups of students; in addition, the effects of high school academic track on science achievement growth rates were significant for most groups, including Asian American females. Locus of control in 10th grade, socioeconomic status, math and science attitudes, and science class behaviors did not have significant effects on Asian American female students' growth rate, although these factors had significant effects for at least one of the other subgroups of students. For instance, 10th grade locus of control was significant for Latinas and for White males (Muller et al.).

Interesting patterns emerged when comparing trends across subgroups, demonstrating an interaction effect between gender and race/ethnicity (Muller et al., 2001). For example, Asian American girls' 8th grade science achievement was lower than White girls, but Asian American girls as a group had a faster growth rate. As a result, Asian American girls outperformed White girls by the 12th grade. Furthermore, the growth rate in science achievement for Asian American girls was slower than Asian American boys, the same as White boys, and faster than all other subgroups (Muller et al.). There were many relationships between factors and outcomes that varied among subgroups, indicating a need to conduct analyses by both race and gender simultaneously. Large variances in outcome variables (8th grade science achievement and science achievement growth rate) within each subgroup suggested within group differences. Muller et al. concluded that future studies needed to incorporate both initial status and

growth rate differences to understand pre-college science achievement across race and gender subgroups.

To better understand the academic experiences among Asian American ethnic groups, Kim, Rendon, and Valadez (1998) used data from the first follow up study of NELS:88, a sample of 10th graders in 1990. The total sample consisted of 973 Asian American students with 257 Chinese, 210 Filipino, 151 Korean, 67 Japanese, 188 Southeast Asian, and 100 South Asian students. This study found differences by ethnic group in math performance (self-reported math grade) and educational aspirations (expectations for years of schooling completed). South Asian American (Asian Indian and Pakistani) students tended to have the highest math performance and educational aspirations. South Asian American students also had the highest level of parent education and occupational status. Southeast Asian American (Vietnamese, Laotian, Cambodian, and Thai) students had the lowest scores on all four variables (Kim et al.).

Using stepwise multiple regression (backward elimination), Kim et al. (1998) determined the personal and school-related factors related to educational aspirations for each ethnic group. The findings were summarized as follows (relationships were significant and positive unless otherwise noted): (a) for Chinese American students, personal factors included good math performance, male, high parent expectations, and positive self-concept, and the school factors were competitive academic school climate, and public school (negative); (b) for Filipino American students, personal factors included good math performance, high parent expectations, and positive self-concept, and a low socioeconomic school was a negative school predictor; (c) for Japanese American students, personal factor predictors were parents' high occupational status, high parent

expectations, and friends who planned college attendance, and the school factors, both with negative relationships, were a low socioeconomic school and an urban school; (d) for Korean American students, academic track and high parent expectations were the only factors that significantly predicted achievement and there were no school factors entering the regression; (e) for Southeast Asian American students, the personal factors were academic track, high parent expectations, and positive self-concept, and the school factor was a low socioeconomic school (negative); and (f) for South Asian American students, high parent expectations was the only significant factor (Kim et al.).

These results showed both similarities and differences across ethnic groups regarding influences on educational aspirations (Kim et al., 1998). For example, high educational expectations from parents was a significant factor for all ethnic groups in the study. Positive academic self-concept was important for Chinese, Filipino, and Southeast Asian American students. Academic self-concept (similar to academic self-efficacy) was measured by the average score of two items: your ability “to do things as well as most other people” and “the chances that you will go to college.” Racial climate was included as a factor, but only in terms of the percent of White students in a school. This measure of school racial composition did not explain educational aspirations for any Asian American group. In addition, gender was significant only for Chinese American students, such that boys tended to have higher educational aspirations than girls. These results challenged two myths, the model minority myth (as not all Asian American students in this study had high aspirations, high math performance, and parents with good jobs and high incomes) and the myth of cultural uniformity (as within group homogeneity was not found) (Kim et al.).

Summary

The research related to achievement outcomes for Asian American men and women and students in STEM covered a range of ages, levels of schooling, and types of achievement. The research identified some important background characteristics in achievement outcomes: home environment (Peng & Wright, 1994), ethnicity among Asian Americans (Kim et al., 1998), high school GPA and SAT scores, socioeconomic status, gender, and race (Astin, 1993; Muller et al., 2001; Pike et al., 2003; Robbins et al., 2004). School environment was not a significant predictor of educational aspirations for any Asian American ethnic group in Kim et al., but only racial composition of the school was considered. Important college environment factors in students' academic achievement included financial aid/support, social involvement, and social support/interactions with peers (Pascarella & Terenzini, 1991; Robbins et al.); college major (contradictory regarding influence of majoring in engineering on grades and graduate exams), academic involvement, and interaction with faculty (Astin; Pascarella & Terenzini; Pike et al.). Peer groups tended to exhibit the strongest influences on student learning and development in college (Astin). However, these studies did not discern the environment factors related to achievement specifically for Asian American students. Academic self-efficacy was the strongest psychosocial predictor of college grades in Robbins et al. (2004). The noncognitive variables that were found to predict college grades for Asian American students were self-concept, realistic self-appraisal, and handling racism (Fuertes et al., 1994).

Self-Efficacy

Self-efficacy, or an individual's expectations of personal ability to accomplish a specific task (Bandura, 1977), plays an important role in the retention and career development of women in STEM (Betz & Hackett, 1997; Hackett et al., 1992; Hackett & Betz, 1981). The research studies presented in this section provide a foundation for the role of self-efficacy in the career development of undergraduate Asian American women in STEM. First, data regarding the validation of self-efficacy measures were considered. Recognizing the homogeneity of early self-efficacy career studies (e.g., Lent, Brown, & Larkin, 1984; Lent et al., 1986) with respect to race/ethnicity as well as major field of study, Gwilliam and Betz (2001) assessed the validity of various self-efficacy measures related to math and science for African American and European American female and male college students. Although the sample was not limited to these groups, the sample sizes for Asian American, Hispanic and international students did not allow for statistical analysis. Recruited from an introductory psychology course at a large Midwestern university, 38 African American men, 73 African American women, 67 European American men, and 185 European American women participated in the study. One of the measures included in this validity study is Educational Requirements Self-Efficacy, which measures confidence in an individual's ability to complete the requirements of scientific and technical majors. Educational Requirements Self-Efficacy was used in Lent et al. (1984, 1986) and Gloria and Ho (2003), described in detail below. Values of coefficient alpha by race and gender subgroups ranged from .93 to .94 for this Educational Requirements Self-Efficacy measure. According to multivariate analysis of variance results, there were no gender differences in Educational Requirements Self-

Efficacy scores, but African American men had a higher average score than European American men. Because additional analysis revealed a bimodal distribution of scores on Educational Requirements Self-Efficacy (due to bimodal level of familiarity with STEM subjects), Gwilliam and Betz concluded that this measure was appropriate to use with students enrolled in STEM fields but was not appropriate for college students in other majors. Significant gender differences for the other math and science related self-efficacy measures favored men over women (Gwilliam & Betz). Together, these results suggest that STEM-related self-efficacy measures may not be appropriate for students majoring outside of STEM, but there was evidence of their validity with undergraduate African American men and women.

Determinants of Academic Self-efficacy

As a social cognitive variable, the level of academic and career-related self-efficacy is influenced by many factors. Ancis and Phillips (1996) found that a college environment construct of academic gender bias was a negative predictor of women's agentic self-efficacy in academic and career goals. Gloria and Ho (2003) found significant relationships between two self-efficacy measures, the racial climate, and social support for Asian American students. And Huang and Brainard (2001) found differences in the predictors of academic self-efficacy between men and women majoring in engineering. Some of the predictors were prior achievement and self-confidence, quality of teaching, grades, and respect from professors.

Agentic self-efficacy was studied by Ancis and Phillips (1996) to determine the factors that influence women's confidence in their ability to carry out agentic behaviors, which are self-initiated proactive actions that promote an individual's career

development. The sample involved 67 women who were full-time undergraduate juniors and seniors in traditional, gender-neutral, and nontraditional majors at a large, public mid-Atlantic university. Five women identified as Asian and two as Asian American. The 42% of the sample that were women of color perceived significantly more gender bias at the institution compared with White women in the study. Perceived gender bias, measured by a modified version of the Campus Environment Survey, significantly contributed to the prediction of agentic self-efficacy by explaining 11% of the variance after controlling for sex role attitudes, gender concentration of major, and race. Participants who perceived more gender bias had lower levels of agentic self-efficacy. Results suggested that gender equity at an institution played a role in women's confidence in their ability to promote their own academic and career development (Ancis & Phillips).

The connection between college environment factors and self-efficacy also was supported by research that explored 160 Asian American undergraduate students' College Self-Efficacy and Educational Requirements Self-Efficacy (Gloria & Ho, 2003). The sample was students attending two large southwestern universities and consisted of 34% Chinese Americans, 20% Korean Americans, 17% Japanese Americans, 11% Vietnamese Americans, 9% Pacific Islanders, and 8% Filipino Americans. There were no significant differences in background characteristics, such as financial support and parent educational attainment, among ethnic groups. The University Environment Scale, a measure of the racial climate, the Cultural Congruity Scale, assessing cultural congruity of values between individual and institution, and the College Environmental Stress Index, a measure of financial and academic stress, comprised a variable set related to Comfort in

the University Environment. A variable set of Social Supports was comprised of perceived social support from family, perceived social support from friends, and perceived mentorship. The two self-efficacy measures were part of a third variable set of Self-Beliefs, which also included a measure of self-esteem. The Educational Requirements Self-Efficacy measure was adapted from Lent et al. (1986). Canonical correlation analysis found that higher cultural congruity and more positive perceptions of the university environment were significantly related to greater College Self-Efficacy, greater Educational Requirements Self-Efficacy, and greater self-esteem (Gloria & Ho). Although self-esteem was significantly and positively related to perceived social support from family and friends for this sample of Asian American undergraduates, the two self-efficacy measures were not. Each variable set significantly predicted persistence decisions, and both comfort in the university environment and self-beliefs explained 8-9% of the variance in persistence decisions when controlling for each other (Gloria & Ho).

Additional results regarding within-group differences by ethnicity were reported as well (Gloria & Ho, 2003). Filipino American students had the most positive perceptions of the university environment and Korean American and Vietnamese American students were second. Chinese American students were least positive in their perceptions of the environment and had the lowest level of cultural congruity with the environment. Japanese American students reported the greatest cultural congruence, the least stress, the highest level of family social support, and the least amount of mentoring. With respect to self-efficacy, Pacific Islander American students had the highest level of College Self-Efficacy and Educational Requirements Self-Efficacy. Korean American

students reported the lowest College Self-Efficacy and Chinese Americans reported the lowest Educational Requirements Self-Efficacy (Gloria & Ho).

Huang and Brainard (2001) compared self-efficacy levels and predictors between men and women undergraduate engineering majors at the University of Washington across class levels and further studied in-depth the predictors of self-efficacy for women in the sample. The measure was labeled Academic Self-Confidence, but its definition was consistent with Bandura's (1977, 1986) definition of academic self-efficacy, particularly because it focused on the specific performance domain of STEM courses. Academic Self-Confidence was defined as "self-confidence in their abilities in various college courses commonly required of SMET [science, mathematics, engineering, and technology] majors" (Huang & Brainard, p. 319). Acknowledging that the 19% response rate for their survey was low, Huang and Brainard limited generalizability to highly motivated, high achieving students in engineering majors with the anticipation that these students would have higher levels of academic self-confidence. Furthermore, data regarding additional background characteristics, such as race, were not provided.

In the data set from the first part of the study, 87 women and 249 men responded to a survey assessing perceptions of quality of teaching, quality of labs and classrooms, respect by faculty, influence by others to pursue an engineering degree, and self-reported college grade point average as well as academic self-confidence (Huang & Brainard, 2001). Men reported higher levels of self-confidence than did women, yet there was no difference in average grades. This finding was consistent across all class levels, although the gap in self-confidence scores was the largest for freshmen. For men, the significant predictors in a multiple regression analysis of academic self-confidence, in order of

strongest to weakest, were grade point average, quality of teaching, quality of lab experience, and influence by others to choose an engineering major (negative). The significant predictors of women's academic self-confidence were respect from professors and grade point average; quality of teaching was a strong and significant predictor of women's academic self-confidence until respect from professors was included in the regression (Huang & Brainard).

Using longitudinal data from an all-female self-selected sample of engineering students at the same institution, Huang and Brainard (2001) further explored the predictors of undergraduate women's academic self-confidence. Huang and Brainard interviewed and surveyed female engineering students at the start and end of their first year and at the end of each subsequent year. Of the 600 first year students who participated in the study, 432 students participated in their sophomore year, 294 in their junior year, 203 as seniors, and 95 as fifth year students. Using two outcome variables, self-confidence in math ability and self-confidence in science ability, Huang and Brainard explored the factors affecting self-confidence by including all variables significantly correlated to academic self-confidence in a multiple regression analysis (Huang & Brainard).

High school grade point average and initial self-confidence levels were consistently strong positive predictors of both math and science self-confidence, as was quality of teaching (Huang & Brainard, 2001). Influence of male friends was a positive and significant predictor of math self-confidence in the sophomore and junior years, and influence of female friends was a positive and significant predictor of science self-confidence in the junior year. In addition, interest in science coursework was a significant

positive predictor of science self-confidence in the freshman through junior years, but interest in math coursework did not contribute to the prediction of math self-confidence. Neither self-confidence measure was significantly influenced by quality of faculty members and teaching assistants (Huang & Brainard).

Results also showed that female undergraduates began their first year of college with strong self-confidence levels in both math ($M=3.97$ out of 5) and science ($M=3.96$) (Huang & Brainard, 2001). However, these levels dropped significantly by the end of the first year (math $M=3.41$; science $M=3.55$) and started to increase again, but never reached the beginning first year levels by the senior or even fifth year (Huang & Brainard). In *Talking about Leaving: Why Undergraduates Leave the Sciences*, Seymour and Hewitt (1997) also documented a disintegration of self-confidence over the years as a result of participation in a science major. Their study involved 335 current and former STEM majors on seven campuses who participated in interviews and focus groups conducted between 1990 and 1993. Though entering college with a high level of confidence and preparation, many women faced subtle discouragements in their science major (Seymour & Hewitt).

Self-Efficacy and Academic Outcomes

The relationship between self-efficacy with academic and career outcomes was explored in a meta-analysis by Multon, Brown, and Lent (1991) of research conducted between 1977 (when Bandura introduced self-efficacy) and 1988. Included in the meta-analysis of the academic performance outcome were a total of 4,998 participants in 38 samples from 36 independent studies that had sufficient information to calculate estimates of effect sizes. Background information provided on the studies' participants

included the setting (elementary, high school, college and non-student), the type of student (average or low achieving), and average age of participants ($M=16.6$) (Multon et al.). The different measures of performance were grouped into three categories: standardized achievement tests, classroom-related measures including grade point average, and basic skills tasks; nine studies (24%) used classroom-related measures as the performance outcome measure. Self-efficacy expectations accounted for about 14% of the variance in academic performance, with a .38 effect-size estimate overall. Significant heterogeneity among effect sizes indicated that the relationship between self-efficacy and performance varied by four conditions. First, longitudinal studies produced stronger relationships (.58) than correlational studies (.32). Stronger relationships also were found in studies of low-achieving students (.56) than of average-achieving students (.33). Third, stronger effect sizes were found among high school (.41) and college students (.35) than studies of elementary school students (.21). Finally, studies that used basic skills measures produced the largest effect sizes (.52) in comparison to classroom-based performance measures (.36) and standardized achievement tests (.13). This meta-analysis of early studies on self-efficacy and academic performance provided positive support for the theoretical relationship between the two constructs. It also highlighted factors that moderate the effect size of the relationship (Multon et al.).

Summary

Significant predictors of academic and career-related self-efficacy included prior achievement, prior self-confidence, some peer influences, and college environment factors including the quality of teaching, respect from professors, and the racial and gendered climates. These predictors match the four sources of efficacy information

(performance accomplishments, vicarious experience, verbal persuasion, and emotional arousal) identified by Bandura (1977). Results regarding the influence of gender were mixed, however. Significant relationships between gender and math and science self-efficacy were found by Gwilliam and Betz (2001) and between gender and STEM academic self-confidence for engineering majors by Huang and Brainard (2001). However, Gwilliam and Betz did not find differences by gender in Educational Requirements Self-Efficacy. Self-efficacy was found to be an important construct to understanding the academic and career development of Asian American students (Gloria & Ho, 2003), but samples in many of the studies on self-efficacy did not include Asian American students. Results of the meta-analysis by Multon et al. (1991) provided support for finding moderate effect sizes in the current research study, based on the characteristics of the study's design. An average-to-high-achieving population, college-aged students, and classroom-based measures of performance (grades) produced effect sizes near .35.

Background Contextual Factors

The research literature related to background contextual factors in the academic and career development of Asian American women in undergraduate STEM majors explored the roles of race and gender issues in family and society, acculturation, and socioeconomic status. Leong (1991) studied the difference between Asian Americans and White Americans in career development characteristics and occupational values using gender and culture (i.e., race) as predictors. Approximately 150 students recruited from psychology courses at the University of Maryland participated in the study; 83 were White and 63 were Asian Americans, primarily of Chinese and Korean ethnicity.

Multivariate analysis of variance results for career development characteristics showed a significant main effect for culture but not for gender or the gender-culture interaction. Asian Americans had significantly higher dependent decision-making styles than White Americans in the sample, significantly lower career maturity attitudes than White Americans, and did not significantly differ from White Americans on vocational identity (Leong, 1991).

The multivariate analysis of variance for occupational values in Leong's (1991) study showed that Asian Americans placed a greater emphasis on extrinsic and security values than White Americans but did not significantly differ on the values of people, self-expression, and power. Extrinsic values concerned good salaries and occupational prestige; security values concerned protecting a stable future. Leong cautioned that higher dependent decision-making styles and lower career maturity attitudes for Asian Americans in comparison to White students did not signify a deficit. Instead, results resonated with a cultural explanation, where Asian Americans tended to be more external in their general orientation and less tolerant of ambiguity. Differences such as these highlighted potential cultural biases in labels, such as maturity, that are assigned to career development factors (Leong).

Family Expectations and Gender Roles

Families have supported Asian American women in pursuing higher education, especially female family members, although men in Asian American families sometimes received more support (Hune, 1998). U.S.-born middle class Asian American women seemed to have more flexibility in major and career choice and faced fewer gender differences in family support for education than immigrant and working-class Asian

American women (Hune). Although lack of family support was a barrier to success in STEM (Fassinger, 1996), ongoing encouragement from parents was positively related to persistence (Sandler, 1999). However, unrealistic parental demands often led to pressure, stress, academic failure or dropping out of college (Hune).

The constructions of gender important to the experience of Asian American women include both gender role expectations in Asian culture and the social constructions of race in the U.S. (Kibria, 1990). For instance, interviewees in the mixed method study of constructing an Asian Indian identity by Srinivasan (2001) described that “it is the women who are called on to hold up the ways of the old country and preserve the name, prestige, and honor of the family” (p. 147). Many of these expectations involved high levels of stress for acculturated daughters who adopted more egalitarian gender perspectives than their parents. Espiritu (2001b) also detailed the intersection of racism and sexism in the lives of young Filipinas in the U.S. Salient factors for Asian American women were ethnic identity, socioeconomic status, and acculturation. Asian American women have experienced contradictions between power and subordination in U.S. economic, racial, and gendered social constructions and within their families (Espiritu). Many Asian American women have necessarily served multiple roles in their families, and a desire for cultural preservation often motivates Asian American families to reinforce traditional gender roles, which include household responsibilities and arranged marriages at an early age (Hune, 1998). The complexity of family encouragement for educational attainment combined with a desire for cultural preservation led Park (2002) to conclude that “those factors intersect to support a somewhat paradoxical situation in which ‘the’ Asian American woman is both more

liberated and oppressed in comparison to her traditional Asian predecessor” (p. 15). The dynamic impact of race and gender in the lives of Asian American women needs to be recognized in order to understand the experiences of Asian American women in STEM majors.

A narrative study of four Asian American (two Chinese and two Japanese) women pursuing science and engineering careers explored personal agency in developing and maintaining an interest in science as they made sense of cultural and family expectations (Chinn, 2002). Data were collected through interviews in the narrative tradition of dialogue and analysis that explored the social contexts in families, schools, and community where participants encountered science. Results described sociocultural factors that were barriers to entry in STEM for these Asian American women from cultures influenced by Confucianism. Results showed that the cultures of Western and Confucian patriarchies combined to impact these four Asian American women. Confucian cultural scripts regarding patriarchy significantly shaped their family’s gender role prescriptions, regardless of generational status. Every narrative related gender conflicts around appearance, interests, and expectations. Parents provided lower educational expectations and less financial resources to these daughters than for their sons. The women struggled against their parents’ expectations to be compliant, feminine, and educated enough to be marriageable. They even adopted behaviors of male peers in their science worlds that conflicted with gendered expectations of behavior, by acting tough, keeping in physical shape, and acting with assertiveness (Chinn).

Positive academic experiences in mainstream K-12 schools encouraged the women in Chinn’s (2002) study to pursue their interests in science and provided them

with advanced opportunities. These early educational experiences counteracted the cultural messages they received in their families. Independence and self-agency were strong influences as well. However, these facilitative factors were not always enough, and the women found it became more difficult the more they advanced. The women felt compelled to mimic men in order to be successful but continued to feel they were not respected or given credibility by the men in their science domains. When the competitive, masculine, and racist aspects of Western male science were invisible or seen as natural to male peers and teachers, these “exemplary” students felt marginalized. Therefore, Chinn recommended that postsecondary educators assess the policies, behaviors, and attitudes that lead to this sense of marginalization.

A third study that explored family relationships for Asian American women used gender, Asian American ethnicity, and acculturation as primary independent factors. Chung (2001) conducted multivariate analysis of variance to determine main and interaction effects of these variables on intergenerational conflict for 320 undergraduate students in Asian American studies courses at several colleges in southern California. The intergenerational conflict measure consisted of three subscales: Family Expectations, Education and Career, and Dating and Marriage. Women had greater intergenerational conflict over dating and marriage than did men; there were no gender differences regarding family expectations or education and career. Furthermore, Japanese Americans experienced less conflict regarding family expectations than Koreans and Southeast Asians and less conflict regarding dating and marriage than Chinese, Korean, Filipino, and Southeast Asian Americans (Chung). Notably there were no significant differences by gender or ethnicity on the education and career subscale. Additional findings from

Chung were that high acculturated Asian American students, measured according to the Suinn-Lew Asian Self-Identity Acculturation Scale (SL-ASIA, Suinn et al., 1987), experienced significantly less conflict regarding family expectations, education and career, and dating and marriage than did low acculturated and bicultural Asian American students. Chung argued that this result highlighted the important role of Asian Americans' level of acculturation in their academic and career development.

Acculturation

The complex process that occurs when cultures meet, acculturation can be expressed in terms of language, behaviors, interpersonal interactions, attitudes, and values (Leong & Chou, 1994). The outcomes of the process include resistance to change, where the culture of origin is retained; assimilation, where the immigrant culture is consumed by the host culture; and multiculturalism, where two or more cultures coexist or are situational in adherence (R. M. Suinn, personal communication, March 9, 2004). Political, economic, demographic, and cultural changes may occur during acculturation, but the process of change may be inconsistent across these categories (Berry, Trimble, & Olmedo, 1986). Orthogonal, multidimensional theories of acculturation recognize the independent nature of retention of culture of origin and adoption of host culture, as well as the complexity in which culture is adopted and expressed (Berry et al.; Cabassa, 2003). Berry et al. identified four outcomes of the process for individuals, drawn from the independent dimensions: integration involves maintenance of culture of origin and adoption of host culture; assimilation involves rejection of culture of origin and adoption of host culture; separation involves maintenance of culture of origin and rejection of host culture; and marginalization involves rejection of both culture of origin and host culture.

Furthermore, level of acculturation to the host culture is related to generational status and, for first-generation individuals, the age at immigration (Birman & Trickett, 2001; García-Coll & Magnuson, 1997). Hirschman (1994) and García-Coll and Magnuson defined the “1.5 generation” as children who immigrate to a new culture with their parents yet experience most of their socialization in the new host culture. Schools are the primary agents of socialization in the dominant host culture, which may be at odds with the child’s family culture of origin. The 1.5 generation is often considered as “caught between two worlds,” as they experience bicultural conflicts and generational conflicts (García-Coll & Magnuson, p. 105). They may feel that they belong to neither world, and must find ways to cope with living in both worlds. Furthermore, the 1.5 generation may be more similar in cultural adoption and expression to their 2nd generation peers (U.S.-born children of immigrant parents) than to their immigrant parents (Hirschman).

Through empirical research, acculturation has been connected to other background factors as well as career development processes. For example, Sodowsky, Lai, and Plake (1991) conducted a study of the sociocultural variables that moderated acculturation for Hispanic Americans and Asian Americans, including generational status, immigration status, religion, sex, and ethnicity. The sample included 149 Asian American and 132 Hispanic students, faculty, and staff (70% were students) at a large Midwestern university. Five Asian American ethnic groups were included: Asians from the Indian subcontinent, Chinese Americans, Japanese Americans, Vietnamese Americans, and Korean Americans. The Majority-Minority Relations Survey (MMRS) consisted of three subscales of Perceived Prejudice, Acculturation, and Language Usage

and measured acculturation of all Hispanic and Asian American groups. The use of a single acculturation measure enabled comparisons between Hispanic and Asian Americans. In this study, Asian Americans perceived significantly more prejudice than did Hispanics, but significant differences in perceived prejudice were not found among Asian American ethnic subgroups. Significant differences among Asian American ethnic subgroups were found on the acculturation and language usage subscales. The Vietnamese American subgroup was less acculturated to dominant American culture than the Japanese American group and the Korean American group; differences were not found between the Asian Indian, Chinese American, Japanese American, and Korean American groups. Japanese Americans used English more than the Vietnamese, Chinese, Asian Indian, and Korean American groups, and Vietnamese Americans used English less than the Korean American and Asian Indian groups (Sodowsky et al.).

Other results of the combined Hispanic and Asian American sample were found (Sodowsky et al., 1991). For example, men and women did not significantly differ on any of the MMRS subscales. Also, first-generation respondents perceived more prejudice, had lower levels of acculturation to dominant American culture, and used English less than second-through-fourth generation respondents. Political refugees were more likely to perceive prejudice, were less acculturated to dominant American culture, and used English less than voluntary immigrants. Respondents who identified with Eastern religions were less acculturated than Catholic respondents, and both were less acculturated than Protestant respondents. Although interaction effects were not discussed, Sodowsky et al. acknowledged the influence of generational status and immigration status on ethnic subgroup differences that were found, as well as the influence of ethnic

subgroups on generational status and immigration status differences that were found. For example, Vietnamese American participants were more likely to be first-generation and political refugees. Additionally, the lack of gender differences in acculturation was most likely related to the acculturation measure which did not address gender role attitudes or masculinity and femininity (Sodowsky et al.). Overall, results supported the role of race, Asian American ethnic subgroup, generational status, immigration status, and religion in acculturation to dominant American culture (Sodowsky et al.).

A study by Kaufman, Chavez, and Lauen (1998) using a national sample of Asian American and Hispanic students who were in 8th grade in 1988 corroborated some of Sodowsky et al.'s (1991) findings. Kaufman et al. used the NELS:88 database to assess the influence of generational status on educational outcomes, including math, reading, and science proficiency, dropout rates, and postsecondary enrollment, while considering differences in language proficiency and use, parent educational attainment, type of high school attended, and postsecondary expectations. Students were classified as first-generation if they were born outside of the U.S.; second-generation students if they were born in the U.S. but one of their parents was born outside of the U.S.; and third-generation (or more) students if they and their parents were born in the U.S. Kaufman et al. noted differences in the ethnic subgroup composition of Asian Americans by generational status, such that Southeast Asian Americans comprised a larger proportion of the first-generation group (23.3%) than they did of the second- or third-generation groups (4.0% and 0.3%, respectively). Kaufman et al. were not able to differentiate generational status differences from ethnic subgroup differences and suggested that observed trends may be related more to ethnicity than generational status.

Nearly half of the sample (47%) was first-generation Asian American; 32% were second-generation and 20% were at least third-generation (Kaufman et al., 1998). First-generation students were more likely to be at or below poverty level than both second and third-generation students (29% versus 8% and 13%). The proportion of students who had at least one parent with a college degree was 39% for first-generation, 63% for second-generation, and 37% for third-generation. Nine-tenths of Asian American students were members of two-parent families, a statistic that did not vary by generational status. Whereas 12% of first-generation students were classified as limited English proficiency, this proportion dropped dramatically to 2% for second-generation and 0.5% for third-generation. A similar but less dramatic pattern was observed for primarily speaking a language other than English at home: 72% for first-generation, 53% for second-generation, and 11% for third-generation Asian American 8th graders in 1988. Additionally, 28% of first-generation 8th grade Asian American students went to low-income schools; this was twice the rate for second and third generation students (Kaufman et al.).

Fewer second-generation students in the sample scored below proficiency in 8th grade math, reading, and science than first-generation and third-generation students (Kaufman et al., 1998). Of second-generation students, 6% scored below math proficiency (compared with 10% first-generation and 14% third-generation students), 8% scored below reading proficiency (compared with 17% first-generation and 13% third-generation), and 15% scored below science proficiency (compared with 28% first-generation and 31% third-generation). About three-quarters of first-generation students, about four-fifths of second-generation students, and about two-thirds of third-generation

students enrolled in an academic high school program. By 1994, 11% of Asian American students who were 8th graders in 1988 had dropped out of high school at least once. Four percent had not completed and were not working on completing high school by 1994. This statistic was 7% for first-generation students, 2% for second-generation students, and 4% of third-generation students (Kaufman et al.).

Using multiple regression analysis, Kaufman et al. (1998) found that the parents of first-generation students held significantly higher expectations for educational attainment than the parents of third-generation students, after controlling for potentially confounding background variables like income and parent education. Furthermore, third-generation Asian American students were least likely to attend college than their first-generation and second-generation peers. The results reported by Kaufman et al. demonstrate that Asian Americans of different generational status had different background characteristics, educational experiences, and achievements. A greater proportion of second-generation students had stronger educational achievements on most measures than both first-generation and third-generation students. The overlap between generational status with other factors, such as ethnicity, immigration status (refugee or voluntary immigration), and acculturation, can assist in interpreting these non-linear generational status results.

In social cognitive career theory, background contextual factors were hypothesized to influence outcomes indirectly through self-efficacy. The relationship between acculturation and another self-concept variable, self-esteem, was tested by Tsai, Ying, and Lee (2001), who surveyed 353 Chinese American students from a large San Francisco area university. Acculturation was operationalized with a Cultural Orientation

measure that includes the three domains of Language Use and Proficiency, Social Affiliation, and Cultural Pride for both Chinese culture and [dominant] American culture. Participants scored mid-range on both the Chinese cultural orientation scale and American cultural orientation scale. There were no significant main or interaction effects by gender on Chinese cultural orientation, but multivariate analysis of variance tests showed significant effects of gender on one American cultural orientation domain, such that women had greater English proficiency than did men but were not different in social affiliation and cultural pride (Tsai et al.).

From a series of hierarchical multiple regression analyses, Tsai et al. (2001) found that cultural orientation variables explained a significant portion of the variance in self-esteem, above and beyond the contributions of age, gender, grade point average, socioeconomic status, and place of birth (in or out of the U.S.). Specifically, greater proficiency in Chinese, greater proficiency in English, greater pride in Chinese culture, and less affiliation with Chinese people or Chinese Americans predicted higher self-esteem. Grade point average and gender were positive significant predictors as well. In separate analyses, the significant predictors of self-esteem for men were proficiency in Chinese, proficiency in English, and grade point average. Of the demographic and cultural orientation variables, pride in Chinese culture was the only significant predictor of self-esteem for women. Results confirmed hypotheses that men's self-esteem was predicated on non-emotional cultural orientation factors, such as language proficiency in both English and Chinese, more than emotional factors, and that women's self-esteem was predicated on an emotional form of cultural orientation, pride in Chinese culture (Tsai et al., 2001). High levels of orientation to aspects of both Chinese and [dominant]

American culture were predictive of positive self-esteem for participants. This study suggests that the relationship between acculturation and self-concept is influenced by gender and that the influence of acculturation may not be linear.

The influence of acculturation on Asian Americans' career development was tested by Park and Harrison (1995) and Leong (2001). Park and Harrison examined the role of acculturation in career-related interests and values for Asian American and Caucasian American undergraduates. Recruited from courses at a west coast university, 416 students comprised the sample. The Asian American sample included 16 Japanese Americans, 21 Korean Americans, 39 Vietnamese Americans, and 108 Chinese Americans who were U.S. citizens or permanent residents. Multivariate analysis of variance showed significant effects for gender and race/ethnicity on career interests measured along Holland types. Women scored higher on Social and Conventional interests and lower on Realistic and Investigative interests than men. Asian American students scored higher on Realistic, Investigative, and Conventional interests and lower on Social interests than Caucasian American students. The most valued of nine possible career anchors for Asian Americans were Service/dedication, Managerial competence, Technical competence, and Lifestyle. The least valued career anchors for Asian Americans were Challenge, Geographical Security, and Creativity/entrepreneurship. There were no significant differences in career values by gender or race/ethnicity. For Asian American students in the sample, acculturation, measured by the SL-ASIA (Suinn et al., 1987), had a significant main effect on career interests, such that the high acculturation group scored higher on the Social and Enterprising interests than the low-medium acculturation group. The role of acculturation on career values was not assessed

(Park & Harrison). Results indicated that race/ethnicity, gender, and acculturation are important considerations in variations in career interests and values and provide support for hypotheses from Byars and Hackett (1998) and Leong and Chou (1994) relating to the role of pragmatic and collective approaches to career development for Asian American women.

Two exploratory studies by Leong (2001) tested the hypotheses proposed by Leong and Chou (1994) that low acculturation Asian Americans experience the greatest amount of occupational stereotyping and discrimination, higher occupational stress, and lower job satisfaction. Results from these studies, although preliminary, highlighted the role of the organizational environment on the relationship between acculturation and occupational indicators. In the first study, 39 Asian Americans who participated in a career development workshop for Asian Americans from two major companies comprised the sample, which was assessed separately by company. Acculturation was measured using the SL-ASIA (Suinn et al., 1987). In both samples, low acculturation to dominant American culture was correlated with lower levels of job satisfaction. In the first company, low acculturation was correlated with greater occupational stress. In the second company, on the other hand, low acculturation was correlated with less occupational stress and strain, contrary to hypothesized relationships (Leong).

The second study in Leong (2001) tested the relationship between employees' level of acculturation and performance ratings received by supervisors, using another Asian American sample from one of the companies from the first study. Supervisor ratings, based on a global rating of adequate, good, or excellent, were obtained from the employees' files collected every six months. Leong found a significant and positive

correlation between acculturation and performance ratings, such that higher acculturation to dominant American culture was related to higher ratings, supporting hypotheses from Leong and Chou (1994). Although these were preliminary studies with many methodological limitations, results provided evidence of Asian American within-group variance in career development based on acculturation.

Socioeconomic Status

Socioeconomic status can be more difficult than other background contextual factors to identify, particularly for students, Asian Americans, and women. Possible financial, human, and social indicators of socioeconomic status include resources available in a student's home, one or both parents' income, parents' educational attainment, or resources available in a student's school or community (Ensminger et al., 2000). Asian Americans historically have received less income for the same or higher levels of education than Whites (Ong, 2000, *The Wage Gap*, 2002). This was particularly relevant for recent Asian American immigrants in comparison to U.S. born Whites (Ong). As a result, purely economic measures may not fully capture the socioeconomic status of an Asian American college student, and parents' level of education may be a good measure of socioeconomic status (but not economic attainment) for this population (Inkelas, 2000). The dynamics of socioeconomic status were assessed in the following studies.

According to data from the 2000 U.S. Census, nearly 80% of the Asian American population had at least a high school education and 44% had at least a bachelor's degree, whereas only 24% of the total U.S. population had at least a bachelor's degree (Reeves & Bennett, 2004). About 60% of Asian Indians, but less than 10% of Hmong, Cambodian,

and Laotian Americans, had a bachelor's degree. A greater proportion of Asian Americans (45%) than the total U.S. population (33%) worked in management and professional positions. The range of participation varied by Asian American ethnic group, from 13% of Laotian Americans to 60% of Asian Indians in management and professional positions. Hmong, Cambodian, Laotian, and Vietnamese American workers were most likely to be in production, transportation, and material moving jobs. Poverty rates for Asian Americans and the total U.S. population were similar at 12.5%. Nine of 12 Asian American ethnic groups had a higher poverty rate than average. Hmong Americans had the highest poverty rate at 38% followed by Cambodian Americans who had a 30% poverty rate. Filipino, Japanese, and Asian Indian groups had poverty rates lower than the national average. About 53% of Asian American households owned their home, in comparison to 66% of the total U.S. population. Asian American women who worked full-time year-round earned more than all U.S. women, but less than all U.S. men. Japanese and Chinese American and Asian Indian women had the highest earnings of women in all Asian American groups; Hmong, Cambodian, and Laotian Americans earned the lowest salaries (Reeves & Bennett).

A multivariate comparative study of Asian American and White women's participation in the labor force and earnings attainment using data from the 1970 census found that Asian American women were more likely to work and earned higher levels of income than White women (Wong & Hirschman, 1983). The sample consisted of women aged 25-64 who identified as Japanese ($n=1,745$), Chinese ($n=978$), Filipino ($n=725$), and Anglo (i.e., White; $n=3,167$). Asian American women tended to be younger and have higher educational attainment, and were more likely to live in California, Hawaii, New

York, or a U.S. metropolitan area than White women. In multiple regression analysis, Wong and Hirschman found that race (Asian American/White) explained a significant portion of the variance in labor force participation, even after adding the contributions of age, generational status, educational attainment, family status (married/single and children/no children), and residence (California, Hawaii, New York, other U.S. metropolitan area, other U.S. non-metropolitan area) to the regression. With these variables taken into account, Chinese American and Filipina American women were 12-13% more likely to be active in the labor force, and Japanese American women were 5% more likely to participate in the labor force than White women. U.S. born women tended to work in professional and clerical positions, whereas first-generation women – primarily Asian American – tended to work in service and blue-collar fields with low wages. Race was no longer a significant predictor in the multiple regression of earnings attainment, once the contributions of age, generational status, educational attainment, residence, and work status (hours worked in the past week and weeks worked in the past year) were entered. That is, Asian American women of the same age, generational status, educational attainment, residence and work status as White women had similar earnings (Wong & Hirschman). Results from these analyses demonstrated that generational status was an important factor in career participation, earnings, and social class. Furthermore, higher income levels for Asian Americans in comparison to White women were related to differences in educational attainment, residence in areas with higher salaries and higher costs of living, and consistently working full-time (Wong & Hirschman).

Luzzo (1992) studied the influence of race/ethnicity and social class on college students' career development, a multidimensional outcome involving career decision-

making attitudes, vocational congruence, and career decision-making skills. Traditional-aged undergraduate students in an introductory psychology course at a state university in California comprised the sample. Of the 401 students who participated in the study, 59 were Asian American, 38 were Filipino, and the rest were African American ($n=27$), Hispanic ($n=49$), and Caucasian American ($n=210$). Social class was measured by the Duncan Index of parent occupations and subsequently grouped into three categories: Lower, Middle, and Upper social class. The variable of career decision-making attitudes was defined as vocational decisiveness/attitudes towards making career choices and was measured by the Career Maturity scale. Vocational congruence was measured by calculating the fit between personal occupational interests and career aspiration. Competence in solving career-related problems was the definition of career decision-making skills. Age and grade point averages were covariates in the three-way multivariate analysis of covariance of career decision-making attitudes, vocational congruence, and career decision-making skills with gender, race/ethnicity, and social class as predictors (Luzzo).

Three-way interaction and two-way interactions were not significant (Luzzo, 1992). Additionally, main effects for gender and social class were not significant, but the main effect for race/ethnicity was significant. Racial/ethnic groups did not differ with respect to career decision-making skills, but scores on career decision-making attitudes and vocational congruence were significantly different. The only significant group difference in career decision-making attitudes was that Caucasian students scored higher than Filipinos and Asian Americans. Again this finding, when interpreted with a cultural lens as did Leong (1991), indicates that the greater tendency of Asian Americans in

comparison to Whites to rely on others when making decisions is a cultural difference rather than a lack of maturity. The only significant group difference in vocational congruence was that Filipino students scored lower than all other racial/ethnic groups (Luzzo).

In the life sequence study of women and minorities in science and engineering described in the self-efficacy section above, Leslie et al. (1998) found that having a father with a physical science, math or engineering occupation was predictive of major choice, and this effect was stronger for men than for women. Furthermore, degree attainment in physical science, mathematics, or engineering for women was positively related to mother's higher educational attainment, whereas this family variable was negatively associated with men's STEM degree attainment (Leslie et al.).

Summary

Cultural and family dynamics for Asian American women highlighted the role of background contextual factors in the academic and career development of Asian American women who major in STEM. Family support and expectations and responsibility to family were found to impact college attendance, career choice, and persistence (Fassinger, 1996; Kaufman et al., 1998; Sandler, 1999). High levels of acculturation were related to less family conflict for Asian Americans (Chung, 2001) but increased family conflict for Asian Indians (Srinivasan, 2001). There were differences in acculturation level by ethnicity and generational status (Kaufman et al.; Sodowsky et al., 1991), but the only gender difference in level of acculturation was related to language proficiency, such that Chinese American women had greater English proficiency than Chinese American men (Tsai et al., 2001). Acculturation to dominant American culture

was a positive predictor of Chinese American students' self-esteem and emotional aspects of acculturation were important to Chinese American women's self-esteem (Tsai et al.). Acculturation to dominant American culture also was a significant positive predictor of Asian American students' social and enterprising career interests (Park & Harrison, 1995) and Asian American employees' job satisfaction and performance ratings (Leong, 2001).

Women and Asian American students had different career interests than men and White students, respectively (Park & Harrison, 1995). However, the presence of differences in career values for women and men and Asian American and White students depended upon the career values measure used (Leong, 1991; Park & Harrison). And evidence regarding the relationship between acculturation and occupational stress was mixed (Leong, 2001). Asian American women were more likely to participate in the labor force and earn a higher income than White women (Ong, 2000, *The Wage Gap*, 2002; Wong & Hirschman, 1983), but the earnings advantage disappeared after controlling for other background factors, including age, generational status, educational attainment, residence, and work status (Wong & Hirschman). Socioeconomic status, as measured by occupational prestige, did not influence career decision-making skills, attitudes, or vocational congruence (Luzzo, 1992), but was directly predictive of major choice and STEM degree attainment when measured by mother's educational level and father's STEM occupation (Leslie et al., 1998). Taken together, these results suggest the moderating effects of several background contextual factors on the academic and career development of Asian American women in STEM as prescribed by social cognitive career theory (Lent et al., 1994).

Climate

The social cognitive career literature recommended, in particular, a focus on proximal environment factors in the career development and educational experience of Asian American undergraduate women in STEM. Proximal environment factors are typically conceptualized as barriers, and at times also as supports, available to an individual (Byars & Hackett, 1998; Fitzgerald & Betz, 1994; Hackett & Betz, 1981; Lent et al., 2003). Another conceptualization of the environment encountered by an individual is the climate for diversity in higher education, which can be understood through the conceptual framework promoted by Hurtado et al. (1999). Two important features of this conceptualization of the climate are its malleability and reliance on perceptions, where distinct groups might have very different impressions of the same climate (Hurtado et al.). This framework was applied to undergraduate STEM fields for women of color by also incorporating “chilly” climate features, first identified by Hall and Sandler (1982).

In Hurtado et al.’s (1999) conceptual framework, an institution’s context for diversity exists within a larger context of government/policy and sociohistory. Asian American women’s sociohistory in the United States in relation to legal, social, and economic issues was described in Chapter I. Within a college or university, the climate is a product of four dimensions: historical legacy, structural diversity, psychological climate, and behavior (Hurtado et al.). The literature presented in this section was organized by these four dimensions of climate. Historical legacy refers to the history of exclusion or inclusion of women or students of color. Structural diversity, also referred to as compositional diversity (J. F. Milem, personal communication, November 22, 2004), is the numerical representation of racial and gender groups at an institution. The

psychological climate relates to “individuals’ views of group relations, institutional responses to diversity, perceptions of discrimination or racial conflict, and attitudes held toward others from different racial/ethnic backgrounds” (Hurtado et al., p. 25). The behavioral dimension of campus climate involves interaction of individuals from different racial or gender groups and the nature of intergroup relations (Hurtado et al.).

Historical Legacy

The historical trends of participation rates in STEM fields of women as a group and people of color as another group are well documented. The National Science Foundation regularly produced reports that documented how these rates of participation changed over the last 30 years (e.g., Hill, 2002, 2000). The next section on compositional diversity describes these trends. On a national policy level, the historical processes of creating and developing “women and minorities in STEM” as an essential statistical category included contemporary social conditions and policy power struggles (Lucena, 2000). National attention to increasing the participation of women and minorities in STEM did not surface until the late 1960s. In the midst of the civil rights movement, calls for equity and social justice provided the momentum for the many reform efforts in the 1970s (Lucena; Sonnert, 1999). Attending to women and racial minorities in science and engineering addressed emerging civic problems, such as social and racial inequality, the energy crisis, and environmental damage. In the 1980s, with President Reagan’s “supply side economics,” programs to increase diversity of science graduates lost their foundational social argument. However, new reports (Holden, 1989; National Science Board, 1987) predicted a pending severe shortfall in the overall number of American scientists; fewer White males were entering the field. And so, women and racial

minorities were able to contribute to the pipeline and to the country's need for enough research and development scientists to maintain its economic competitiveness, particularly with Japan (Hilton & Lee, 1988; Lucena). In 1980, the Science and Technologies Opportunities Act mandated the National Science Foundation to increase the number of women, people of color, and people with disabilities in science and engineering (Sonnert).

Ten years later, the Immigration Act of 1990 substantially increased employment-related immigration (Greenwood & Ziel), and the number of scientist and engineering immigrants increased by 87% (Lucena, 2000; Streeter, 1993). Immigrants from Asian countries constituted a growing proportion of the science and engineering professionals admitted to the U.S., rising from 45% in 1991 to 58% in 1993. In 1993, 20% of the foreign-born science and engineering professionals were from China and 17% were from India (Streeter). These trends combined with a policy focus on increasing the presence of under-represented groups may have led to the lack of identification of Asian Americans with the "women and minorities" statistical category (*Land of Plenty*, 2000, 2000).

When the predicted shortfall never happened in the 1990s and STEM employment rates decreased, the pipeline argument lost its validity (Lucena, 2000). A pipeline also didn't accurately reflect true paths of individuals in careers in science. In the 1990s, the "leaky pipeline" and a more global economic perspective increased the need to revise reform efforts (Lucena; Sonnert, 1999). Recently, creating better science through gender and racial balance became the argument for "women and minorities in STEM" (Lucena). Diversity in scientists and engineers was expected to increase the probability of diversity

in the choice of topics and problems and the types of hypotheses developed to explain these problems (Sonnert).

Compositional Diversity

This dimension of the STEM climate has received the most attention from researchers and policymakers. The literature abounds with participation rates for women and men and for students of color (Babco, 2001; Chubin & Babco, 2003; Hill, 2002, *Land of Plenty*, 2000, 2000), but some of these reports (e.g., Chubin & Babco) did not provide statistics for Asian American students. Babco (2001) reported that Asian Americans comprised 3.6% of the U.S. population and 11.8% of all bachelor's degrees in engineering awarded in 2000. Only recent reports, as in Coley (2001) and Huang, Taddese, and Walter (2000), calculated participation rates based on race *and* gender. When only race was identified, Asian Americans had the highest participation rate in STEM of all other students, including Whites, given their proportion in the overall college student population (Huang et al., 2000). However, disaggregating the Asian American category by ethnicity revealed that Southeast Asian, Filipino and other Pacific Islander students were under-represented in STEM environments (Chinn, 1999). Under-representation was used to identify that this group's level of participation in STEM was less than their representation in the total undergraduate college population. The National Science Foundation and the Department of Education have recently distinguished between Asian Americans and Pacific Islanders (National Center for Education Statistics, 2001; National Science Foundation, 2003a), but Southeast Asian Americans (such as Laotian, Cambodian, and Vietnamese Americans) are not differentiated from East Asian

Americans (such as Japanese, Chinese, and Korean Americans) and Asian Indians in policy or reporting functions.

Disaggregating the Asian American category by gender revealed additional differences. In a study of college majors, Minatoya and Sedlacek (1981) found that although 40% of Asian American men at a large eastern university chose to study physical science, engineering, and mathematics, only 11% of Asian American women chose these majors. Recent national statistics from 2001, furthermore, showed that Asian American and Pacific Islander women received only 24% of the engineering bachelor's degrees received by Asian Americans, and 32% of computer science, 47% of mathematics, and 49% of the physical science bachelor's degrees (National Science Foundation, 2004). As Asian American women comprised 52% of the Asian American college student population (National Science Foundation, 2004), these statistics identified a gender gap among Asian American students in participation rates for each of these fields. Furthermore, gender patterns in participation and degree attainment observed for Asian Americans fell within a continuum of gender patterns by race: White women had a smaller share of bachelor's degrees received by White students; Black, Hispanic, and American Indian women received a larger share (Clewel & Campbell, 2002; National Science Foundation, 2000).

Patterns within the life sciences were different, however, as women comprised more than 50% of these undergraduate majors. In 2001, Asian American women received 57% of all bachelor's degrees awarded to Asian American students in the biological sciences and 64% of those in agricultural sciences (National Science Foundation, 2004). The percentage of biological science degrees awarded in 2001 to women in other racial

groups was as follows: Whites, 59%; American Indian/Native Alaskan, 55%; Hispanic, 61%; and Black, 72% (National Science Foundation). Again, Asian American trends fell between Whites and other women of color on a continuum of representation (National Science Foundation).

The proportion of bachelor's degrees awarded to each racial group of women also demonstrated historical trends. The proportion of degrees awarded to women of color has been increasing since 1990. Of all bachelor's degrees awarded to women, 5.5% were awarded to Asian American women in 1991 and this increased to 8.2% in 2000. In the same time frame, the percent of degrees awarded to White women decreased from 77% of all women in 1991 to 67% in 2000 (Hill, 2002).

The gender composition of the STEM climate provides partial explanation for the persistent gender gaps in participation and degree attainment in STEM, particularly through the concept of critical mass. Critical mass is attributed to Kanter (1977), who did not use the term but provided a theoretical framework for understanding group interaction among subgroups of unequal proportions, particularly by gender. According to Kanter, when gender ratios are less skewed, members of the smaller group are more likely to exert an influence on the group. Critical mass suggests a threshold of proportional representation that enables an event to occur, such as students feeling comfortable or forming allies (American Heritage Dictionaries, 2000; Kanter). Astin and Astin (1992) found a positive correlation between proportion of peers in a STEM major and individuals choosing and persisting in that major. Role models and mentors are more readily available in environments where small groups have reached a critical mass, and the presence of similar others was found to support women's career development

(Fassinger, 2001). Women were twice as likely as men to identify a mentor as actively influencing their choice of a STEM major and career (Fassinger). Faculty relationships were theorized to be important to Asian American women in particular because of the external validation they provided (Byars & Hackett, 1998; Leong & Chou, 1994).

Validation from others for an individual's culture (College Board, 1999; Rendón, Jalomo, & Nora, 2000) was found to increase both self-efficacy and sense of belonging (Bonous-Hammarth, 2000). On the other hand, a poor person-environment fit was likely between personal values and peer group values for students of color and women who lacked a critical mass (Bonous-Hammarth).

A critical mass of women in STEM is readily available at women's colleges. Hackett, Esposito, and O'Halloran (1989) used stepwise multiple regression analyses of role model influences, performance self-esteem, and gender-role as predictors of career salience, educational aspirations, and choice of non-traditional major and occupation for a sample of predominantly White graduating seniors at a small women's liberal arts college. In this study, role model influences were significant predictors of all outcomes, except choice of major, both in isolation and when other predictors were included in the model. Performance self-esteem was another significant predictor, but gender-role attitudes were not predictive of these outcomes (Hackett et al., 1989). Women's colleges were consistently more successful than predominantly White coeducational institutions in retaining women in STEM fields (Betz, 1997; Tidball, Smith, Tidball, & Wolf-Wendel, 1999). In all-female settings, women felt connected, were more likely to assume leadership roles, and received greater levels of attention from faculty and the institution (Eccles, 1997; Scantlebury, 2002). In an analysis of the distinctive characteristics of

successful women's colleges, Tidball et al. reported that women at women's colleges were more likely to major in traditionally male-dominated fields, such as STEM fields, and were more likely to change their major into male-dominated fields than were women at coeducational colleges. Persistence and departure from male-dominated fields was equivalent for women at both types of colleges (Tidball et al.). The research literature did not describe the success of subgroups of women in STEM at women's colleges, but did show that creating a critical mass of women in science at predominately White coeducational institutions led to positive outcomes (e.g., Hathaway et al., 2001; McEneaney & Radloff, 2000).

Similarly, minority serving institutions were consistently more successful than predominantly White coeducational institutions in retaining students of color in STEM fields (Betz, 1997; Tidball et al., 1999). Since schools with high percentages of Asian American students are not federally designated as minority serving institutions (Cayabyab, 2003), data were not available to compare student achievement across institutions where the proportion of Asian American students varied.

The compositional diversity of an environment ultimately shapes the climate that Asian American women face in their academic STEM majors (Hurtado et al., 1999). The presence of a critical mass of a social group has been found to support educational outcomes for members of that social group (Astin & Astin, 1992; Betz, 1997; Bonous-Hammarth, 2000; Tidball et al., 1999). Compositional diversity, then, creates the atmosphere of the psychological and behavioral aspects of the STEM climate, which have been characterized as "chilly" (Hall & Sandler, 1982; Sandler, 1999).

Psychological and Behavioral Climate

The psychological climate for Asian American women in STEM refers to an individual's perceptions of campus dynamics, and the behavioral climate refers to more objective experiences and observed actions (Hurtado et al., 1999; Lent et al., 1994, 2000). The psychological and behavioral aspects of the climate are shaped by several environmental factors. A social system and culture of science dominated by Western patriarchy within U.S. colleges and universities filters the interactions between students and their institutions and helps to shape how climate factors influence the success of Asian American women (Scantlebury, 2002). These climate factors were linked to students' race and gender, the inclusiveness of curriculum and instructional practices, and interpersonal interactions with peers and faculty (Rosser, 1997; Sonnert, 1999). In this section, perspectives on Asian American women in higher education, the role of stereotypes and discrimination, and the nature of the chilly climate for women and people of color, and for Asian Americans in particular were reviewed.

Asian American women in higher education. A comprehensive report published by the Association of American Colleges and Universities (Hune, 1998) detailed aspects of the experience of Asian American women in institutions of higher education. As a synthesis of information and not a research study itself, this comprehensive report highlighted a range of issues. The literature was reduced to major results and the issues were mostly stripped of context, examples, and the dynamic processes involved in the racial and gendered experiences of this group. However, Hune provided a robust summary of the general climate in higher education for Asian American women students,

faculty, staff, and administration. The report also provided recommendations to better serve the needs of this population.

Asian American women have dealt with everyday inequities; the stereotypes of the educationally successful model minority; and alienation, invisibility, and silence (Hune, 1998). Due to the model minority stereotype, some Asian American women have been tracked into stereotyped coursework, such as math and science programs, or ignored for academic assistance. The exotic/erotic, passive/demure, and rational/nonsensual stereotypes of Asian American women have contributed to a chilly campus climate, sexual objectification, and achievement barriers. This population has faced overattention and underattention; as tokens, other members of the campus community have essentialized their race, but also have viewed Asian American students as outsiders, ignoring diversity within the Asian American community and rejecting Asian American issues on campus. At times, Asian American women have experienced racialized sexual harassment and have had difficulty distinguishing between gendered and racial discrimination. Asian American women have not always been taken seriously due to perceptions about their small stature and youthful appearance. Many Asian Americans found themselves in a precarious position in the racial dynamics on campus, and Asian American women often felt ostracized by both White women and other women of color. Asian Americans tended to view assertiveness as the primary response to gain respect for their concerns (Hune).

Often the first in their families to attend college as well as first generation in the U.S., Vietnamese, Cambodian, and Hmong American students often experienced more isolation than U.S. born Asian Americans, due to increased language barriers and lack of

heuristic knowledge about college (Hune, 1998). Limited English proficiency and accent discrimination has encouraged some Asian Americans to believe it was safer to major in math or science. However, on average, Asian American women tended to major in health-related fields, education, humanities, and the arts; they outnumbered Asian American men in the social sciences and business (Hune).

Hune (1998) described the classroom climate as nuanced with several overlapping experiences. For example, Asian American women in the classroom were often both silent (polite) and silenced; the latter was more frequent, as men tended to dominate classroom discussions and White women often challenged Asian American women as authorities. Many Asian American women have feared ridicule or misunderstanding if they were to speak, and classmates and instructors have been surprised when Asian American women did speak. Alienation was a byproduct of course material that has promoted Western culture and male perspectives. Asian American women in male-dominated majors have responded to the intimidating climate they perceived by avoiding social settings, such as study lounges, thereby reducing their visibility in these disciplines. On the other hand, Asian American studies courses tended to be positive, affirming, cooperative, and non-threatening environments, but these courses were offered only at a small number of institutions (Hune).

Appraising the climate issues presented in the report, Hune (1998) concluded that treating Asian American women as an over-represented minority was:

a sweeping and unsubstantiated generalization that hinders their progress in academe. It ignores inequalities within and among Asian American groups and by gender, restricts their access to fields of study and employment areas where they are under-represented, and denies opportunities to economically disadvantaged Asian Americans. (p. 27)

More substantial information was needed to better understand the campus climate for Asian American women. Research that used a more complex view of Asian American women's identities, to include gender, socioeconomic status, generation in the U.S. and in college, language, and Asian American ethnicity may provide better information. The report also raised the need to study this population using a more complex view of higher education, by breaking down the monolithic system to explore sub-environments such as departments, divisions, and institution types to assess more proximal environmental influences on the experiences of Asian American women (Hune).

Stereotypes and discrimination. Career interests are greatly influenced by societal messages and educational inequities. In a Consensual Qualitative Research (CQR) analysis of interviews with nine Asian American female professionals in the Boston metropolitan area, Park (2002) explored the intersection of racism and sexism in the careers and workplaces of the participants. The women were diverse in terms of demographics and were employed in an array of career fields, including journalism, research biology, social work, and business. Results showed that the intersection of racism and sexism appeared in many ways. Because the participants were one of few Asian American women in their workplace, they experienced professional isolation, little mentorship, and few role models. In addition, they needed to negotiate both the negative stereotypes attributed to Asian American women – quiet, meek, naïve – and the model minority stereotype attributed to Asian Americans – smart, hardworking, and skilled. The consequences of this precarious position resulted in others perceiving them as “worker bees” or lacking “leadership ability.” The women struggled with either complying or challenging the stereotypes. At times these stereotypes limited their opportunities for

promotions and access to jobs, but not as often as expected by the researcher. Stereotypes also led to invisibility, where women felt ignored or expendable (Park).

In terms of participants' experiences with racism and sexism, they reported that they were objectified through sexist jokes, they were expected to follow gender roles, and that their supervisors were Whites and men (Park, 2002). Social class was described by participants as an important factor that also influenced their career experiences. The personal impact of their career experiences included distress, self-doubt, expended energy, and cynicism. Personal characteristics, such as fortitude, and external resources, such as colleagues and friends, helped ameliorate the effects of the social climate for the participants. Although the women in Park's study identified negative experiences, they described their work environments as unusually open and liberal, highlighting the relationship between career choice and perceptions of access and opportunity to succeed.

Park (2002) studied the role of stereotypes and discrimination in a range of career fields. Within STEM, the stereotypes of scientists, people of color, and women together have influenced individuals' academic and career interests, choices, and persistence (Betz, 1997). The culture of science has legitimized rational thought and objective truth. It has been portrayed as logical and unemotional and removed from the scientist (Scantlebury, 2002). The Western male cultural influence has pervaded contemporary science and technology fields. Western male theory, pedagogy, and support networks have dominated the sciences, thereby placing women and women's science at the margins (Rosser, 1997; Sonnert, 1999).

Occupational stereotypes and assumptions about a model minority have inextricably linked Asian Americans with careers in STEM fields (Leong, 1985).

Additional occupational stereotypes have clearly defined STEM professions as masculine (Fassinger, 1996). Scientists have been predominantly depicted in the media, in textbooks, and in the minds of youth as older White men in lab coats and rarely as young women or people of color (*Land of Plenty*, 2000). Chinn (2002) studied the impact of stereotypes on Asian American women working as scientists and engineers and found that although model minority stereotypes connected Asian American women to STEM fields, gender stereotypes embedded in Confucianism provided difficulties for women from cultures, such as Chinese and Japanese cultures, that are influenced by Confucianist patriarchy.

In addition to the impact of stereotypes, overt discrimination also has affected Asian American women in STEM. However, discrimination in STEM has mostly transformed from overt and conscious negative behaviors into a more subtle form of discrimination captured by the phrase, “null environment” (Freeman, 1979). A null environment, characterized by indifference, derives from a sense of treating people of different genders and races as equal while ignoring historical and social inequities, stereotypes, socialization, and cultural preferencing (Fassinger, 2001). A qualitative study of women in science, based on historical-relational theory, concluded that power relations between a dominant group and marginalized groups in STEM have been maintained in this transformation (Eisenhart et al., 1998). Ultimately, many feminist scholars have concluded that barriers for White women, women of color, and men of color in STEM will remain until the fundamental culture of science has been changed, and the dominance of Western male perspectives have been challenged (Scantlebury, 2002).

Chilly climate. A chilly campus climate is similar to a null environment but involves more negative and more active factors. A chilly climate for women has been reported on college campuses since the 1970s (Hall & Sandler, 1982; Sandler, 1999), but research results since then have been mixed (Drew & Work, 1998). For example, an analysis of data from 15,960 students completing the College Student Experience Questionnaire (CSEQ) in 1994 failed to support the overall notion of a chilly climate for women but did find that women reported smaller gains than men in seven areas related to technology and science (Drew & Work). Drew and Work did not control for differences in background characteristics, aptitude, or major field of study, a major limitation. Furthermore, estimates of gains were based on self-reports, and the relationships between college experience measures and estimates of gains for men and women were not tested. Nonetheless, none of the statistically significant differences that were found in college experiences with faculty, relationships with peers, relationships with faculty, and relationships with administrators, had meaningful effect sizes (Drew & Work). Also, many of the significant differences were contrary to expectations by a chilly climate hypothesis. Women reported participating in class and interacting with faculty more often than men and rated their relationships with faculty and their peers more positively than men. However, men were more likely to interact informally with faculty and conduct research with faculty than women. In estimates of gains in learning, there were no differences in four areas, women reported greater gains than men in 12 areas, and men reported greater gains in seven technology and science areas. The effect sizes of the technology/science differences were moderate, indicating that differences were meaningful. Drew and Work suggested that interventions to address the chilly climate

have been successful and a chilly climate is no longer pervasively experienced by all women, but that research was needed to determine if subgroups of women may still experience the climate differently than the majority. The results suggest that subenvironments, such as science and technology educational environments where gender differences in learning gains were found, should be explored in future research. The different types of interaction with faculty also suggests the existence of a null environment, where women may not be treated poorly, but men are awarded advantages (Freeman, 1979). The women in this study may not have been aware of the subtle nuances of a null environment in a covertly chilly climate.

A study by Whitt, Edison, Pascarella, Nora and Terenzini (1999) demonstrated the impact of a chilly climate on cognitive development with data from more than 1,700 women in 23 colleges and universities. Although the researchers did not conduct analyses by race, the sample was reported to be nationally representative by race. The findings showed that, after controlling for other confounding factors, perceptions of a chilly campus climate were significantly and negatively related to four of the seven cognitive outcomes at the end of the second year of college and to five of the seven cognitive outcomes at the end of the third year. The cognitive outcomes linked to climate were writing and thinking skills, understanding science, academic preparation for a career, understanding the arts and humanities, and for the third year only, reading comprehension. Climate was not related to critical thinking or understanding self and others (Whitt et al.).

Whitt et al. (1999) extended the work of Pascarella et al. (1997) who found modest but significant negative effects of climate only on one outcome: academic

preparations for a career. Pascarella et al.'s one-year longitudinal study of the same sample included the same measure of perceptions of chilly climate and the same measures of cognitive outcomes presented in Whitt et al., although reading comprehension was aggregated with math and critical thinking to create a composite measure of cognitive ability. Consistently across the three-year longitudinal analysis (Whitt et al.), the relationship between climate and writing and thinking skills was stronger for women with higher pre-college cognitive ability than it was for those with lower pre-college scores. However, higher ability was not associated with perceptions of a more negative climate; only the relationship between participants' perceptions of climate and their writing and thinking skills was stronger (Whitt et al.). Ability appeared to act as a moderator between climate and writing and thinking skills. This study demonstrated a negative link between a chilly climate for women and women's achievement; furthermore, this link extended to a broader array of aspects of cognitive development over time.

A chilly climate for students of color in higher education has been studied by exploring experiences with prejudice and discrimination on campus and in the classroom. For example, Cabrera and Nora (1994) found that first-year Asian American students perceived more prejudice and discrimination at a large Midwestern public research university than Whites, but less than African Americans and similar to Hispanic students. Furthermore, Asian Americans perceived similar levels of in-class experiences with prejudice and discrimination as did African American and Hispanic students (Cabrera & Nora). Using structural equation modeling, Cabrera and Nora found that Asian American students' perceptions of prejudice and discrimination explained 10% of the variance in

their sense of alienation. The model was not significant for White students. However the model explained 22% of the variance in alienation for African Americans and 15% of the variance for Hispanic students (Cabrera & Nora).

Similarly, Ancis, Sedlacek, and Mohr (2000) found through multivariate analysis of variance that Asian American students experienced significantly less racial conflict and racial segregation than African Americans, perceived significantly less faculty and student respect for different racial groups than White students, and were significantly less satisfied overall than White students. This study included 130 Asian American students (58 women and 72 men) in a sample of 578 first-year students and juniors at a large mid-Atlantic university that had implemented a multiyear campus-wide diversity programming initiative. Asian American students reported greater pressure to conform to racial and ethnic academic stereotypes than White students and Latino/a students. Asian American students also experienced more faculty racism and less fair treatment by faculty, teaching assistants, and students than White students. There were no significant differences in level of comfort with racially-ethnically similar and dissimilar faculty and peers between Asian American students and other students in the sample (Ancis et al.).

In a study of the attitudes of undergraduate Asian American students regarding campus involvement, Wang, Sedlacek, and Westbrook (1992) found that the participants rarely used the minority student office, felt they had little time to get involved in student groups but enjoyed social interactions with other students, and did not feel isolated or left out because of their race. The respondents were 152 undergraduate Asian American students at a large eastern university; 60% of the respondents were majoring in STEM. Within group differences were found by class year, gender, generational status, and

ethnicity using multivariate analysis of variance. Seniors and women were less likely to find the university supportive of minority students than younger students and men, respectively. First-generation in the U.S. students were more likely to enjoy Asian American organizations and less likely to have close friends of other races and felt less a part of campus life than U.S. born students. Vietnamese American students felt isolated and left out at the institution and were most likely of all ethnic groups to have close friends that were mostly Asian American (Wang et al.).

The STEM climate. Research literature has consistently documented a chilly climate in STEM education environments for White women as well as women and men of color (Conefrey, 2000; Hughes, 2000; Sonnert, 1999). The Women in Engineering Program Advocates Network (WEPAN) conducted a multi-institutional study of women in engineering using the WEPAN Student Experience Survey. Over 8,000 students at 29 institutions responded to the survey which included 45 items addressing students' perceptions of the quality and impact of teaching, teaching assistants, labs, departmental assistance, and curriculum (Brainard, Metz, & Gillmore, 1999). Women reported lower levels of self-confidence than men in engineering courses, physics courses, and general academics; differences by gender were not found in self-confidence in math courses and chemistry courses. Women also reported lower confidence than men that engineering was the right major for them and lower confidence in using lab equipment and asking questions in class. Women felt more overwhelmed than men by the fast pace and heavy workload of the engineering curriculum. These differences existed for students at all academic levels, from first-year students through seniors (Brainard et al.). The indicators of a chilly STEM environment, as noted in Brainard et al.'s WEPAN study, were

connected to higher attrition and lower levels of achievement than expected for White women in a study by Brainard and Carlin (1998). But they were not found to contribute significantly to higher rates of attrition for African-American, Hispanic, and Native American students (Bonous-Hammarth, 2000).

Grandy (1997) and Chinn (1999) studied the climate in STEM for Asian American women and the relationship between chilly climate factors and educational and career outcomes for Asian American women. Grandy surveyed 1,508 college seniors in natural sciences, mathematics, and engineering majors who completed the Graduate Records Examination (GRE) in 1990 and intended to continue their studies of STEM in graduate school. The stratified random sample consisted of 771 men and 737 women and was comprised of 58% White, 15% Asian American, 15% Black, 10% Hispanic, and 3% Native American students. The analysis tested how students differed by race or gender in academic preparation, undergraduate experiences and activities, perceived quality of their undergraduate department, evaluation of their own skills, career plans, and expectations, and their plans for graduate study (Grandy, 1997). Gender and race analyses were conducted separately, but a small number of within-group differences were reported. Grandy documented that Asian American students in STEM were on average less satisfied with their educational environment than any other racial group. This national study corroborated the findings of a 1985 survey of undergraduate students at California State University campuses that found that Asian American students were the most critical of their academic experiences, including course offerings, instruction, career counseling, and general counseling services, in comparison to students in any other racial group (Hsia & Hirano-Nakanishi, 1989).

Overall, results of Grandy's (1997) study showed that effect sizes of racial/ethnic differences were larger than those of gender differences. However, some gender differences were found with respect to achievement, experiences, and family background and support. Key findings that differentiate between men and women are presented first and then results for Asian American students are provided. Men scored higher than women on both the math and verbal sections of the GRE, even when controlling for major field, and more men planned to earn a doctorate than women (Grandy). In terms of college experiences, women worked and volunteered more hours per week than men. Women also noted more relational impacts from faculty and family than did men. Women agreed more strongly than men that professors encouraged graduate work, that experiences with coursework discouraged the pursuit of graduate study, that it was difficult to imagine themselves in the role of scientist or engineer, and that they highly regarded their peers in STEM. More pronounced differences on these experiences were found between women and men in engineering majors than other STEM majors. Regarding family, twice as many women than men (20.6% vs. 11.5%) had mothers in a STEM occupation, but there were no gender differences on father's occupation. Almost all students (95%) reported parental approval of their undergraduate and graduate majors (Grandy).

The findings of differences between Asian American students and students in other ethnic groups offered new perspectives on the Asian American experience in STEM majors. On a self-rating of performance (similar to academic self-efficacy), Asian American students rated themselves on average with other racial groups even though they had the highest achievement average, measured by GRE quantitative scores (Grandy,

1997). However, although Asian American students rated their college experience positively, they were more critical of their undergraduate experience than were White, Black, or Hispanic students. In general, Asian American students felt more neglected by their faculty and more disappointed by the lack of opportunities for intellectual development, including quality of coursework and conducting research with faculty, than White, Black, and Hispanic students. In fact, White students agreed significantly more strongly than Asian American students that they enjoyed their major courses better than other subjects, that they would choose to major in the same field if they started over again, and that their instructors encouraged them to continue in their major and to pursue graduate work. The effect sizes of these particular findings were relatively large. Asian American students rated 10 of 15 items related to departmental satisfaction positively, but with the lowest ratings of all racial groups (Grandy).

In terms of family support, Asian American students had slightly more family obligation for persisting in their STEM field (Grandy, 1997). Furthermore, their parents had the most education and were more likely to be in technical fields themselves. However, about half of Asian American students did not have a parent in a technical career (46% of fathers and 72% of mothers were in non-technical fields), and one-third of their fathers did not have a bachelor's degree (Grandy). As this was a comparative study across racial groups, analysis of within group differences, noted by the variance in parent education, was not a goal of this study. Only one within group result was reported: Asian American women were less well represented in biological sciences and more heavily represented in engineering and mathematical sciences; results showed no differences in representation for Asian American men by major field (Grandy). The findings related to

representation in STEM majors was quite different from the National Science Foundation data reported in the previous section on compositional diversity, where Asian American women were more likely to major in a life science than in engineering, mathematics, or a physical science (Hill, 2002, 2000; National Science Foundation, 2004). Differences in data on participation rates by major should be further explored but were most likely related to differences between the undergraduate population and the subset that chose to enter graduate STEM study and potential gender differences in life science undergraduates pursuing a medical degree (MCAT-takers instead of GRE-takers) versus an advanced science degree.

By analyzing the data with Asian American students as a distinct comparison group, Grandy (1997) uncovered that Asian American students tended to view their STEM experience less positively than other racial groups on a number of factors. One of the four recommendations for future research proposed by Grandy was to study Asian American students' low satisfaction and poor outlook on their careers. The gender and racial differences across many aspects of college STEM education that were uncovered by this study provided important information regarding the salience of students' identity in STEM experiences, expectations, and achievements. However, interpretation of these findings was limited by the sample; although a large national set of students, the sample was limited to those students who intended to enter STEM graduate study.

Chinn (1999) took an in-depth approach to Asian American within-group experiences in STEM by conducting narrative analysis of case study interviews of four Hawaiian and Filipino women in engineering to understand the supports and barriers for minority women in engineering. Chinn used a social capital/social network concept of

school socialization to uncover the factors influencing the participants' entrance into STEM, a traditionally Western and male dominated career area. Parents, relatives, and friends offered supportive and academically-oriented early socialization experiences, such as exposure to reading and science at a young age and introduction to role models. In addition, mimicry of dominant culture was an essential strategy for success. For example, one Japanese/Hawaiian woman's Hawaiian father believed that Japanese Americans and foreign Japanese maintained an increasing amount of power and dominant status in Hawaii. As a result, he encouraged his daughter to learn Japanese culture, language, and values so that she would be successful (Chinn).

Mimicry of masculine behaviors and patterns of thinking was another strategy for success in engineering (Chinn, 1999). One participant suggested the strategy of creating study groups with men to learn their thinking patterns, and to avoid asking questions during class, which, she believed, would show she was weak and would initiate derogatory impressions and insulting comments. The women chose styles of dress and physical conditioning that minimized their femininity, and they often accepted as a compliment when they were treated "like one of the guys" (Chinn, p. 629). However, the male colleagues of these women had a more difficult time transcending gender roles; one woman's male friend refused to act as her "best man" in her wedding because he would be filling the traditional female role of maid of honor. Attendance at middle-class schools provided these working-class women with access to the cultural capital of middle-class patterns of speech, behavior, and thinking patterns otherwise unavailable to them. Mimicry of middle-class values also was instrumental in these women's success in engineering education and careers (Chinn).

Another strategy for success was “back-talk” (Chinn, 1999). The study’s participants repeatedly faced discriminatory comments and ideas about women, Hawaiians, and Filipinos. At times, they chose to challenge dominant group members in order to reject their stereotypes and maintain their own sense of identity. The women also tended to straddle multiple cultural groups in their social networks of relationships. Chinn concluded that the women paid a price for their entry into engineering, through psychological oppression: feelings of isolation and inferiority arising from racism and sexism at the institutional (school tracking, grouping, classroom environment), cultural (engineering, dominant ethnic group), and interpersonal levels (teachers, colleagues).

Summary

The four dimensions of an institution’s climate for diversity as they related to the experiences of Asian American women in STEM provided a rich description of the college environment experienced by Asian American women who major in STEM. The historical legacy of creating statistical categories of “women and minorities in STEM” and focusing policy and research attention on under-represented groups limited the study of Asian American students who have been considered over-represented (Lucena, 2000). With the shift in policy argument from the pipeline metaphor to the need to create better science, the possibility for studying Asian Americans in science was created. Asian American participation rates by STEM major, gender, and ethnicity were presented (Babco, 2001; Coley, 2001; Hill, 2002; Huang et al., 2000, 2000). Critical mass was shown to influence choice and persistence in major; the benefits of critical mass were particularly notable at women’s colleges and minority serving institutions (Astin & Astin, 1992; Betz, 1997; Tidball et al., 1999).

Exploration of the psychological and behavioral aspects of the climate noted the experiences of Asian American undergraduate women in higher education, particularly the stereotypes, discrimination, and resulting invisibility and silencing many Asian American women felt in campus environments (Hune, 1998). The impact of stereotypes and discrimination related to racism and sexism on Asian American professional women was presented, including the psychological toll of professional success (Park, 2002). These stereotypes, the dominant culture of science, and occupational stereotyping placed Asian American women in conflict of belonging and not belonging at the same time (Chinn, 2002; Leong, 1985; Park; Rosser, 1997; Sonnert, 1999). A chilly climate was not found to be pervasive or universally perceived by all women (Drew & Work, 1998; Hall & Sandler, 1982; Sandler, 1999), but perceptions of a chilly climate for women negatively influenced cognitive development in college (Pascarella et al., 1997; Whitt et al., 1999). Asian American students reported negative racial climates and unfair experiences with faculty; these types of factors helped predict their sense of alienation from their campuses (Ancis et al., 2000; Cabrera & Nora, 1994). In STEM, women experienced lower self-confidence in academic endeavors along with greater stress (Brainard et al., 1999). Asian American students were the least satisfied with and most critical of their STEM academic experiences (Grandy, 1997). Early learning opportunities; learning and adopting the ways of the dominant ethnic group, dominant social class values, and dominant male behaviors; vocally challenging discriminatory comments; participating in multiple groups; and relying on personal fortitude and supportive colleagues were all strategies that helped some Asian American women succeed in STEM (Chinn, 1999; Park). Some of the costs of success were psychological

and interpersonal, such as self-doubt, expended energy, and isolation (Chinn, 1999; Park).

Social Cognitive Career Research

Social cognitive career theory provided a strong theoretical foundation for research examining the educational and career development of Asian American women in STEM education. Research regarding the constructs of achievement, self-efficacy, background contextual factors, and climate/college environment factors elaborated the role of each construct in the academic development of Asian American women. Research studies that align with social cognitive career theory's model of academic and career development, presented in this section, offered additional support and recommendations for the current research study. Lessons from the limitations of these studies helped to further define parameters for a study of Asian American women's academic and career development in STEM.

Several studies looked at academic and career development of science and engineering college students. Two studies conducted by Lent, Brown, and Larkin (1984, 1986) demonstrated the applicability of a career theory in explaining academic processes for students in STEM. However, the analyses did not incorporate gender or race as primary factors. Vogt (2003) used gender and gender discrimination as primary variables in a study of STEM achievement. The study conducted by Hackett et al. (1992) may be the only study of social cognitive career development of engineering college students that attempted to account for Asian American women as a subgroup. Of 218 students in the entire sample, only 8 identified as Asian American women, preventing the use of

statistical analysis to test the social cognitive career model for this specific group (Hackett et al.).

Flores and O'Brien (2002), instead, intentionally focused on one group by applying social cognitive career theory to an ethnic subgroup of Latina students in high school finding evidence that socioeconomic, feminist attitudes, and acculturation variables were important elements in the career development of women of color. Nora and Cabrera (1996) and Greenstein (2000) studied how the proximal environment influenced academic development for multiple racial groups. Greenstein conducted separate path analyses for Asian Americans to study the influence of racial climate and academic self-efficacy. Lastly, Tang et al. (1999) applied elements in the social cognitive career theory model to the career choice processes of Asian American college students. Each of these studies is elaborated below.

Self-efficacy and Academic Performance

Lent, Brown, and Larkin (1984, 1986) found statistically significant relationships between self-efficacy and grades for undergraduate students in technical majors. Lent et al. (1984) studied the influence of the level and strength of self-efficacy, measured by the Educational Requirements Self-Efficacy scale and defined as belief in one's ability to complete the educational requirements of 15 science and engineering fields. The outcomes were cumulative grade point average, grade point average in technical courses only, and number of quarters enrolled in the technical college; the sample was 42 undergraduates enrolled in a career planning course for students considering STEM majors at a Midwest university. Multivariate analysis of variance revealed that STEM students in high self-efficacy groups had higher cumulative grade point average and

higher technical grade point average than students in low self-efficacy groups. Furthermore, every student in the high self-efficacy groups (100%) persisted in the technical college for the four quarters (one year) included in the timeframe of the study. This was a significant difference from the 58% of students in the low self-efficacy groups who persisted for four quarters in the technical college. Self-efficacy scores did not differ by gender but did decline over time, from pre-test to post-test to follow-up. Results demonstrated that both level and strength of educational requirements self-efficacy were related to persistence and performance (grades). Educational requirements self-efficacy was significantly related to prior academic achievement and ability as measured by high school rank and math score on the Preliminary SAT, supporting the role of prior performance accomplishments in the development of self-efficacy expectations proposed by Bandura (1977) and Hackett and Betz (1981).

In a similar study, Lent et al. (1986) examined the role of self-efficacy in predicting academic performance and persistence in science and engineering, while accounting for other academic factors, including ability, prior achievement, and career interests. The sample consisted of 105 undergraduate students enrolled in a career planning course for students considering STEM majors at a Midwest university. Measures of self-efficacy included the Educational Requirements Self-Efficacy scale and the Academic Milestones Self-Efficacy scale, defined as confidence in one's ability to perform tasks essential to academic success in STEM. The Academic Milestones Self-Efficacy measure was designed to be more task-specific than the more global measure of Educational Requirements Self-Efficacy, since task-specific self-efficacy was theorized to be more relevant to task outcomes (Bandura, 1977). In this study, the two measures of

self-efficacy were only moderately correlated with each other, suggesting that they measured distinct, unique social cognitive characteristics (Lent et al., 1986).

Lent et al. (1986) found similar results to Lent et al. (1984), except that self-efficacy did not change significantly from pre-test to post-test. A gender analysis showed no significant differences in self-efficacy between men and women in the sample and high self-efficacy students had significantly stronger academic outcomes than low self-efficacy students (Lent et al., 1986). Additionally, hierarchical regression analysis procedures were used to assess the predictive nature of each of the self-efficacy measures on technical grade point average, persistence, and perceived career options. Lent et al. (1986) found that both Educational Requirements Self-Efficacy and Academic Milestones Self-Efficacy accounted for a significant amount of variance in technical courses grade point average after controlling for math PSAT score, high school rank, and expressed interest in STEM careers. Career interests did not enter the regression equations for technical grade point average or persistence, but was the strongest significant predictor of perceived career options. Academic Milestones Self-Efficacy contributed somewhat more than Educational Requirements Self-Efficacy to the prediction of grades and persistence, though this difference was not statistically significant (Lent et al., 1986).

Gender and Ethnicity in Career Development

Vogt (2003) used Bandura's (1986) social cognitive theory to understand the influence of academic environments of women in undergraduate engineering majors at four highly ranked research universities on the West Coast. The sample included 409 men and 304 women across all four class levels, although the sample was skewed towards

sophomores and freshmen. Vogt did not find differences in grade point averages by students' gender or class level. Differences by race were not tested, but approximately 65% of the sample identified as White ($n=263$) or Chinese American ($n=204$); 151 students identified as another Asian American ethnicity or as Pacific Islander. In this study, Vogt tested a path model of the relationships between academic environment, academic self-regulated behaviors, self-confidence, and achievement (grade point average). The environment included two scales: Discrimination, which measured perceived gender discrimination, and Academic Integration based on Tinto's (1993) retention model. Self-confidence also included two scales: a measure of self-efficacy in a student's major (i.e., engineering), derived from O'Neil and Herl (as cited in Vogt), and an academic self-confidence scale from the Cooperative Institutional Research Program survey. Academic self-regulated behaviors included effort, help-seeking, peer learning, and critical thinking (Vogt).

Correlational analyses revealed that women had lower engineering self-efficacy, lower academic self-confidence, perceived greater discrimination, and expended greater effort and help-seeking behaviors (Vogt, 2003). Discrimination and academic integration were minimally correlated with grade point average, but both were highly correlated with engineering self-efficacy and academic self-confidence, such that less discrimination and high academic integration were related to higher self-efficacy and self-confidence. Engineering self-efficacy and academic self-confidence were significantly and positively correlated with grade point average, suggesting an indirect effect between environment variables and achievement through self-efficacy/self-confidence. In the path analyses for both women and men, academic integration had significant positive direct effects on self-

regulated behaviors and self-confidence measures; self-regulated behaviors significantly and positively influenced self-confidence; and self-confidence significantly and positively influenced grade point average. The results for the discrimination path model also were similar for men and women. The path between discrimination and self-regulated behaviors was not significant, but discrimination was significantly and negatively related to self-efficacy/self-confidence. Again in this model, self-regulated behaviors significantly and positively influenced self-efficacy/self-confidence; and self-efficacy/self-confidence significantly and positively influenced grade point average. The total direct and indirect effects of the environment on the path between self-confidence and grade point average show that academic integration helped to raise grades and discrimination lowered grades (Vogt).

The results of Vogt's (2003) study offer evidence that men and women do not differ much in their engineering education experiences. However, subtle differences that favored men were found. Although women exhibited greater effort and help-seeking behaviors than men, women had lower engineering self-efficacy, lower academic self-confidence, and greater perceived discrimination. Vogt suggested that the cumulative effects of these differences may add up to a small deficit for women and a small advantage for men, resulting in an overall gender gap. The predominantly Asian American sample supports generalizing results to Asian American STEM students, although analyses by race were not part of this study's research design. Vogt recommended future research that tested the influence of discrimination based on race or socioeconomic status for engineering students.

In a study of gender, ethnicity, and social cognitive factors predicting the academic achievement of students in engineering, Hackett et al. (1992) responded to a call for research that explored the career development of students of color, clarified inconsistent findings related to gender, and utilized more complex models. The study examined the relation between social cognitive factors (academic and occupational self-efficacy, outcome expectations, and vocational interests) and academic performance and included factors of race, gender, stress, personal social support, faculty support, and coping measures. Hackett et al. used the definitions and measures for Educational Requirements Self-Efficacy (renamed Occupational Self-Efficacy) and Academic Milestones Self-Efficacy (abbreviated to Academic Self-Efficacy) used in Lent et al. (1986). Their racial analysis only involved a comparison of Mexican American and European American participants, which Hackett et al. identify as *ethnic* groups. The complexity of the model extended prior research on social cognitive career variables. Women and students of color at one institution were over-sampled, and although the cell sizes were too small for most groups to be included in statistical analyses, descriptive statistics were presented for men and women in each racial group (Hackett et al.).

Two forward-selection stepwise multiple regression analyses were conducted; one for semester grade point average and one for cumulative grade point average (Hackett et al., 1992). Using the entire sample, but not including race in the analysis, the strongest predictor of both semester and cumulative grade point average was academic self-efficacy. High school grade point average, faculty support, and SAT-Math were positive predictors, and faculty discouragement, interests, support and strain were negative predictors of grade point average. The negative influence of the interests and support

variables contradicted expectations. Interests appeared to act as a suppressor in the regression model. Additionally, Hackett et al. speculated that support and grade point average were inversely related because students often sacrificed their social interactions in order to keep up on their coursework, and those who achieved at lower levels may have needed and received greater amounts of support. In an analysis of the factors related to academic self-efficacy, the variables of interests and faculty encouragement were significant positive predictors, and stress and faculty discouragement were significant negative predictors (Hackett et al.).

In the second set of analyses, each forward-selection multiple regression was run for a sub-sample of only Mexican American and European American students, as other groups did not have adequate cell sizes (Hackett et al., 1992). Gender also was included in this set of analyses. Among all the variables in the multiple regression, academic self-efficacy was the strongest predictor of both semester and cumulative grade point average. Whereas ethnicity did not significantly predict achievement (grades), ethnicity was a significant predictor of academic self-efficacy, such that European Americans were more likely to have a positive sense of academic self-efficacy than Mexican Americans. Consistent with prior research on highly selective student samples, few gender differences in self-efficacy and achievement were identified (Hackett et al.). However, even with a primary research question on the influence of gender, this study used a 75% male sample. Indeed, the applicability of findings related to predictors of achievement and self-efficacy to women in engineering was difficult to establish given the overwhelming proportion of men in the study. Results from this study suggested that academic self-efficacy was the strongest predictor of achievement and that academic self-

efficacy mediated the effects of prior achievement, stress, strain, coping, gender, and ethnicity on academic achievement. Hackett et al. did not test this mediating role of self-efficacy, and they recommended testing the hypothesized model using structural equation modeling.

Whereas Hackett et al. (1992) cast a wide net in sampling in order to study the implications of race and gender, Flores and O'Brien (2002) focused on a particular subgroup. Flores and O'Brien tested the social cognitive career theory model of Mexican American high school adolescent women's career goals. The sample of 364 high school seniors attended two large public high schools in a south Texas town near the Mexican border. The model included background contextual influences of acculturation level, feminist attitudes, and mothers' role modeling (socioeconomic indicators of mothers' educational attainment and occupation); proximal environment influences measured by perceived support from parents and perceptions of occupational barriers; nontraditional career self-efficacy; nontraditional career interest; and nontraditional career goals (career aspirations, career choice prestige, and career choice traditionality). Career interests were hypothesized to partially mediate the relationship between self-efficacy and career goals, and proximal contextual influences were hypothesized to directly influence career goals (Flores & O'Brien).

The three models for career aspiration, career choice prestige, and career choice traditionality demonstrated a poor fit with the data and were rejected (Flores & O'Brien, 2002). Additional analyses recommended modifications to each model which were tested with a random hold-out sample; in each instance, the modified model demonstrated a good fit with the data. The career choice prestige model was modified by adding paths

from acculturation level and feminist attitudes directly to career choice prestige. The career choice traditionality model was modified by adding paths from acculturation level and feminist attitudes to career choice traditionality. The career aspiration model was modified by adding a path from feminist attitudes to career aspiration. In the modified models, highly acculturated (according to the Acculturation Rating Scale for Mexican Americans) participants tended to choose less prestigious and more traditional careers. And women with more feminist attitudes tended to choose more traditional careers and have higher career aspiration. The modified model explained 8% of the variance in career choice prestige, 11% of the variance in career choice traditionality, and 13% of the variance in career aspiration (Flores & O'Brien).

Nontraditional career self-efficacy, adapted from the Occupational Self-Efficacy questionnaire (Church, Teresa, Rosebrook, & Szendre, 1992), measuring confidence in one's ability to learn to perform seven male-dominated jobs, significantly and positively influenced nontraditional career interests and career choice prestige and had a significant negative influence on career choice traditionality (Flores & O'Brien, 2002). Parental support had a significant positive influence on career choice prestige and career aspiration; perceived occupational barriers had a significant positive influence on career choice prestige. None of the background contextual factors (acculturation, feminist attitudes, mother's education, and mother's occupational traditionality) were significantly related to nontraditional career self-efficacy. Flores and O'Brien suggested that other background factors, such as prior academic experiences, family expectations, socioeconomic status, or ability level, may have stronger influences on nontraditional

career self-efficacy. They also recommended analyzing separate models based on participants' acculturation level to determine differences that may not be linear.

Nora and Cabrera (1996) incorporated school environment, conceptualized as racial climate, academic experiences, and social involvement, in a study of the academic and intellectual development, performance, and persistence of [racial] minorities and nonminorities (i.e., White students). Nora and Cabrera used a combined theoretical model of college persistence to study the direct and indirect effects of the racial climate. Results pertaining to academic development and performance are presented here. Nora and Cabrera surveyed 831 first-year students (U.S. citizens and permanent residents only) at a public, commuter, predominantly White, doctoral-granting Midwestern university; the sample included 21.5% Asian Americans. The model included background characteristics of precollege ability (ACT score) and parental encouragement along with college environment factors of academic experiences with faculty and staff and social involvement. Social involvement was measured by the Interactions with Peers scale (Pascarella & Terenzini, 1980). Three interrelated scales were used to measure Perceptions of Prejudice-Discrimination: campus climate, faculty and staff discriminatory attitudes, and in-class discriminatory experiences. Structural equation modeling was used to estimate the model independently for racial minorities and for White students, as the sample size was not sufficient to assess the model for each racial minority group (Nora & Cabrera).

The construct of academic and intellectual development was measured as students' self-perceptions that academic experiences influenced their intellectual growth as well as their satisfaction with experiences at the institution and with their own

intellectual growth (Nora & Cabrera, 1996). The model explained 57% of the variance in academic and intellectual development for the racial minority student group and 65% of the variance in academic and intellectual development for the nonminority student group. For the racial minority student group model, parental encouragement contributed the strongest significant total effect as a positive predictor; academic experiences with faculty and staff (positive), perceptions of prejudice-discrimination (negative), and social involvement (positive) also were factors with significant total effects. For the nonminority student group model, academic experiences with faculty and staff contributed the strongest significant total effect (positive); parental encouragement (positive), social involvement (positive), and perceptions of prejudice-discrimination (negative) also were factors with significant total effects (Nora & Cabrera).

Nora and Cabrera's (1996) theoretical model explained 19% of the variance in academic performance as measured by cumulative grade point average for racial minorities and 27% of the variance for nonminorities. Precollege academic ability (ACT scores) was the strongest significant predictor of academic performance (positive), with the largest direct and total effect for both racial minorities and nonminorities. Precollege academic ability did not contribute an indirect effect on performance. For both groups, academic and intellectual development exerted the next strongest total effect (positive) on cumulative grade point average, followed by perceptions of prejudice-discrimination (negative), academic experiences with faculty and staff (positive), parental encouragement (positive), and social involvement (positive). Perceptions of prejudice-discrimination contributed a significant negative direct effect on nonminorities' grade

point average, but the effect was wholly indirect for racial minority students (Nora & Cabrera).

The level of academic preparedness was important for both racial minority students and White students, as was parental encouragement (Nora & Cabrera, 1996). Both groups perceived a negative racial climate, but racial minority students' perceptions were more negative than White students' perceptions. Perceptions of prejudice-discrimination exerted similar levels of total effects on cumulative grade point average for both groups. Surprisingly, perceptions of prejudice-discrimination had a significant direct negative effect only for White students. The authors suggested that racial minority students were more immune than White students to prejudice-discrimination because they had more experience with negative racial environments. Nora and Cabrera concluded that the theoretical model of persistence was appropriate for both racial minority and White students, but that other factors related to culture, such as family responsibility, might be important in the model for racial minority students. They also suggested that the relationships in the model were consistent across the racial groups comprising the racial minority category, but future research needed to test this assertion (Nora & Cabrera).

Asian American Academic and Career Outcomes

Greenstein (2000) conducted a path analysis to examine the relationships between classroom racial climate, campus racial climate, academic self-efficacy, and academic and intellectual development by race. Academic self-efficacy, measured using the College Academic Self-Efficacy Scale (Owen & Froman, 1988), was defined as “student’s beliefs in his/her ability to successfully complete academic related activities and skills” (Greenstein, p. 21). Data were collected by survey from 53 Asian American,

57 Black, 58 White, and 53 Latino junior and senior undergraduate students and by two focus groups comprised of survey participants. Participants were enrolled at a large mid-Atlantic research university, the site of the present research study. The path model involved academic self-efficacy partially mediating the relationships between both types of racial climate and a self-reported measure of academic and intellectual development (Greenstein).

There were no significant differences between Asian American students and any other racial group in level of academic and intellectual development (Greenstein, 2000). However, Asian American students' average score on academic self-efficacy was the lowest of all racial groups, and significantly lower than the average score for Latino students, who had the highest level of academic self-efficacy. The low academic self-efficacy score for Asian American students may be an indicator that Asian American students were often critical of themselves, feeling they were not living up to expectations derived from the model minority myth. This suggestion was supported by focus group data also collected during the study (Greenstein).

The path analysis determined that the data fit the model well overall and for the Asian American group in particular (Greenstein, 2000). All relationships in the path model were positive for the Asian American student group. The strongest relationship for Asian American students was between classroom racial climate and academic and intellectual development, followed by the relationship between academic self-efficacy and academic and intellectual development, the only two statistically significant direct paths. Furthermore, the classroom climate and academic and intellectual development relationship was strongest for Asian American students than for any other race, and Asian

American students had the lowest self-efficacy scores of all racial groups. For Asian American students, the relationship between classroom racial climate and academic self-efficacy was primarily direct but small and not statistically significant, and the influence of campus racial climate on academic and intellectual development was predominantly indirect through self-efficacy. Gender differences were not evident in the data, although the sample size was not large enough to permit analysis by gender within each racial group (Greenstein).

Tang et al. (1999) assessed the role of background contextual factors – acculturation, family socioeconomic status, and family involvement – in social cognitive career theory for Asian American undergraduates. The analysis explored Asian Americans' career self-efficacy, measured by the Confidence Inventory (Betz, as cited in Tang et al.) which assesses self-efficacy for Holland occupational types, and traditionality of career choice. The authors used path analysis and tested the fit of the social cognitive career model to data collected from 187 Asian American students at eight major universities. Participants included 48% women and 41% Chinese, 7% Korean, 2% Japanese, 26% Vietnamese, 7% Hmong, 2% Laotian, 12% Filipino, and 3% other Asian ethnic backgrounds (Tang et al.).

Seventy-five percent (75%) of participants chose a “traditional” Asian American occupation, as calculated by the proportion of Asian Americans in a field relative to the total proportion of Asian Americans in the workforce (Tang et al., 1999). The most frequently cited occupations were engineer, physician, and computer scientist. The results indicated that the model did not fit the data. Although the overall model was not a good fit, acculturation, measured by the SL-ASIA (Suinn et al., 1987), was found to have a

significant negative relationship to self-efficacy, interests, and career choice. In addition, family involvement was significant and positively related to career choice but not related to self-efficacy. Self-efficacy was significantly related to interests and career choice, but interests were not related to career choice. Strong parent influence, low acculturation levels, and high self-efficacy were linked with more traditional career choices. Results of post hoc analyses recommended removing the path from family socioeconomic status to interests, and adding paths from family involvement to interests and from family socioeconomic status to career choice to improve the model's fit, but these modifications needed to be tested in future studies. The study provided evidence of the role of acculturation in social cognitive career theory and offered support for the theorized influence of self-efficacy on both interest and career choice. On the other hand, socioeconomic status and family involvement seemed to be directly rather than indirectly related to career choice.

Summary

Social cognitive theory (Bandura, 1986) and social cognitive career theory (Lent et al., 1994) have been useful in empirically understanding the career development of students in STEM and has demonstrated some utility in describing the general career development of women of color with some modification. The social cognitive career theory outcome of career choice was tested by Tang et al. (1999); the outcome of career interests also was tested by Tang et al. as well as Hackett et al. (1992) and Flores and O'Brien (2002). The performance outcome (i.e., achievement) of social cognitive career theory was tested in Hackett et al., Lent et al. (1984, 1986), Nora and Cabrera (1996), and Vogt (2003). Tang et al. and Flores and O'Brien did not find empirical support for their

career goals/career choice models. However, their results supported the significant role of acculturation and family socioeconomic indicators in career goals/choice, although Tang et al. and Flores and O'Brien suggested that these factors were directly related to outcomes, rather than indirect through self-efficacy. Career interests did not predict career goals or choice for Mexican American adolescent women and Asian American college students and did not predict achievement for engineering college students (Flores & O'Brien; Lent et al., 1986; Tang et al.). Flores and O'Brien suggested that social cognitive career theory be adjusted to reduce the relevance of interests in career decisions for women of color.

Greenstein (2000), Hackett et al. (1992) and Lent et al. (1984, 1986) did not find gender differences in academic self-efficacy, but Vogt (2003) found a small advantage for men. The racial and gendered climate was found to influence academic outcomes, as was social involvement with peers. Perceptions of prejudice-discrimination on campus and in the classroom had a significant negative influence on both academic and intellectual development and grade point average for students of color, including Asian American students, in Nora and Cabrera (1996) and Greenstein. Vogt found that perceptions of gender discrimination had a significant negative effect on the self-efficacy and grade point average of women in engineering majors, in a sample that was 50% Asian American. Additionally, Nora and Cabrera found that social involvement with peers had a positive total influence on both academic and intellectual development and grade point average for students of color.

The performance model was tested using samples of undergraduate STEM students, predominantly White and male. Lent et al. (1984, 1986), Hackett et al. (1992),

and Vogt (2003) provided empirical support as their results matched the model's hypotheses and adequately described the factors influencing academic achievement. Vogt's sample was 50% women and 50% Asian American, but the study did not assess racial differences. Hackett et al. found that race was related to self-efficacy in that being European-American, in comparison to being Mexican-American, was predictive of a more positive sense of self-efficacy, but neither gender nor race was significant in predicting achievement in Hackett et al. In all four of these studies, self-efficacy was consistently a strong predictor of performance, as measured by academic grade point average.

The research design of sampling women of one racial subgroup was a particularly relevant strength of Flores and O'Brien's (2002) study as it provided a sufficient number of cases that enabled complex statistical analyses of adolescent Mexican American women's career development. This design contrasts with previous studies of more general populations, which tended to either eliminate cases of Asian American women from analyses beyond descriptive statistics or aggregate data from Asian American women with data from other women or White students.

The limitations of this body of research on social cognitive career theory provided recommendations for the current research study of the academic development of Asian American women in STEM. For example, the small sample size and enrollment in a specific career planning course of participants in the Lent et al. (1984, 1986) studies limited the ability to generalize to students who did not have a similar experience in their academic and career development. Lent et al. (1986) and Hackett et al. (1992) recommended studying the mediating effects of self-efficacy between career-related

interventions and career-related outcomes, replicating their studies with a larger sample and broader range of majors and career-related experiences, and exploring the causal nature of the relationship between self-efficacy and academic performance. Hackett et al. also suggested future research with larger samples of women of color to examine the interaction of gender and ethnicity and to test the path model they developed. Flores and O'Brien (2002) recommended that future research consider additional proximal environment variables, such as school environment, that were not included in social cognitive career theory but may influence career development for women of color.

Self-efficacy was found to be an important construct to understanding the academic and career development of Asian American students (Greenstein, 2000; Tang et al., 1999). However, additional research was needed to test the modified model proposed by Tang et al. and confirm the findings related to acculturation, family involvement, and self-efficacy. Tang et al. recommended future research that (a) explored these patterns for various Asian American ethnic groups, (b) included a measure of generational status, and (c) developed a valid measure of family involvement. Future studies of Asian American students' career development could incorporate gender, another form of within-group variance, and performance outcomes, either achievement or persistence (as opposed to the outcome of career choice).

Therefore, the recommended constructs to assess in a complex model based on social cognitive career theory and research for the academic and career development of Asian American undergraduate women in STEM were background characteristics of gender, race, and ethnicity; background contextual factors of socioeconomic status and acculturation; and college environment factors, such as faculty support and

discouragement, the racial and gendered climate, and academic peer support; and academic self-efficacy. Furthermore, the mediating role of academic self-efficacy in the effects of background and environment variables on academic achievement should be explicitly tested. Acculturation appeared to be an important element in the career development processes of Asian American college students, at least with respect to choice (Tang et al., 1999). Although Lent et al. (1994) hypothesized that this background contextual factor exerted an indirect influence on performance through self-efficacy, Tang et al. and Flores and O'Brien found support for a direct effect on career *choice*. In the comparative model analysis, Lent et al. (2003) hypothesized that some collectivist cultural groups may have more direct links between family involvement and career outcomes. The relationship between acculturation and career-related performance was an area of the model that needed to be tested.

Summary

The theoretical evolution of social cognitive theory, self-efficacy theory, and social cognitive career theory prescribed the interrelationships among background contextual factors, proximal college environment factors, academic self-efficacy, and achievement for undergraduate Asian American women in STEM majors. Research in science and engineering achievement, using social cognitive career theory and its antecedents, found that gender, race, acculturation, socioeconomic status, and ethnicity were important elements in the career and academic development of Asian American women in STEM majors, but no study has tested the set of interrelationships for this population of students in relation to their academic achievement. College grades have been found to predict educational attainment, career choice, and hiring decisions. Yet the

proliferation of the model minority myth combined with a national priority on studying historically under-represented populations in STEM has limited the knowledge base regarding Asian American STEM students' academic success. The theoretical model derived from social cognitive career theory tested in the current research study is depicted in Figure 1 (see Chapter I).

Chapter III: Research Methodology

This study attempted to remedy the lack of research attending to the experiences of Asian American women in science, technology, engineering, and mathematics (STEM) majors by testing a model of academic and career development provided by social cognitive career theory (Lent et al., 1994). The theoretical and empirical literature regarding the career development of Asian American women in STEM guided the specification of variables in the theoretical model (Byars & Hackett, 1998; Greenstein, 2000; Hackett et al., 1992; Hall & Sandler, 1982; Hurtado et al., 1999; Leong & Chou, 1994; Tang et al., 1999). The purpose of this research study was to examine, for undergraduate women of various Asian American ethnic backgrounds, the influence of background contextual and college environment factors on their sense of academic self-efficacy and achievement in STEM majors.

This chapter provides an overview of the research design and descriptions of the population and institutional context, the sample, and the participants. After the variables are defined and instrumentation is identified, the chapter then provides an overview of the procedures involved in administering the online survey and collecting institutional data. The statements of hypothesis are presented along with a detailed description of the theoretically derived path diagram. The statistical aspects of data analysis, including underlying assumptions, conclude the chapter.

Research Design

The research design involved cross-sectional, single-institution, survey research. Data were collected through an online survey and analyzed through quantitative

statistical procedures of multivariate analysis of variance and path analysis. Social cognitive career theory (Lent et al., 1994) provided the theoretical foundation for the research design by delineating the relationships among past performance, academic level, academic peer support, racial and gendered climate, socioeconomic status, and acculturation with academic self-efficacy and achievement. Social cognitive career theory hypothesizes that background contextual factors (socioeconomic status and acculturation) and college environment factors (academic peer support and climate) exert influence on social cognitive (self-efficacy) and academic outcome (achievement) variables, and self-efficacy mediates the relationships between all variables and achievement (see Figure 1 in Chapter I; Byars & Hackett, 1998; Lent et al.). The research design involved two phases of data analysis. In the first phase, the presence of differences between Asian American ethnic groups in the social cognitive career model's variables was analyzed. The second phase consisted of a path analysis of the relationships among the social cognitive career variables for Asian American undergraduate women majoring in STEM. This design is supported by the philosophical framework of critical inquiry in the feminist tradition. The theoretical model aligns with Riger's (1998) perspective, which advocates for an interactional view of gender that recognizes individual agency within a sociocultural context of power and domination.

The study was designed as a single institution study to eliminate the potential confounding factors of a multiple institutional study. This delimitation enabled stronger analysis of the social cognitive career theory model as a function of the background factors of race, gender, and ethnicity rather than the institutional variables of campus culture, geographical location, and overall compositional diversity that also may

influence differences in students' experiences (Hurtado et al., 1999). The data for this study were collected at a large public, doctoral research extensive university on the east coast. This particular institution was selected for the site of data collection because it offered a broad range of undergraduate major programs in science, engineering, and mathematics, and because the Asian American population comprised 14% of the undergraduate student body (Office of University Communications, 2004), more than twice the national average of 5.6% (National Science Foundation, 2004). At the same time, the gender ratio among Asian American students in STEM majors at this institution (36% women; Office of Institutional Research & Planning, 2003) was similar to national trends (Hill, 2002). These characteristics of the institution provided an adequately sized sample to meet the statistical requirements for conducting analyses, thereby enabling data collection from a single institution while also maintaining generalizable results.

Data on past performance and academic level were collected before survey administration and outcome data on semester achievement were collected after the survey was administered. The research design was cross-sectional as data for background contextual factors (socioeconomic status and acculturation), college environment factors (academic peer support and climate) and academic self-efficacy were collected in a single survey administration. The theoretical direction of influence between these constructs flows from background contextual factors to academic self-efficacy and from college environment factors to academic self-efficacy (Lent et al., 1994). In Lent et al. (2003), contextual variables did not exhibit a strong direct effect on career choice outcomes for engineering students, but did have an indirect effect on career choice through social cognitive variables, providing support for this direction of influence of context on self-

efficacy. Furthermore, campus climate is defined as perceptions, attitudes, and expectations that may change over time and may vary by individual or subgroups within an institution (Hurtado et al., 1999). This definition suggests that *current* data are more meaningful in explaining this construct's relationship to other variables than historical climate data, which may be outdated. Because the theoretical model was recursive (i.e., unidirectional) and specified the direction of influence for simultaneously occurring elements in the model, a cross-sectional design was considered appropriate. As a result, however, this research design eliminated testing of causality.

Survey methods collect information from a sample in an efficient systematic process minimizing the impact of the study on the participants (Norusis, 1990). Therefore, utilizing a survey was a prudent choice for this type of study that explored dynamic social psychological processes. The survey instrument was comprised of several different scales measuring the theory's constructs and was made available to the sample through a web-based interface. Institutional databases provided data on compositional diversity by STEM major, past performance, and achievement. The constructs of social cognitive career theory were operationalized through measures used in several related studies, providing an efficient and systematic process for collecting information about the constructs (see Greenstein, 2000; Hackett et al., 1992; Lent et al., 1986; Vogt, 2003). As this study extended prior research on social cognitive career theory to address the career development of another population of students, it also built upon the reliability and validity evidence collected in these prior studies. Collecting the same type of data in the same format for each participant strengthened conclusions drawn from the data and facilitated generalizing results to the population under study.

Since the research literature suggested variance in the elements of academic and career development of Asian American students (Hune, 2002; Kim et al., 1998; Sodowsky et al., 1991), the first phase of the research design included multivariate analysis of variance (MANOVA) to test for Asian American ethnic group differences in the primary constructs of past performance, academic peer support, racial climate, gendered climate, socioeconomic status, Asian and American acculturation, academic self-efficacy, and achievement. Results from these analyses were used to determine if ethnic groups were considered separately or if they were aggregated in the second phase of analysis: examining relationships among the variables. Since sample size prevented the use of a multiple-groups path analysis procedure in the event of ethnic group differences, the results of the MANOVA tests informed the selection of either multiple regression or path analysis procedures to examine the relationships between the background and college environment variables with self-efficacy and achievement. If statistically significant differences in the primary constructs by Asian American ethnic group were present, multiple regression models would be run separately for each group. If statistically significant differences were not found, path analysis would be run for the entire sample.

The statistical procedures of path analysis account for the dynamic nature of context and agency in social-psychological processes. A path diagram maintains the complexity of social cognitive career theory (Lent et al., 1994), and analysis examines the collective impact of contextual variables by identifying their direct, indirect, and total effects on achievement for Asian American undergraduate women majoring in STEM. Path analysis also analyzes the mediating influence of self-efficacy on the relationships

between contextual factors and achievement. Although path models imply a theoretical causal order (Klem, 2000), path analysis procedures may be used to test any theoretical system of inter-relationships (Hoyle & Panter, 1995; Schumacker & Lomax, 1996). Several researchers who introduced the method of path analysis to, first, genetics and then the social sciences (Duncan, 1985; Li, 1975; Wright, 1985) noted that the procedures were not limited to cause and effect relationships and that path analysis offered a “pattern of interpretation” for any set of relationships between variables in a theoretical model (Duncan, p. 62).

Population and Institutional Context

The population of interest for this study was Asian American undergraduate women majoring in STEM. The sample was drawn from this population at a large, doctoral-granting, public research university on the east coast. The definition of Asian American was based on Nomura’s (2003) introduction to a reader on Asian American women’s history, where she included U.S. citizens or permanent residents in the U.S. of “Chinese, Filipino, Japanese, Korean, South Asian (e.g., Indian, Pakistani, Bangladeshi, Sri Lankan, Nepalese), and Southeast Asian (e.g., Vietnamese, Hmong, Lao, Cambodian, Indonesian, Thai, Malaysian, Singaporean) ancestry” (p.16). Although often grouped with Asian Americans, individuals of Pacific island ancestry as well as indigenous people of Pacific islands colonized by the U.S. were not included in the definition of this research study’s population, as Pacific Islanders have distinct histories of oppression with the U.S. (Hirschman, 1994; Nomura). Although not excluded from the sample, the number of Pacific Islanders at the institution where the current research study occurred

indicated that few, if any, were likely to be in the study's sample (Counseling Center, 2004).

STEM majors included all majors offered by this institution's School of Engineering, College of Computer, Mathematical, and Physical Sciences, College of Life Sciences, and College of Agriculture and Natural Resources, which included majors in the natural sciences (physics, chemistry, biology, agriculture), engineering (including computer science), and mathematics. Students with majors exclusively in the social sciences and psychology were not included in the population parameters for this study. The nature of the social science and psychology disciplines is distinctly different from other science fields that have a more persistent history as male-dominated fields, that provide laboratory and project based work, that mandate many prerequisite courses, and that assign frequent problem-based assignments (Elliott et al., 1996).

The university has an undergraduate enrollment of 25,000 with approximately 32% students of color; Asian Americans comprise approximately 14% of the undergraduate student body (Office of University Communications, 2004). Data from the 2000 Census through July 2003 indicated that the metropolitan region in which the university is located grew 6% and the Asian/Asian American population grew 17% from the 2000 Census data through July 2003, particularly in the suburban areas (Cohn, 2004). By 2003, the region was approximately 8% Asian/Asian American (Cohn).

Historically, the Asian American Student Union was founded at the university in 1991, the same year that the university started offering Asian American Studies courses. Between 1995 and 1997, Asian American students, faculty, and staff escalated their activism to establish an Asian American Studies program with certificate or major

degree-granting ability (Asian American Studies Program, 2001). Vocal protests, a march into the President's Office, rallies such as Stereotype Day, and petitions were used to increase awareness of their effort. In May, 2000, a certificate program in Asian American Studies was formally established (Asian American Studies Program; Slusark, 2004).

Even though activism to establish the certificate program was a success, Asian American students continued to report racial tensions. One month after the terrorist attacks on September 11, 2001, a South Asian American female student wrote a guest column for the student newspaper describing how a group of men in a car harassed her and a friend by screaming and swearing at them to go back to their country; the student surmised that the group assumed she was of Middle East descent and, in their minds, connected her to the attacks (Antony, 2001). Despite this incident, the attempted murder-suicide, and the degrading theme party at a local dance club described in Chapter I, Asian Americans have continued to demand an increase in attention to the needs of their population at the university and in the region.

The Asian American Student Union at this university has continued to push for resources to improve and expand the Asian American Studies program. As a result, the campus administration promised to begin the national search for a director, to add courses, and to reconsider classroom locations (Slusark, 2004). An increased presence at the university was supported with an increased presence regionally. For example, in September, 2003, the institution's state Governor reauthorized a Commission of Asian Pacific American Affairs, an advisory body to the Governor and the State Office on Asian Pacific American Affairs (Ehrlich, 2003).

Sample and Participants

Institutional data were used to identify the population of undergraduate Asian American women in STEM majors. The full population sample included all students identified in this way at the start of the Spring 2005 semester: 30 Asian American women in agriculture and natural resources; 61 in computer science, mathematics, and physical sciences; 96 in engineering; and 290 in life sciences.

The required sample sizes for multivariate analysis of variance and multiple regression were estimated through power analysis. According to Cohen (1992), with an alpha level of .01 and estimated medium to large effect sizes, multivariate analysis of variance for six groups (an estimated number of Asian American ethnic subgroups included in this analysis) requires a sample size between 20 and 49 for each group to reach an adequate power level of .80. Furthermore, multiple regression analysis with six independent variables (total college credits, high school grade point average, socioeconomic status, acculturation, racial climate, and gendered climate), .80 power, .05 alpha, and large effect size estimates requires a minimum of 45 participants in each group (Cohen). The power analysis was used to determine the minimum sample size required for each ethnic group to be included in the multivariate analysis of variance and multiple regression analysis. For path analysis, Klem (2000) recommended 5-10 cases per parameter (variable covariances, paths, and residuals (error terms)) in the model, and Bentler and Chou (1987) recommended a 5:1 ratio of sample size to total number of parameters. The model used in this study had 38 parameters, suggesting that a respondent sample size between 190 and 380 participants was adequate.

A total of 228 students participated in the study. The response rate to the survey was 50.9%. The initial sample of Asian American women majoring in one of the four STEM colleges at the university consisted of 477 students. Of the 477 students in the sample, two students could not be contacted due to incorrect or missing electronic mail addresses and phone numbers; four students requested to be removed from the mailing list by following the “Remove” link provided in the electronic mail invitation and reminder messages; and four students accessed the survey website but declined consent. These 10 students were not included in response rate calculations (however, these 10 students were considered non-respondents in the analysis of non-response, presented next). Of the remaining 467 students, a total of 245 students participated in the research study by consenting to participate and providing survey responses. However, seven students did not complete the survey and at least 30% of data from their surveys were missing. Since the large amount of missing data were not considered missing at random (MAR; Kline, 2005), these seven students were not included in the respondents group (Bentler & Wu, 2000; Kline). Also, three students who participated identified that they did not belong in the target population. That is, one individual did not identify as Asian American and two individuals did not identify a STEM major; they were removed from the respondents group and not included in response rate calculations. Furthermore, seven students who consented to participate were removed from the respondents group and not included in response rate calculations because semester grade point average data were missing. A review of these students’ college credits suggested that they likely did not complete coursework for grades during the semester of the study, and the missing data were not considered MAR. Semester grade point average data were missing for nine non-

respondents as well, and they also were not included in response rate calculations. Hence, the response rate was 228 out of 448, or 50.9%.

More than half, 61%, of the 228 participants were majoring in Life Sciences, as shown in Table 1 in the Respondents column. About 24% of participants were in Engineering, 12% in Computer, Math, and Physical Sciences, and only 2.2% in Agriculture and Natural Resources. More descriptive information about the participants is provided in Chapter IV.

Table 1

College of Major for Respondents and Non-Respondents

<u>College of Major</u>	Respondents		Non-Respondents		Total	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Agriculture & Natural Resources	5	2.2	24	10.4	29	6.3
Computer, Math, & Physical Sciences	28	12.3	29	12.6	57	12.4
Engineering	55	24.1	34	14.8	89	19.4
Life Sciences	140	61.4	143	62.2	283	61.8
<u>Total</u>	<u>228</u>	<u>100.0</u>	<u>230</u>	<u>100.0</u>	<u>458</u>	<u>100.0</u>

Note: $\chi^2(3, N=458)=17.444, p=.001$.

Analysis of Non-Response

The college of major and some background characteristics of the 228 participants were compared with those of non-respondents ($N=230$) to assess the presence of non-response bias. One-way analysis of variance (ANOVA) and chi-square analysis tested for significant differences at $p<.05$ between respondents and non-respondents in data available from institutional sources.

Statistically significant differences between respondents and non-respondents in their major college was found, $\chi^2(3, N=458)=17.444, p=.001$. As shown in Table 1, although the proportions of respondents in computer, math, and physical science and life sciences were similar to the proportions of non-respondents, agriculture and natural resources was underrepresented in the respondents group and there were more engineering students in the respondents group than in the non-respondents group. Furthermore, ANOVA results indicated statistically significant differences between respondents and non-respondents in high school GPA, SAT verbal and math scores, total college credits, and past college cumulative GPA ($p<.05$) as displayed in Table 2. The mean high school GPA for respondents was 4.14 ($SD=.42$) compared to 4.02 ($SD=.47$) for non-respondents, $F(1,386)=7.304, p=.007$. On average, respondents also had higher SAT scores than non-respondents with a 26 point advantage on both the verbal section, $F(1,397)=6.995, p=.008$, and the math section, $F(1,397)=12.596, p=.000$. At the start of the Spring 2005 semester, respondents had fewer credits ($M=77.1, SD=37.5$) than non-respondents ($M=83.9, SD=36.9$), $F(1,455)=3.885, p=.049$, and higher cumulative GPA ($M=3.17, SD=.58$) than non-respondents ($M=2.97, SD=.61$), $F(1,448)=12.463, p=.000$.

Table 2

Academic Background Variable Means for Respondents and Non-Respondents

Academic Background		Respondents	Non-Respondents	Total	<i>F</i>	<i>df</i>	<i>p</i>
High School GPA	<i>Mean</i>	4.14	4.02	4.08	7.304	1, 386	.007
	<i>SD</i>	.42	.47	.45			
	<i>N</i>	197	191	388			
SAT Verbal Score	<i>Mean</i>	609.5	583.8	596.7	6.995	1, 397	.008
	<i>SD</i>	100.4	92.8	97.5			
	<i>N</i>	201	198	399			
SAT Math Score	<i>Mean</i>	674.2	648.7	661.6	12.596	1, 397	.000
	<i>SD</i>	74.4	68.6	72.6			
	<i>N</i>	201	198	399			
Total College Credits	<i>Mean</i>	77.1	83.9	80.5	3.885	1, 455	.049
	<i>SD</i>	37.5	36.9	37.3			
	<i>N</i>	228	229	457			
Past Cumulative GPA (college)	<i>Mean</i>	3.17	2.97	3.07	12.463	1, 448	.000
	<i>SD</i>	.58	.61	.61			
	<i>N</i>	225	225	450			

Note: *N*=458; Ranges for participant responses were High School GPA (2.41, 4.88), SAT Verbal (220, 800), SAT Math (380, 800), Total College Credits (4, 166), Past Cumulative GPA (0.21, 4.00).

*Variables**Background Characteristics*

Students' race, gender, and major were background characteristics that were constants in the study, which delimited the sample as Asian American women majoring in STEM. Ethnicity was a fourth background characteristic, a primary independent variable for data analysis. Since Asian American ethnicity is a difficult construct to delineate as the act of defining a group has many sociopolitical implications (McEwen et al., 2002; Nomura, 2003), *ethnicity* was defined by participants' self-identification with an Asian American ethnic group. This included Chinese, Filipino, Japanese, Korean, Asian Indian, Pakistani, Bangladeshi, Sri Lankan, Nepalese, Vietnamese, Hmong, Lao, Cambodian, Indonesian, Thai, Malaysian, Singaporean, and other Asian American or

Pacific Islander (McEwen et al.; Nomura). Individuals who identified with more than one Asian American ethnicity were considered part of a multi-ethnic group.

Past performance was defined as high school grade point average. This is consistent with definitions of prior performance in Hackett et al.'s (1992) study of self-efficacy and college grades, where high school grades were significant positive predictors of semester and cumulative grade point average.

Academic level was added as a control variable, operationalized as the total number of accumulated college credits earned by students. Studies document a change in social cognitive career variables over time, indicating that academic and career development processes for more advanced students are different from those of less advanced students (Astin & Astin, 1992; Lent et al., 1984; Whitt et al., 1999). This definition of academic level was selected for the current research study because students who have accumulated more college credits tend to take more advanced courses, have been in higher education longer, and have more academic experiences than those with fewer college credits.

Background Contextual Factors

Socioeconomic status and acculturation were the recommended background contextual factors to assess in an academic and career development model based on social cognitive career theory for Asian American women (Byars & Hackett, 1998). In addition, they were used by Tang et al. (1999) in a study of social cognitive career theory and Asian American college students. Although other background contextual factors, such as generational status, racial/ethnic identity, and generation in college, also may influence students' achievement, these constructs are correlated with each other and with

acculturation, socioeconomic status, and Asian American ethnicity (Chinn, 1999; Hune, 1998; Suzuki, 2002). In fact, Leong and Chou (1994) developed a model that integrates models of ethnic identity development and acculturation processes. And in a study of generational status and educational outcomes, Kaufman, Chavez, and Lauen (1998) were not able to discern if the results of generational status differences were related more to differences among ethnic subgroups. Since the assumption of minimal multicollinearity was important to maintain in statistical analysis, the background contextual factors were limited to acculturation and socioeconomic status.

Acculturation was defined as the complex process of change in adherence to values, beliefs, attitudes, and behaviors by Asian Americans as they are exposed to the dominant U.S. culture (Kim et al., 1999; Suinn et al., 1987). As a complex process, acculturation is multidimensional and the process of acculturation along these dimensions may occur at different rates. Furthermore, adherence to dominant U.S. culture may be independent of retention of an Asian ethnic culture along any one dimension (Birman & Trickett, 2001). During the change process, individuals may resist changing their values and behaviors, they may adopt new values and behaviors, or they may rely upon both cultural values and behaviors at different times (R. M. Suinn, personal communication, March 9, 2004). In the current research study, acculturation was measured by the American Acculturation Index and the Asian Acculturation Index of the Language, Identity, and Behavioral Acculturation Scale (LIB; Birman & Trickett, 2001).

Socioeconomic status was defined as the level of financial, human, and social resources available to an individual or family through educational attainment, occupational status, and sources of income and wealth (Ensminger et al., 2000). The SES

index used in this research study included indicators of parents' educational attainment, parents' occupational status, and participants' perceived family socioeconomic status.

College Environment Factors

The college environment that Asian American undergraduate women in STEM majors encounter was conceptualized as the structural/compositional, psychological, and behavioral aspects of the racial climate and gendered climate and academic peer support (Hurtado et al., 1999). *Compositional diversity* was defined as the percent of women and the percent of Asian American undergraduate students in students' STEM major. The *racial climate* was defined as perceptions of faculty-student interactions and racial sensitivity in the classroom, measured by the Faculty and Classroom Behavior scale (Neal, 1992). The *gendered climate* was defined as perceptions of direct or vicarious discouragement or discrimination by faculty or peers based on gender, measured by the Gender Discrimination scale (Vogt, 2003). This study relied upon participants' perceptions of the racial and gendered climate, not objective measures of the college environment. Since perceptions depend upon an individual's level of awareness, an individual may not recognize negative elements that are present in the environment (Lent et al., 1994). However, Lent et al. (1994, 2000) identified both objective and subjective aspects of the environment as influences on academic and career development. According to Hurtado et al., different groups may view the same climate differently, distinguishing the climate from other aspects of the college environment. The current study tested how personal impressions of the college environment influenced an individual student's sense of academic self-efficacy and achievement, consistent with Lent et al. (1994, 2000).

Academic peer support was defined as the quality of a student's peer-group interactions (Pascarella & Terenzini, 1980). The selection of academic peer support in the study was based on the consistently strong evidence of the influence of peers on college learning and development (Astin, 1993; Pascarella & Terenzini, 1991), as used in Nora and Cabrera's (1996) integrated model of persistence. This variable was measured by the Interactions with Peers scale (Pascarella & Terenzini, 1980).

Self-Efficacy

Academic self-efficacy, measured by the Academic Milestones Self-Efficacy scale (Lent et al., 1986), was defined as confidence in one's ability to perform tasks essential to academic success in STEM (Hackett et al., 1992; Lent et al.). Other forms of career-related self-efficacy include occupational self-efficacy, mathematics self-efficacy, and self-efficacy related to Holland types (Betz & Hackett, 1997). Academic self-efficacy (in STEM) was selected because self-efficacy is most predictive of outcomes when it is specific to those outcomes (Bandura, 1986) and has been used in previous studies of STEM achievement (e.g., Hackett et al.; Lent et al.).

Achievement

Achievement was defined as semester grade point average from the semester during which the study occurred. Semester grade point average was selected as the indicator of achievement as opposed to cumulative grade point average for several reasons. First, semester grade point average was used in other social cognitive achievement studies (e.g., Hackett et al., 1992; Lent et al., 1984, 1986) that had statistically significant findings. Second, the use of semester grade point average protected the integrity of the theoretical model. Cumulative grade point average measures

the accumulation of performance over time, but the research study focused on the relationship between current perceptions of climate and academic self-efficacy on current performance. Thus, semester grade point average was used as the measure of achievement in this research study.

Instrumentation

This section provides information on the instruments used to measure the variables in the study. Details about scale items, response options, and reliability and validity are provided if this information was available in the literature. This section also details scoring procedures and modifications that were made to the scales.

Background Characteristics

Demographics inventory. Although institutional data sources were used to select the sample by students' race, gender, and major, these background characteristics also were collected by a set of items in the survey in a demographics inventory (Appendix A). This was to ensure that respondents were members of the intended population as well as to collect the most current and accurate information. Students also were asked through the survey to indicate their citizenship status, generation in the U.S., and their ethnicity, based on the definition by Nomura (2003), which were not available in institutional data sources. The response options for these variables are provided in Table 3. Additional background information, including birth year, residence, academic level, transfer status, and campus involvements, was collected; these survey items also are listed in Appendix A.

Table 3

Operational Definitions of Background Characteristic Variables

Background Characteristic	Response Options
Race	(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) Race/ethnicity not included above
Gender	(1) Male; (2) Female
Major	(1) Agriculture and Natural Resources; (2) Computer, Mathematics, and Physical Sciences; (3) Engineering; (4) Life Sciences
Citizenship Status	(1) Born in the U.S.; (2) Foreign born, naturalized U.S. citizen; (3) Foreign born, resident alien/permanent resident of the U.S.; (4) International student with visa; (5) Other
Generation in the U.S.	(1) 1 st generation [follow-up question: At what age did you first arrive in the United States, either to live or for school?]; (2) 2 nd generation; (3) 3 rd generation; (4) 4 th generation; (5) 5 th generation; (6) Don't know what generation best fits since I lack some information
Ethnicity	(1) Chinese; (2) Filipino; (3) Japanese; (4) Korean; (5) Asian Indian; (6) Pakistani; (7) Bangladeshi; (8) Sri Lankan; (9) Nepalese; (10) Vietnamese; (11) Hmong; (12) Lao; (13) Cambodian; (14) Indonesian; (15) Thai; (16) Malaysian; (17) Singaporean; (18) Other Asian or Pacific Islander
Socioeconomic Status	<p><i>Mother's educational attainment and Father's educational attainment:</i> (1) High school or less; (2) Some college; (3) Associate's degree; (4) Bachelor's degree; (5) Master's, Doctorate or professional degree (JD, MD, PhD)</p> <p><i>Mother's current occupational status and Father's current occupational status:</i> (1) Unemployed/not working; (2) Manual laborer; (3) Service worker; (4) Skilled worker; (5) Professional or top administrator</p> <p><i>Perceived family socioeconomic status:</i> (1) Lower class; (2) Lower-middle class; (3) Middle class; (4) Upper-middle class; (5) Upper class</p>

Background Contextual Factors

Language, Identity, and Behavioral Acculturation Scale. Acculturation was measured by the Language, Identity, and Behavioral (LIB) Acculturation Scale (Appendix B; Birman & Trickett, 2001), which was originally designed to assess acculturation of Russian immigrants in the U.S. The LIB provides scores on an American Acculturation Index and a Russian Acculturation Index. Each index includes 10 items on a language competence subscale, 7 items on an identity acculturation subscale, and 9 items on a behavioral acculturation subscale. Two items were added to each behavioral acculturation subscale in a version of the LIB used in a study of Vietnamese immigrant experiences for a total of 11 items (S. Patel, personal communication, December 16, 2004). The Russian Acculturation Index of the LIB was adapted for the current study as an Asian Acculturation Index by replacing the term “Russian” in item stems with either the phrase “Asian (e.g., Chinese, Vietnamese, Indian, Sri Lankan, etc.)” or “Asian language of your ancestry/heritage (e.g., Chinese, Vietnamese, Hindi, etc.)” A composite score for American acculturation was calculated by adding the items from the three American subscales and dividing by 28, with a range from 1 (low American acculturation) through 4 (high American acculturation). A composite score for Asian acculturation was calculated in the same way with a range from 1 for low Asian acculturation through 4 for high Asian acculturation. In Birman and Trickett, Cronbach alpha reliability of the American Acculturation Index was .90, and Cronbach alpha reliability of the Russian Acculturation Index was .94. In the current study, Cronbach alpha reliability of the Asian Acculturation Index was .94, and Cronbach alpha reliability of the American Acculturation Index was .92.

SES Index. Socioeconomic status, the level of financial, human and social resources available to an individual or family through educational attainment, occupational status, and sources of income and wealth (Ensminger et al., 2000), was approximated using the SES index, a composite measure of five items: mother's educational attainment, father's educational attainment, mother's occupational status, father's occupational status, and participants' perceived family socioeconomic status. These items, in Appendix C, are not direct indicators of income, but income plays a role in the values of these items. In addition, although educational attainment and occupational status are specific to participants' parents, participants may account for contributions from other family members in their responses to perceived family socioeconomic status. The response options for educational attainment, occupational status, and perceived socioeconomic status are provided in Table 3. This index is similar to measures used in Tang et al.'s (1999) study of the career development of Asian American students and in Greenstein's (2000) study of racial climate and self-efficacy. In a study of the validity of socioeconomic status measures for students, Ensminger et al. found that students aged 14-19 were more accurate with their mothers' reports of socioeconomic status than students aged 10-13 and that student reports on a composite socioeconomic status measure were highly correlated with mothers' reports of income. Each of the items was scored on a scale from 1 to 5, where 5 indicated either highest educational attainment (master's, doctorate or professional degree), highest occupational status (professional or top administrator), or highest perceived family socioeconomic status (upper class). The composite score for the index was calculated as the mean of the individual item scores for each participant (Ensminger et al.). That is, the scores on each

item were added and the total was divided by 5 for a composite score that ranged from 1 (low socioeconomic status) to 5 (high socioeconomic status). Cronbach alpha reliability for the current research study was .75.

College Environment Factors

The instrument contained three measures of the proximal college environment: gendered climate, racial climate, and academic peer support.

Gender Discrimination Scale. The climate for gender was assessed using the Gender Discrimination scale (Appendix D; Vogt, 2003). The nine-item scale was created by Vogt, based on results from Seymour and Hewitt (1997). The scale consists of items regarding students' interactions with their male peers and faculty in academic settings, and perceptions of fair treatment based on their gender by their peers and faculty. Because the item stems referred specifically to engineering, they were modified slightly for this study to also include science and mathematics majors. Responses were recorded along a five-point Likert scale from 1 ("not at all true") to 5 ("very true"). The Gender Discrimination scale was scored by summing the item scores and dividing by 9, the total number of items (Vogt). To be consistent with the measure of the racial climate, the gendered climate scale was reverse scored so that higher gendered climate scores indicated more positive perceptions of the gendered climate and lower scores indicated greater perceived gender discrimination. Internal consistency of this scale measured by Cronbach alpha reliability, in Vogt's study of undergraduate engineering men and women, after eliminating one item based on results from principle components factor analysis, was .73 for men and .76 for women. In the current study, Cronbach alpha reliability was .78 and all nine items were included in the scale.

Faculty and Classroom Behavior Scale. The racial climate was evaluated through items regarding faculty and classroom behavior and academic climate from the Assessment of the Status of Minorities in Education (ASME) Undergraduate Student Inventory used in Neal (1992). The Faculty and Classroom Behavior scale (Appendix E) involved 14 items about aspects of faculty-student interactions and racial sensitivity in the classroom. Five additional items from the ASME academic climate section were added to the Faculty and Classroom Behavior scale, as was done in a study of the racial climate at the current research study's institution (Greenstein, 2000); these items concerned the racial diversity of course content and racial sensitivity and tolerance by faculty and students in the classroom. Respondents rated their level of agreement with each item along a 5-point Likert scale. Scores were calculated by averaging the values of responses to all 19 items; scores ranged from 1 to 5. Reliability was analyzed in Neal's study of over 10,000 student respondents enrolled at 11 Illinois colleges and universities, and Cronbach alpha reliability for the 14 item Faculty and Classroom Behavior scale was .74. In Greenstein's study of the impact of the campus and classroom racial climate on academic self-efficacy and academic development for members of four racial groups (including Asian American students), Cronbach alpha reliability for the 19-item classroom racial climate scale was .67. Cronbach alpha reliability for the 19-item scale in the current study was .71.

Interactions with Peers Scale. Another environment variable, academic peer support, was measured using the Interactions with Peers scale (Appendix F; Pascarella & Terenzini, 1980). The scale includes seven items regarding personal relationships with other students and the influence of these relationships on an individual's academic,

personal, and social growth. Respondents rated their level of agreement with each item using a 5-point Likert-type scale. The scale was constructed through operationalization of Tinto's (1993) model of persistence and confirmatory factor analysis with a calibration sample of 497 students and a cross-validation sample of 266 students (Pascarella & Terenzini). This longitudinal study of dropout and persistence by Pascarella and Terenzini was conducted at Syracuse University with a sample representative of the Syracuse population on sex, race/ethnicity, academic college, SAT score, and cumulative grade point average. Cronbach alpha reliability of the Interactions with Peers scale in this study was .84. Cronbach alpha reliability in Nora and Cabrera's (1996) study of minority student adjustment to college was .87, and in the current study, Cronbach alpha reliability was .83. Scores were calculated as the average of responses on the seven items.

Self-efficacy

Academic Milestones Self-Efficacy Scale. Academic self-efficacy was measured by the Academic Milestones Self-Efficacy scale (Appendix G; Lent et al., 1986). The scores were calculated by averaging responses to 9 items, which were measured on a 10-point scale indicating level of confidence in one's ability to successfully complete the item. Scores for the scale ranged from 1 to 10, and higher scores indicated higher levels of academic self-efficacy. The item stems, which referred specifically to engineering, were modified slightly for this study to include science and mathematics majors as well as engineering majors. For example, the item "How much confidence do you have in your ability to excel in your engineering major over the next semester?" was modified for the current study as "How much confidence do you have in your ability to excel in your science, math or engineering major over the next semester?" Cronbach alpha reliability

was .89 in Lent et al. and .95 in Hackett et al. (1992). Cronbach alpha reliability in the current study was .92.

Procedures

An emerging body of literature regarding Internet survey methods guided the survey procedures used in this research study. This literature has recorded the influences of mode, type of contact, incentives, and sample demographics on response rates, response bias, and non-response bias. In a meta-analysis of 68 web surveys, Cook et al. (2000) found the average response rate was 39.6%. Of the 15 predictor variables assessed, the most influential variables on response rates were the number of contacts, personalization of contact, and precontacts. Specifically, contacting participants three times (in addition to the initial invitation to participate) was more effective than fewer or more contacts. A personalized e-mail invitation was more effective than a generic message, and some form of pre-notification was associated with higher and less variable response rates (Cook et al.). Use of both a scarcity statement (e.g., “You are part of a select group to evaluate our institution”) and a participation deadline increased response rates by 8% in an experiment based on a web survey of non-applicants to a liberal arts college (Porter & Whitcomb, 2003). In addition, Goodman et al. (2002) addressed the survey customization, user identification, legal aspects, costs, multiple sittings, skipping items, and incentives issues of administering an online survey instrument. For that longitudinal study of women in engineering, the response rates ranged between 33% and 41% each of the three years of the study, which is consistent with paper and pencil mail survey response rates (Goodman et al).

In an experiment of mode influences on survey responses, Carini, Hayek, Kuh, Kennedy, and Ouimet (2003) found that students who responded to the National Survey of Student Engagement via the web in the spring of 2000 tended to respond more favorably than did those who responded by paper survey on all eight scales. The effect sizes of the differences were small at less than .15, and the authors concluded that there were no substantial differences between the two modes of survey administration. When students had an option to complete the survey by paper or by web, the odds of responding over the Internet increased more than 25% when students resided on campus, were younger, male, and White or Latino/a over African American, majored in math and science fields or had more than one major; institutional factors included selectivity and level of academic support (Carini et al.).

In a study of the response rates and non-response bias in various web and paper survey administrations of Your First College Year, a follow-up to the CIRP Freshman Survey conducted by the Higher Education Research Institute, Sax, Gilmartin, and Bryant (2003) found that response rates were higher among women than men (27% vs 13%), but the response rate for women on the paper with web option administration (30%) was significantly greater than on the web-only with incentive administration (21%). Asian American students responded at the highest rate among all racial/ethnic groups (31%); the administration formats with the highest response rate among Asian Americans was the web-only with incentive administration (37%) followed by the paper with web option (33%). Sax et al. also found that students with higher SAT scores were more likely to respond to the web-only with incentive administration.

In conclusion, prior research suggested that, although women were less likely to respond via the web if also given the option of responding by paper, women, Asian American students, and science/engineering majors were more likely to respond to Internet surveys, thereby suggesting a higher potential response rate for the population included in the current study. This study followed recommendations derived from the research results described here to maximize the response rate. This included personalized messages, imposing a response deadline, using three contacts after the initial invitation, and entering respondents into a selection process for awarding incentives to participate. These procedures are detailed below.

Testing the Survey

To determine the functionality of the web survey to collect data accurately, to correct any glitches in the web program, to assess the length of time required to complete the survey, and to determine user interpretation of instructions for completing the instrument, the survey was administered to 12 graduate students and other individuals with knowledge of Asian American women in STEM and/or the constructs within the path model. Individuals were asked to complete the survey as if they were a participant. Further, they were asked to provide feedback on the survey to ascertain issues related to converting scales to an online format and using the scales with a sample of Asian American undergraduate women. Testing the survey instrument also helped approximate the time participants would need to complete the survey. And it enabled trouble-shooting any technical issues for the web program, including accurate recording of responses and data storage processes. As a result, a small number of technical modifications were made to the web program before administering the survey. For example, a response matrix was

incorrectly coded to allow only one response, and was therefore changed to allow multiple responses.

Administering the Survey

There were 129 items on the survey which required between 10 and 15 minutes to complete. There was no time limit for completing the survey. The order of measures on the survey instrument began with academic self-efficacy followed by proximal environment (academic peer support, gendered climate, racial climate), background contextual factors (acculturation, socioeconomic status), and background information. Items regarding background characteristics were the last items of the survey, since requests for personal information on the first page of an Internet survey has been found to influence early withdrawal (O'Neil, Penrod, & Bornstein, 2003).

Electronic mail accounts for undergraduate Asian American women in the sample were identified by the contact information recorded in institutional data sources. Incorrect or non-working electronic mail addresses in the data sources were possible, and e-mail messages sent to two students were returned to sender. The university's online student directory was accessed for the most up-to-date contact information for these two students. However, additional information was not available, and these two students could not be contacted. The first electronic mail message provided an invitation to participate in the study as well as information about the purpose of the study (Appendix H). The message also had an embedded Internet link that directed students to the web based survey instrument. This website was secure, using SSL encryption, and involved an automated login procedure to ensure the data were being provided by students identified in the sample and that each participant responded to the survey only once. The login procedure

involved a randomly generated Custom ID number embedded in the Internet link to the survey, eliminating the use of names and other individually identifiable data to track respondents and connect their survey responses to data provided by the institution. This and subsequent messages included an Internet link that enabled students to decline participation and be removed from the survey contact list. Students that declined participation in this way were not sent any reminder messages.

The first reminder, a short electronic mail message, was sent one week after the initial invitation to participate as a follow-up to those who had not yet completed the survey (Appendix I). A second reminder was delivered via electronic mail to non-respondents one week later (Appendix J). The first and second reminder messages provided students the opportunity to relay to the researcher any complications they had in accessing the survey instrument. Although the second reminder was planned to involve a telephone call along with the electronic mail message, this option was not implemented because the response rate was high. A third follow-up message was sent two and one-half weeks after the first message indicating that there were three days remaining to complete the survey (Appendix K). In all, the survey was available for three weeks following delivery of the first invitation.

The first screen of the web survey provided information about the research study on the consent form (Appendix L). An electronic acceptance of the informed consent was required before participants could access the survey. When students declined the informed consent, they were directed to a new screen and thanked for their time (Appendix M). In addition, students had the opportunity to end their participation at any time during the data collection process. Once all measures were completed, respondents

were asked to provide comments on the items and topics on the survey (see Appendix A). A total of 35 students provided substantive comments on survey content, their responses to survey items, and the survey process, available in Appendix N.

Respondents were provided with contact information to use if they desired more information or had concerns about their participation. Respondents also had the opportunity to request information about the results of the study via electronic mail, and a total of 170 respondents requested this information.

In each electronic message and at the conclusion of the survey, participants were informed of an incentive for participation and completing the survey: an optional prize drawing for gift cards to the campus bookstore and IKEA home goods store. On a screen at the conclusion of the survey participants were offered the option of entering the prize drawing and were asked to enter their electronic mail address at which to be notified if they were selected (Appendix O). Nine gift cards (six \$20, two \$50, and one \$75) were awarded to a random selection of the 234 participants who entered the drawing. The selection process was conducted after online access to the survey was disabled. Winners were notified by electronic mail and gift cards were delivered via postal mail.

Collecting Institutional Data

Institutional data sources were accessed in January and July 2005. In January 2005, the registrar's office provided background information data regarding gender, race/ethnicity, academic major, citizenship status, date of birth, and SAT scores. Data regarding past performance (high school grade point average) and academic level (the total number of college credits earned by students) also were collected at this time.

Racial compositional diversity was operationalized as the percent of Asian Americans in a student's academic major in the current semester, and *gendered compositional diversity* was operationalized as the percent of women in a student's academic major. These two variables were calculated, based on students' majors, using publicly available data from the university for the semester of the study (Spring 2005).

Achievement was measured using semester grade point average, also collected from the Registrar's office for each member of the sample. Achievement data were collected in July 2005, after the conclusion of the Spring 2005 semester during which the survey was administered. Number of college credits earned in the semester and cumulative grade point average also were collected at this time.

Hypothesis Statements

Asian American Ethnic Group Differences

The first five hypotheses, 1a through 1e, were tested in an analysis of differences among Asian American ethnic groups in social cognitive career development variables.

Hypothesis 1a. Asian American ethnic groups significantly differ in socioeconomic status. Drawing upon available literature and general population demographics (Hune, 2002; Kim et al., 1998), it was hypothesized that South Asian American students had the highest scores and Southeast Asian American students had the lowest scores on the socioeconomic status index.

Hypothesis 1b. Asian American ethnic groups significantly differ in acculturation, such that East Asian American and South Asian American students score higher on the American acculturation index and lower on the Asian acculturation index than Southeast Asian American students. This hypothesis was based on research such as Sodowski, Lai,

and Plake (1991) where Vietnamese American students, faculty, and staff at a Midwestern university had lower levels of American acculturation than Korean American and Japanese American students, faculty, and staff; and Chinese American, Japanese American, Korean American, and Asian Indians did not significantly differ on level of acculturation to American culture.

Hypothesis 1c. Asian American ethnic groups do not significantly differ in perceptions of the racial climate, perceptions of the gendered climate, and sense of academic peer support. Although Asian American ethnic groups have distinct cultures and sociopolitical histories, they have historically been perceived, stereotyped, and treated as a single racial group within the U.S. (Espiritu, 1992; Helms & Cook, 1999; Nomura, 2003; Shah, 1997), suggesting that perceptions of climate are not different across ethnicity.

Hypothesis 1d. Asian American ethnic groups do not significantly differ in academic self-efficacy. Race/ethnicity was theoretically linked to self-efficacy (Byars & Hackett, 1998; Lent et al., 2000), but the research literature has not examined the relationship between Asian American ethnic subgroups and self-efficacy.

Hypothesis 1e. Asian American ethnic groups significantly differ in achievement, such that South Asian American and East Asian American students have the highest semester grade point averages and Southeast Asian American students have the lowest semester grade point averages. This hypothesis was based on research such as Kim et al. (1998) who found that Asian Indian and Pakistani (South Asian American) students had the highest and Vietnamese, Laotian, Cambodian, and Thai (Southeast Asian American)

students had the lowest 10th grade math performance and educational aspirations among six Asian American ethnic groups.

Social Cognitive Career Path Model

This next set of hypotheses focused on the presence of statistically significant relationships between academic self-efficacy and achievement with their predictors as described in the model developed from social cognitive career theory (Lent et al., 1994). A path diagram (Figure 2) was proposed, based on theoretical hypotheses, to explain the relationships among the variables. The path diagram reproduced in Figure 2 is the statistical representation of the theoretical path model presented in Chapter I (see Figure 1). Standardized path coefficients measured the magnitude of direct effects from one variable to another, as indicated by a straight directional arrow in the path diagram. Variables that are explained by other variables in a model are considered endogenous, similar to dependent variables. Unlike dependent variables, however, endogenous variables may themselves help explain another variable or variables further along the path diagram. Endogenous variables must be completely determined by the variables in the path model and their residual error terms. Exogenous variables, like independent variables, are not explained by other variables in the model (Klem, 2000). Relationships among exogenous variables are not assessed in path analysis; these relationships are indicated by a curved multidirectional arrow in the diagram (Klem). The path diagram represented the *hypothesized* relationships among variables in this research study.

In the path diagram, the total number of accumulated college credits, the indicator of students' academic level, is an exogenous control variable and was hypothesized to directly influence the two forms of perceived climate (racial and gendered), students'

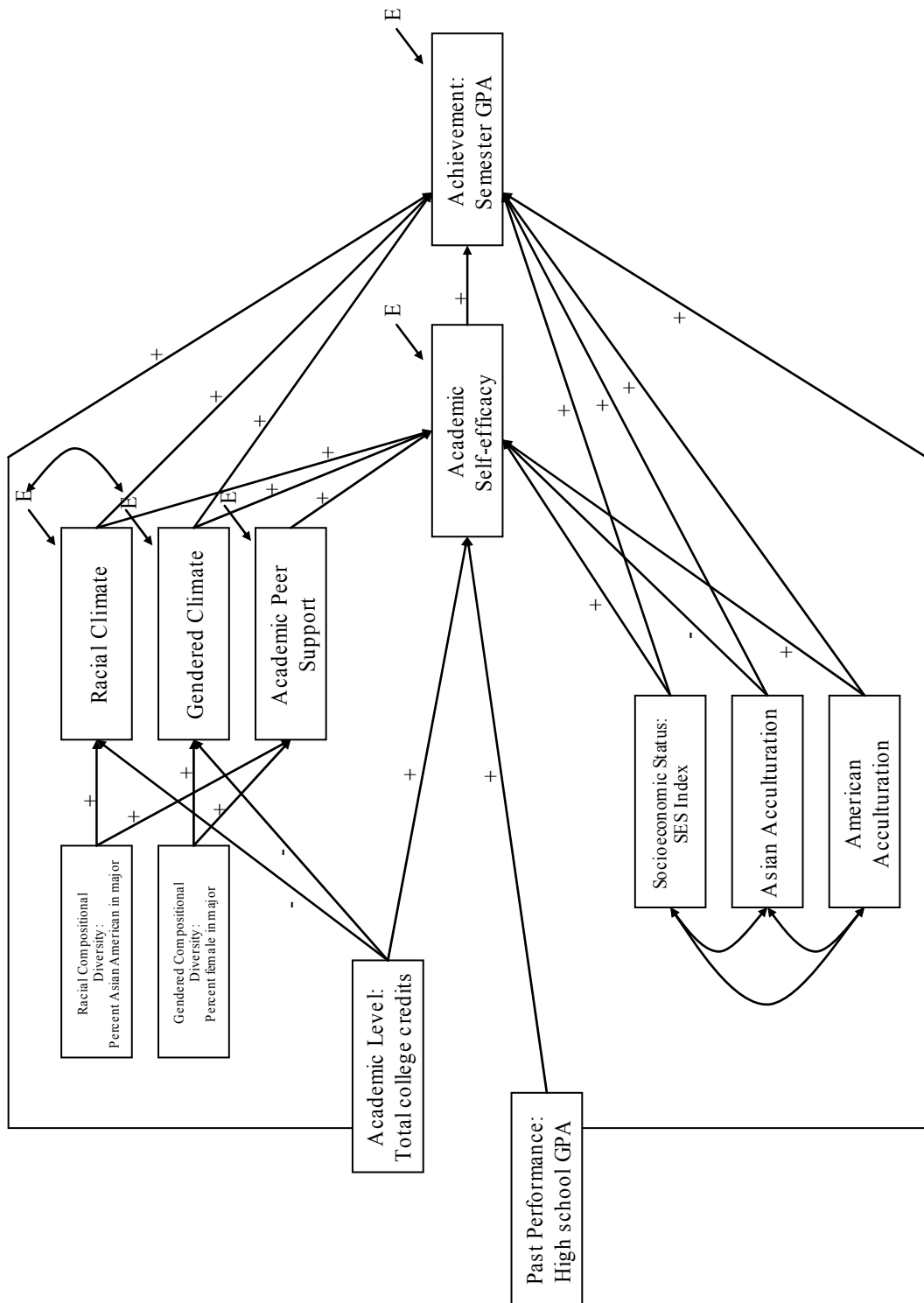


Figure 2. Hypothesized path diagram of academic and career development.

academic self-efficacy, and semester grade point average (GPA). The influence was expected to be positive for academic self-efficacy and semester GPA and negative for the climate measures. Specifically it was hypothesized that students with more college credit were more likely to have a greater sense of self-efficacy and higher semester GPA than students with less college credit (Astin, 1993; Huang & Brainard, 2001; Multon et al., 1991; Pascarella & Terenzini, 1991; Wang et al., 1992). Students with more college credit were predicted to have more negative perceptions of the racial and gendered climates than students with less college credit. For example, in a study of the influence of a chilly climate for women on cognitive outcomes, Whitt et al. (1999) found that the magnitude of the negative effects of a chilly climate increased over the first three years of college.

Another exogenous variable in the diagram is past performance, indicated by high school GPA. The diagram specified that higher high school GPAs were associated with a greater sense of self-efficacy and higher semester GPA. In previous research, high school GPA was consistently the strongest predictor of college grades (Astin, 1993), and social cognitive career theory proposes that past performance is positively and directly related to both academic self-efficacy and semester GPA (Lent et al., 1994). Additional evidence comes from Nora and Cabrera's (1996) study of racial climate and college persistence, where precollege academic ability was the strongest significant predictor of cumulative GPA (positive) for both racial minority and White students. In Hackett et al. (1992), past academic performance was a significant predictor of cumulative GPA, but only when academic self-efficacy was removed from the regression model, suggesting that academic self-efficacy mediated the relationship between past performance and achievement. Lent

et al. (1986) found that academic self-efficacy accounted for significant variance in predicting GPA in technical courses above and beyond the contributions of past performance indicators (math PSAT and high school rank).

The socioeconomic status (SES) index and both measures of acculturation (Asian and American) were exogenous variables expected to correlate with each other. As background contextual factors, the SES index and acculturation indexes were prescribed in the diagram to have direct influences on academic self-efficacy and semester GPA. Social cognitive career theory states that background contextual factors are indirectly related to career outcomes, including achievement, through social cognitive variables of self-efficacy and outcome expectations (Lent et al., 1994). However, Tang et al. (1999) and Flores and O'Brien (2002) suggested that acculturation and family socioeconomic indicators were directly related to outcomes, rather than indirect through self-efficacy.

Leong and Chou (1994), in applying career theory to the career-related experiences of Asian Americans, hypothesized that higher levels of acculturation to American culture and lower levels of acculturation to Asian culture are related to higher academic self-efficacy; however, Tang et al. (1999) found a negative relationship between level of American acculturation and self-efficacy. In Tang et al.'s study of Asian American career choice, the relationship between American acculturation and career choice was both direct and indirect through self-efficacy, but the path from SES to self-efficacy was not significant. The relationships from SES and acculturation to achievement were not tested (Tang et al.). Since empirical research suggested a direct relationship from SES and/or acculturation to achievement for Asian American students (Flores & O'Brien, 2002; Tang et al.), but theory has not proposed this direct relationship

(Lent et al., 1994), it was expected that the relationships between these variables were both direct and indirect.

The influence of compositional diversity, measured by the percent female and the percent Asian American within a student's major, on self-efficacy and semester GPA is presented in the diagram as positive and indirect through the perceived climate measures and through academic peer support. The positive influence was consistent with Byars and Hackett's (1998) hypothesis that the availability of within-group role models has a positive relationship with self-efficacy for Asian American women. Racial compositional diversity was hypothesized to directly influence perceptions of the racial climate, and gendered compositional diversity was hypothesized to directly influence perceptions of the gendered climate, such that a greater percentage of women or Asian Americans was related to more positive perceptions of the racial or gendered climate, respectively. Furthermore, racial compositional diversity and gendered compositional diversity were hypothesized to positively and directly influence academic peer support. All of these relationships were consistent with Hurtado et al. (1999) and literature regarding critical mass (Astin & Astin, 1992; Fassinger, 2001).

In the diagram, perceptions of the racial climate and gendered climate also had the common influence of total college credits. Perceptions of the racial climate and perceptions of the gendered climate were expected to have additional unmeasured influences, represented by the residual error terms (denoted by the letter E) for each variable, in common. The interrelationship among residuals is depicted by the double-headed curved arrows between residuals (G. Hancock, personal communication, April 8, 2004).

Perceptions of the racial and gendered climates were expected to influence semester GPA both directly and indirectly through academic self-efficacy. Social cognitive career theory (Lent et al., 1994) posits that climate, a proximal environment variable, has a direct effect on achievement, although Byars and Hackett (1998) theorized that the relationship is indirect through self-efficacy, which also was supported by research evidence (Lent et al., 2003). However, Greenstein (2000) found for Asian American students that the direct relationship from *classroom* racial climate to academic development was stronger than the indirect relationship through self-efficacy. And Vogt (2003) found that perceived gender discrimination had an indirect relationship to achievement through self-efficacy. The inconsistent evidence suggested that self-efficacy would partially mediate the relationship in the current study, and the relative strengths of the direct and indirect effects may depend upon measurement, specific construct, and proximity of climate to self-efficacious experiences.

Theory (Byars & Hackett, 1998; Fitzgerald & Betz, 1994; Lent et al., 2000) and research (Greenstein, 2000; Hackett et al., 1992) suggested that more negative perceptions of the climate are related to both lower self-efficacy and lower achievement. Therefore, the relationships depicted in the path diagram from racial climate perceptions to self-efficacy and to semester GPA, and from gendered climate perceptions to self-efficacy and to semester GPA were expected to be positive, such that higher scores on these two climate measures were related to higher scores on the academic self-efficacy measure and higher semester GPA.

Academic peer support is another proximal contextual variable depicted in the path model. It was an endogenous variable theorized to have a positive indirect

relationship with semester GPA through academic self-efficacy (Astin, 1993; Nora & Cabrera, 1996; Pascarella & Terenzini, 1991).

The final relationship presented in the path diagram is the proposed direct influence of academic self-efficacy on semester GPA. Social cognitive career theory (Lent et al., 1994) suggests that higher levels of academic self-efficacy are related to higher academic achievement, supported by the research of Hackett et al. (1992) and Lent et al. (1984, 1986).

Social cognitive career theory incorporates a few other variables and corresponding relationships that were not included in the path model presented in Figure 1 or the path diagram presented in Figure 2. Specific variables that were omitted from this research study were outcome expectations, career interests, and performance goals, which are hypothesized by social cognitive career theory to partially mediate the relationship between academic self-efficacy and performance (i.e., achievement) (Lent et al., 1994). In prior research, career interests did not significantly influence GPA in technical courses, persistence, career goals, or career choice (Flores & O'Brien, 2002; Lent et al., 1986; Tang et al., 1999), suggesting that career interests are not predictive of the achievement of Asian American women in STEM majors. The omissions of outcome expectations and performance goals were delimitations of the current research study that may be considered in future research on the career development of Asian American women in STEM majors.

Three hypothesis statements were derived from the relationships proposed in the path diagram in Figure 2 for the purpose of statistical analysis in the current research study.

Hypothesis 2a. Past performance, socioeconomic status, American acculturation, Asian acculturation, academic peer support, racial climate, and gendered climate significantly contribute to explaining academic self-efficacy. Specifically, high school grade point average, the socioeconomic status index, the American acculturation index, positive racial climate, positive gendered climate, and academic peer support have significant positive relationships with academic self-efficacy. The Asian acculturation index has a significant negative relationship with academic self-efficacy, such that higher levels of Asian acculturation are related to lower academic self-efficacy.

Hypothesis 2b. Past performance, socioeconomic status, American acculturation, Asian acculturation, academic peer support, racial climate, gendered climate, and academic self-efficacy significantly and positively contribute to explaining achievement. Higher scores on high school grade point average, the socioeconomic status index, the American acculturation index, the Asian acculturation index, academic peer support, racial climate, gendered climate, and academic self-efficacy are related to higher semester grade point averages.

Hypothesis 3. Academic self-efficacy mediates the relationships from past performance, academic level, socioeconomic status, American acculturation, Asian acculturation, racial climate, gendered climate, and academic peer support to achievement, such that high school grade point average, total college credits, the socioeconomic status index, the American acculturation index, the Asian acculturation index, racial climate, gendered climate, and academic peer support influence semester GPA indirectly through academic self-efficacy.

Data Analysis

Asian American Ethnic Group Analysis

Students' ethnicity was categorized into subgroups to facilitate ethnic group analysis. The development of subgroups was informed in part by Nomura (2003) and was based on the number of respondents who identified each ethnicity. For example, Nomura considered Vietnamese, Hmong, Lao, Cambodian, Indonesian, Thai, Malaysian, and Singaporean as part of a Southeast Asian group. A multi-ethnic group included students who identified with multiple Asian American ethnicities. Demographic and background information, such as citizenship and generation in the U.S. status, age, academic level, transfer status, current housing arrangement, and campus involvements, were summarized for participants and for each ethnic subgroup.

The cell sizes for each ethnic group were calculated to determine their adequacy for conducting MANOVA. Based on power analysis, MANOVA with groups less than 20 would not meet .80 power for large effect sizes at $p < .01$ (Cohen, 1992). Means for high school GPA, the SES index, the American acculturation index, the Asian acculturation index, academic peer support and each measurement of the climate were calculated and presented for the sample of respondents overall and for each ethnic subgroup. Means for the academic self-efficacy measure and semester GPA were presented in a similar manner. The presence of group differences of these measures was tested through MANOVA. Wilks's λ was used to determine if any statistically significant group differences, at $p < .01$, were present among the combined dependent variables; significant pairwise differences among groups for each variable were determined through the Tukey

procedure, also at $p < .01$ alpha (Stevens, 1992). These tests were conducted to reject or not reject hypotheses 1a through 1e.

Furthermore, if group differences were found in more than half of the nine measures, it would be concluded that Asian American ethnic groups could not be combined and multiple regression analysis would be utilized to determine statistically significant relationships between independent and dependent variables. Differences in a preponderance of the measures would indicate that academic and career development differed by group. This criterion was built upon the hypotheses of statistically significant differences on six measures but no differences on three measures (racial climate, gendered climate, and self-efficacy). If ethnic groups differed in less than half of the nine measures, ethnic groups would be aggregated for path analysis. Based upon results from MANOVAs, it was determined that ethnic groups could be aggregated. Thus, path analysis procedures were implemented to analyze data from the full sample.

Path Analysis

Path analysis tested if the theoretical model of social cognitive career theory (Lent et al., 1994) fit the data collected in this research study. Statistical data analysis of the hypothesized relationships in the path diagram (Figure 2) was assisted by EQS 6.1, statistical software designed for covariance analysis (Bentler & Wu, 2000). The covariance matrix from the observed data provided the foundation for parameter estimation through maximum likelihood (ML), the standard and most widely used method of estimating parameters (Hoyle & Panter, 1995; Mueller & Hancock, 2004). It assumes normality of variables, but has been found to be robust even when assumptions

are violated (Hoyle & Panter). Skewness and kurtosis were calculated to determine if data for variable measures were within the normal range.

The path analysis relied upon a set of linear multiple regression equations, graphically represented by the path diagram in Figure 2 (Blalock, 1985; Duncan, 1985; Klem, 2000; Li, 1975). The system of regression equations was analyzed concurrently to determine the model's consistency or fit with observed data. The model chi-square (χ^2_M) is a statistical test of the overall difference between the implied covariances calculated from the model and the observed covariances calculated from the data (Klem). However, the model chi-square statistic is noted as a stringent test of perfect fit (Kline, 2005; Mueller & Hancock, 2004). More commonly used assessments of model fit are indexes that determine degree of fit (Hu & Bentler, 1999). As there is no one agreed upon measure of fit between data and model, multiple fit indexes were calculated (Hoyle & Panter, 1995; Mueller & Hancock). In this research study, model chi-square, the goodness-of-fit index (GFI), the root mean square error of approximation (RMSEA), the standardized root mean square residual (SRMR), and the comparative fit index (CFI) were calculated and reported.

The SRMR and GFI are tests of absolute fit. The SRMR is an index of the difference between observed and predicted correlations; values less than or equal to .10 indicate good fit (Kline, 2005). The GFI, similar to the R^2 of multiple regression analysis, describes the relative amount of variances and covariances accounted for by the model; values greater than or equal to .95 were considered to indicate good fit (Mueller & Hancock, 2004). The RMSEA, a parsimonious index, examines the same discrepancy between observed and model matrices as the model chi-square statistic but also accounts

for the complexity of the model (Mueller & Hancock). RMSEA values less than or equal to .05 indicate a good fit (Hu & Bentler, 1999). The final index presented was an incremental fit index, the CFI, which evaluates the improvement of fit of the path model over a baseline “null” model that specifies no relations (Hoyle & Panter; Mueller & Hancock). The recommended cutoff for the CFI is greater than or equal to .95 (Mueller & Hancock). Hu and Bentler recommended a two-index combinational rule for determining goodness-of-fit in order to minimize both Type I and Type II errors. Specifically, Hu and Bentler recommended that a model may be retained if $SRMR \leq .08$ and $RMSEA \leq .06$, or if $SRMR \leq .08$ and $CFI \geq .95$.

If measures of the model’s degree of fit were adequate, the model was considered plausible, and it was retained. (Byrne, 2001; Klem, 2000). However, the measures indicated a lack of fit, and the initial model was rejected. A theoretical and empirical analysis of the path diagram was then conducted to identify sources of misfit and potential model modifications (Kline, 2005). Post hoc model generation is only recommended when there is a compelling basis for it (Hoyle & Panter, 1995). A review of the theoretical path model in light of statistical results was warranted, as there were a few noted discrepancies in the literature, particularly regarding the relationships from contextual factors to career outcomes. The role of contextual factors in social cognitive career theory has been recognized as under-studied and not well understood (Byars & Hackett, 1998; Hackett, 1997; Lent et al., 2000). For example, background contextual factors are hypothesized in social cognitive career theory to indirectly relate to achievement through self-efficacy (Lent et al., 1994), but empirical research suggested a direct relationship from socioeconomic factors and acculturation to career outcomes

(Flores & O'Brien, 2002; Tang et al., 1999). Direct paths from socioeconomic status and acculturation to achievement were included in the current study's model. Also, social cognitive career theory (Lent et al., 1994) hypothesizes a direct effect of proximal contextual variables on achievement, but Byars and Hackett hypothesized an indirect relationship to career outcomes through self-efficacy. Direct paths from racial climate and gendered climate to both academic self-efficacy and achievement were included in the current study's model.

This secondary process of respecifying specific elements in the model was exploratory in nature because it was in part dependent upon the data collected, potentially leading to Type I and Type II errors (Hoyle & Panter, 1995; Kline, 2005; MacCallum & Austin, 2000). Confirming the model by testing it with a hold-out sample would address some of the threat to validity of relationships from the exploratory analysis, but the sample size of this research study precluded this as a possibility. Therefore, a future research endeavor is required to make any conclusions regarding the proposed new model. The Lagrange Multiplier (LM) and Wald tests were utilized to assess multivariate change in model chi-square values. Specifically, the LM test statistically assessed reduction in model chi-square associated with adding paths to the model that were previously constrained to zero. The Wald test supported model trimming by statistically assessing the impact of deleting paths in the model that were small and not significant (Byrne, 2001; Mueller & Hancock, 2004). Theoretical perspectives and prior research findings were used as guides to determine if changes empirically proposed would be made.

After respecification, the overall model fit was assessed using the same fit indexes, and parameters of the new model were estimated (Klem, 2000). Individual parameter estimates for each path were reported, along with their standard errors. This included direct, indirect, and total effects for each proposed relationship among variables in the path model. Standardized path coefficients measured the magnitude of direct effects from one variable to another, as indicated by the directional arrows in the path diagram (Figure 2). Indirect effects were determined by summing the product of path coefficients for each route between two variables. The total effect was the sum of the direct effect and indirect effect of one variable on another (Klem). The statistical significance of these indirect and total effects was determined through procedures implemented in EQS 6.1 (Bentler & Wu, 2000). Unstandardized direct, indirect, and total effects were tested for statistical significance at $p < .05$ in order to reject or not reject hypotheses 2a and 2b. To test the hypothesis that academic self-efficacy functioned as a mediating variable (hypothesis 3), the statistical significance at $p < .05$ of the total effects of each exogenous variable and the climate variables on academic self-efficacy and the indirect and total effects of these variables on achievement were evaluated.

Assumptions

Assumptions related to MANOVA, maximum likelihood (ML) estimation, causal modeling, and general statistical assumptions applied to data analysis conducted in this research study. Assumptions for the MANOVA procedures included multivariate normality for each group, homogeneity of covariance, and equal group sizes. When group sizes are unequal, however, the Tukey procedure is able to control type I error with a simple transformation as long as variances are homogeneous (Stevens, 1992). The lack of

multivariate normality has been shown to only minimally affect type I error, and the test statistics are robust against this type of error when non-normality exists (Stevens). If homogeneity of covariance did not exist, alpha level was adjusted (lowered for small group sizes) to mitigate the effects of violating this assumption (Stevens).

Path analysis relied on the ML estimation assumption of multivariate normality. Analysis of skewness and kurtosis enabled assessment of this assumption. Path analysis also relied on multiple regression and causal modeling assumptions: no measurement error (inaccuracy in measuring the variables), no specification error (variables included in the model did not belong or variables that were important were missing), and correct causal order (Klem, 2000). The study's theoretical foundation of social cognitive career theory (Lent et al., 1994) and research evidence and theoretical critiques of social cognitive career theory helped address specification and causal order assumptions. The measures were previously used in related empirical studies to minimize the potential for measurement error.

Some general statistical assumptions included the absence of interaction effects among variables, minimal multicollinearity, and adequate sample size to be confident in the results (Klem, 2000). Theoretical and prior empirical research did not suggest that interaction or high multicollinearity were issues in the model. However, the multicollinearity assumption was tested prior to analysis by calculating Pearson Product Moment correlations for the social cognitive career variables (Pallant, 2003). Klem recommended 5-10 participants for each estimated parameter (38). The sample size (228) was adequate to test the model in this research study.

Summary

This research study used MANOVA to determine group differences by ethnicity of prior achievement, academic level, racial and gendered climate, socioeconomic status, Asian acculturation, American acculturation, academic self-efficacy, and achievement for Asian American undergraduate women majoring in STEM. Based on results of the MANOVA, path analysis procedures were used to examine the relationships between past performance, academic level, racial and gendered compositional diversity and climate, academic peer support, socioeconomic status, and acculturation with academic self-efficacy and achievement. Data were collected from a sample of students majoring in one of four colleges at a single university through an online survey. This study contributed to empirical understanding of social cognitive career theory (Lent et al., 1994) by exploring the role of background contextual factors and proximal environment factors, an area of limited research. It also tested the theory's relevance for undergraduate Asian American women in STEM. This study has the potential to provide information to educators and policy-makers, increasing their understanding of the experiences of Asian American women in STEM and the influence of contextual factors on the quality of students' experiences and academic outcomes.

Chapter IV: Results

The purpose of this research study was to examine, for undergraduate women of various Asian American ethnic backgrounds, the influence of background contextual and college environment factors on their sense of academic self-efficacy and achievement in science, technology, engineering, and mathematics (STEM) majors. This chapter presents the results from data analysis: demographic and background information of the participants, including ethnicity; ethnic group differences in academic development factors determined through MANOVA; and path analysis results.

Preliminary Analysis

Demographic and Background Information

Demographic and background information collected through the survey provided a detailed portrait of the participants. The information described here is available in Table 4. Every participant identified as Asian American with 2.2% also identifying as White/Caucasian.

Almost half (47%) of the participants identified as first generation in the U.S. and another 53% identified as second generation in the U.S. Only one individual identified as third generation or more. Of the first generation in the U.S. participants, one-third (34%) immigrated to the U.S. at age 5 or younger, 31% between ages 6 and 13, and 31% between the ages of 14 and 19. Another 5% of first generation in the U.S. participants immigrated after age 19. About 80% of the participants identified as U.S. citizens (53% born in the U.S. and 28% naturalized citizens). Nearly 15% of participants were permanent residents of the U.S. and 3.5% had international student visas.

Table 4

Background and Demographic Information for Participants

Demographic	Participants	
	<i>n</i>	%
Race/ethnicity^a		
African American/Black	0	0.0
Asian or Pacific Islander/Asian American	228	100.0
American Indian or Alaskan Native	0	0.0
Hispanic/Latino	0	0.0
White/Caucasian	5	2.2
Other race/ethnicity	0	0.0
Generation in U.S. Status		
First generation	107	46.9
Second generation	120	52.6
Third generation	1	0.4
Age at immigration to U.S.		
0-5	36	33.6
6-13	33	30.8
14-19	33	30.8
20-37	5	4.7
Citizenship Status		
Born in the U.S.	120	52.6
Naturalized U.S. citizen	64	28.1
Permanent Resident of U.S.	34	14.9
International student visa	8	3.5
Other	2	0.9
Self Cultural Identity		
More Asian than American	75	33.0
More American than Asian	40	17.6
Equal Asian and American	89	39.2
Neither Asian nor American	11	4.8
None of the Above	12	5.3
Missing	1	--
Age^b		
18	18	7.9
19	52	22.8
20	50	21.9
21	47	20.6
22	29	12.7
>22	32	14.0

Note: *N*=228, except *n*=107 for age at immigration to U.S. and *n*=49 for number of semesters at university for transfer students.

^aMay select more than one race/ethnicity. ^b*M*=21.3, *SD*=2.7.

Table 4 (continued)

Demographic	Participants	
	<i>n</i>	%
College of Major		
Agriculture & Natural Resources	5	2.2
Computer, Math, & Physical Sciences	28	12.3
Engineering	55	24.1
Life Sciences	140	61.4
Academic class level		
First year	49	21.5
Sophomore	55	24.1
Junior	62	27.2
Senior	62	27.2
College credits prior to Spring 2005		
<30	30	13.2
30 to 59	49	21.5
60 to 89	63	27.6
90 to 119	56	24.6
120 or more	30	13.2
Transferred into University		
No	179	78.5
Yes	49	21.5
For transfers, # semesters at university		
1-2 Semesters	18	36.7
3-4 Semesters	20	40.8
5-6 Semesters	6	12.3
7-9 Semesters	5	10.2
Current living arrangement		
Own house or condo	4	1.8
Parent or relative home	80	35.1
Off-campus rental	38	16.7
Sorority or fraternity	1	0.4
On-campus	105	46.1

Note: $N=228$, except $n=107$ for age at immigration to U.S. and $n=49$ for number of semesters at university for transfer students.

^aMay select more than one race/ethnicity. ^b $M=21.3$, $SD=2.7$.

When participants were asked how they think of themselves culturally overall with respect to Asian and American cultures, the largest percentage, 39%, identified equally Asian and American, followed by 33% who identified more with Asian culture than with American culture and 18% who identified more with American culture than

Asian culture. About 5% of respondents identified with neither Asian nor American culture, and another 5% selected the option, “none of the above.” Participants were not provided with definitions of Asian culture or American culture. Furthermore, they were able to provide written comments regarding their responses to this item, and 12 provided extra information. Their comments are available in Appendix P.

The participants were primarily traditionally aged college students aged 18 to 22, yet 14% of participants were older than 22. The distribution of participants was consistent across all four academic class levels: 22% first year, 24% sophomore, 27% junior, and 27% senior. The number of college credits completed by participants varied as follows: 13% with less than 30 credits, 22% with 30 to 59 credits, 28% with 60-89 credits, 25% with 90-119 credits, and 13% with 120 or more credits. Approximately one-fifth (22%) of the participants transferred into the university. Of these transfer students, 37% had been at the current university for 1-2 semesters, 41% for 3-4 semesters, 12% for 5-6 semesters, and 10% for 7-9 semesters. Almost half (46%) of the participants lived on-campus in a university apartment or residence hall, 35% lived in the home of a parent or relative, and 17% lived in an off-campus rental.

Table 5 outlines participants’ level of involvement in informal study groups, support organizations for women, Asian American or other racial/ethnic organizations, organizations related to a STEM major, and other campus organizations. A total of 58% of participants stated they were not at all involved in support services or organizations for women, 45% stated they were not at all involved in Asian American clubs or organizations, and 31% stated they were not at all involved in STEM related

organizations. In contrast, only 12% were not at all involved in informal study groups and 23% were not involved in other campus groups.

Table 5

Campus Involvement of Participants

Type of involvement	Not At All				Very Much
	1	2	3	4	5
Study groups	11.8	14.9	27.2	28.9	17.1
Orgs for women	57.5	19.7	11.8	5.7	5.3
Racial/ethnic orgs ^a	44.5	21.6	11.9	10.6	11.5
STEM orgs	30.7	10.1	19.7	23.2	16.2
Other orgs	23.2	17.1	14.5	25.4	19.7

Note: N=228.

^aOne participant did not respond to this item.

Ethnicity

Ethnicity of participants is presented in Table 6. As many participants selected more than one ethnicity, the sum of percentages is greater than 100%. The largest group was Chinese, with 90 participants selecting Chinese ethnicity, followed by 53 participants who selected Asian Indian. None of the participants identified as Sri Lankan, Nepalese, Hmong, Lao, Singaporean, or Pacific Islander. Two of the 16 students who selected “Other Asian American or Pacific Islander” identified Burmese and 14 students identified Taiwanese. A total of 25 participants (11%) identified an ethnic background of either two or three ethnicities. Table 6 also lists revised ethnicity frequencies with multi-ethnic participants identified separately; in this part of the table, the sum of percentages is 100%.

Table 6

Asian American Ethnic Background of Participants

Ethnicity	Participants		Multi-Ethnic		Revised	
	<i>n</i> ^a	%	<i>n</i>	%	<i>n</i>	%
Chinese	90	39.5	19	21.1	71	31.1
Filipina	13	5.7	3	23.1	10	4.4
Japanese	3	1.3	0	0.0	3	1.3
Korean	39	17.1	2	5.1	37	16.2
Asian Indian	53	23.2	4	7.5	49	21.5
Pakistani	5	2.2	2	40.0	3	1.3
Bangladeshi	2	0.9	0	0.0	2	0.9
Vietnamese	23	10.1	7	30.4	16	7.0
Cambodian	3	1.3	2	66.7	1	0.4
Indonesian	4	1.8	2	50.0	2	0.9
Thai	3	1.3	2	66.7	1	0.4
Malaysian	1	0.4	1	100.0	0	0.0
Other						
Burmese	2	0.9	2	100.0	0	0.0
Taiwanese	14	6.1	6	42.9	8	3.5
Multi-ethnic	--	--	--	--	25	11.0
Total	255	111.8	52	20.4	228	100.0

^aMay select more than one ethnicity.

For purposes of analysis, four ethnic groups were created as described in Table 7. The groupings were developed by the researcher, guided in part upon Nomura's (2003) definitions. However, the current study deviated from Nomura in that Nomura identified the specific ethnicities of Chinese, Filipina, Japanese, and Korean as distinct ethnicities without reference to a larger subgroup; furthermore, Nomura did not identify East Asian American or multi-ethnic Asian American subgroups which were used in the current study. Sociopolitical tensions are inherent in subdividing the panethnic Asian American group. Asian ethnicities have loose cultural and historical affiliations (Espiritu, 1992), but a shared racialized identity is imposed on individuals with Asian ethnic backgrounds in the contemporary U.S. (Espiritu, 1992; Helms & Cook, 1999; Nomura, 2003; Shah, 1997). Nomura described the difficulty in establishing boundaries of categorization by detailing arguments for the inclusion of Filipina Americans among Southeast Asian

Table 7

Asian American Ethnic Groups of Participants

<u>Group</u>	<u>n</u>	<u>%</u>
East Asian American		
Chinese	71	55.0
Filipina	10	7.8
Japanese	3	2.3
Korean	37	28.7
Taiwanese	8	6.2
Total	129	56.6
South Asian American		
Asian Indian	49	90.7
Pakistani	3	5.6
Bangladeshi	2	3.7
Total	54	23.7
Southeast Asian American		
Vietnamese	16	80.0
Cambodian	1	5.0
Indonesian	2	10.0
Thai	1	5.0
Total	20	8.8
Multi-ethnic Asian American		
Asian Indian-Indonesian	1	4.0
Asian Indian-Malaysian	1	4.0
Asian Indian-Pakistani	1	4.0
Asian Indian-Vietnamese	1	4.0
Chinese-Burmese	2	8.0
Chinese-Cambodian	1	4.0
Chinese-Filipina-Korean	1	4.0
Chinese-Filipina	1	4.0
Chinese-Korean	1	4.0
Chinese-Taiwanese	5	20.0
Chinese-Taiwanese-Vietnamese	1	4.0
Chinese-Thai	2	8.0
Chinese-Vietnamese	5	20.0
Filipina-Cambodian	1	4.0
Indonesian-Pakistani	1	4.0
Total	25	11.0
<u>Total</u>	<u>228</u>	<u>100.0</u>

Note: N=228.

Americans (due to the Philippines' geographic location near Malaysia and Indonesia), Pacific Islander Americans (due to the history of U.S. colonial rule in the Philippines), and Latinas/Hispanics (due to the history of Spanish colonial rule and influence in the Philippines). Furthermore, Chan (1991), Takaki (1993), and Espiritu (1995) documented the parallel histories of immigration to the U.S. among Japanese, Chinese, and Filipina Americans as laborers on Hawaiian plantations and in West coast agricultural industries in the early 1900s and as professionals and through family reunification policies after the 1965 Immigration Act. On the other hand, after 1965 Vietnamese, Cambodian, and Hmong immigration was predominantly by refugees from those countries (Chan; Espiritu; Takaki).

In the current study, the East Asian American group included 129 participants who identified their ethnicity as one of Chinese, Filipina, Japanese, Korean, or Taiwanese. The South Asian American group included 54 participants who identified their ethnicity as one of Asian Indian, Pakistani, or Bangladeshi. The Southeast Asian American group included 20 participants who identified their ethnicity as one of Vietnamese, Cambodian, Indonesian, or Thai. The multi-ethnic Asian American group included the 25 participants who identified two or three ethnicities in their ethnic background. For example, two participants in the multi-ethnic Asian American group selected both Chinese and Burmese ethnicities. Note that the groups were dominated by one ethnicity. Chinese American participants were 57% of the East Asian American group, Asian Indian participants were 91% of the South Asian American group, Vietnamese American participants were 80% of the Southeast Asian American group,

and 76% of the multi-ethnic group identified Chinese American as part of their ethnic background.

The background and demographic information presented in Table 4 for the full sample also are presented in Table 8 for each ethnic group. Only a few trends across groups were evident. A larger proportion of the multi-ethnic group (76%) was second-generation and identified as U.S. citizens compared to the other three groups (47% to 60% second-generation; 48% to 60% U.S. citizens). A larger proportion of the Southeast Asian American (65%) identified themselves culturally as equally Asian and American than the other three groups (34% to 48%).

The participants majoring in Agriculture and Natural Resources were all in the East Asian American group, but the majority of all groups majored in the Life Sciences. Descriptive analysis showed that about twice as many multi-ethnic students (36%) as each of the other three groups (between 11% and 20%) lived in off-campus rentals. Around half of East Asian American (50%) and South Asian American (48%) participants lived on-campus compared to 30% of Southeast Asian American and 32% of multi-ethnic Asian American participants.

Table 9 provides means for each ethnic group on several prior achievement and campus involvement measures. The comparisons presented here are descriptive only; mean differences by ethnic group on these variables were not tested for statistical significance. As shown in Table 9, the South Asian American group had the highest SAT Verbal average ($M=635.4$, $SD=93.3$) and the East Asian American group had the highest SAT Math average ($M=684.1$, $SD=72.6$). On average, participants in the Southeast Asian American group had the most college credits ($M=83.2$, $SD=31.5$). The East Asian

Table 8

Background and Demographic Information for Participants by Ethnic Group

Demographic	East Asian		South Asian		Southeast Asian		Multi-ethnic	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Generation in U.S. Status								
First generation	67	51.9	26	48.7	8	40.0	6	24.0
Second generation	61	47.3	28	51.9	12	60.0	19	76.0
Third generation	1	0.8	0	0.0	0	0.0	0	0.0
Age at immigration to U.S.								
0-5	23	34.3	8	30.8	3	37.5	2	33.3
6-13	22	32.8	5	19.2	5	62.5	1	16.7
14-19	20	29.9	10	38.5	0	0.0	3	50.0
20-37	2	3.0	3	11.5	0	0.0	0	0.0
Citizenship Status								
Born in the U.S.	63	48.8	26	48.1	12	60.0	19	76.0
Naturalized U.S. citizen	38	29.5	15	27.8	6	30.0	5	20.0
Permanent Resident of U.S.	21	16.3	11	20.4	1	5.0	1	4.0
International student visa	6	4.7	1	1.9	1	5.0	0	0.0
Other	1	0.8	1	1.9	0	0.0	0	0.0
Self Cultural Identity								
More Asian than American	43	33.6	23	42.6	4	20.0	5	20.0
More American than Asian	24	18.8	8	14.8	3	15.0	5	20.0
Equal Asian and American	44	34.4	20	37.0	13	65.0	12	48.0
Neither Asian nor American	8	6.3	1	1.9	0	0.0	2	8.0
None of the Above	9	7.0	2	3.7	0	0.0	1	4.0
Missing	1	--	0	--	0	--	0	--
Age ^a								
18	6	4.7	10	18.5	1	5.0	1	4.0
19	31	24.0	13	24.1	3	15.0	5	20.0
20	31	24.0	8	14.8	5	25.0	6	24.0
21	30	23.3	9	16.7	4	20.0	4	16.0
22	15	11.6	6	11.1	6	30.0	2	8.0
>22	16	12.4	8	14.8	1	5.0	7	28.0
College of Major								
Agriculture & Nat. Resources	5	3.9	0	0.0	0	0.0	0	0.0
Computer, Math, & Physical Sciences	16	12.4	6	11.1	4	20.0	2	8.0
Engineering	33	25.6	16	29.6	2	10.0	4	16.0
Life Sciences	75	58.1	32	59.3	14	70.0	19	76.0

Note: $n=129$ for East Asian American; $n=54$ for South Asian American; $n=20$ for Southeast Asian American; and $n=25$ for Multi-ethnic Asian American.

^aEast Asian American ($M=21.3$, $SD=2.3$); South Asian American ($M=21.3$, $SD=4.0$); Southeast Asian American ($M=21.1$; $SD=1.3$); Multi-ethnic Asian American ($M=21.6$, $SD=2.0$)

Table 8 (continued)

Demographic	East Asian		South Asian		Southeast Asian		Multi-ethnic	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Academic class level								
First year	27	20.9	15	27.8	3	15.0	4	16.0
Sophomore	34	26.4	11	20.4	4	20.0	6	24.0
Junior	36	27.9	13	24.1	5	25.0	8	32.0
Senior	32	24.8	15	27.8	8	40.0	7	28.0
College credits prior to Spring 2005								
<30	17	13.2	9	16.7	1	5.0	3	12.0
30 to 59	28	21.7	12	22.2	3	15.0	6	24.0
60 to 89	36	27.9	12	22.2	8	40.0	7	28.0
90 to 119	33	25.6	14	25.9	5	25.0	4	16.0
120 or more	16	11.6	7	13.0	3	15.0	5	20.0
Transferred into University								
No	104	80.6	39	72.2	17	85.0	19	76.0
Yes	25	19.4	15	27.8	3	15.0	6	24.0
For transfers, # semesters at university								
1-2 Semesters	11	44.0	5	33.3	0	0.0	2	33.3
3-4 Semesters	13	52.0	5	33.3	1	33.3	1	16.7
5-6 Semesters	0	0.0	5	33.3	0	0.0	1	16.7
7-9 Semesters	1	4.0	0	0.0	2	66.7	2	33.3
Current living arrangement								
Own house or condo	2	1.6	1	1.9	0	0.0	1	4.0
Parent or relative home	43	33.3	21	38.9	9	45.0	7	28.0
Off-campus rental	19	14.7	6	11.1	4	20.0	9	36.0
Sorority or fraternity	0	0.0	0	0.0	1	5.0	0	0.0
On-campus	65	50.4	26	48.1	6	30.0	8	32.0

Note: $n=129$ for East Asian American; $n=54$ for South Asian American; $n=20$ for Southeast Asian American; and $n=25$ for Multi-ethnic Asian American.

^aEast Asian American ($M=21.3$, $SD=2.3$); South Asian American ($M=21.3$, $SD=4.0$); Southeast Asian American ($M=21.1$; $SD=1.3$); Multi-ethnic Asian American ($M=21.6$, $SD=2.0$)

Table 9

Prior Achievement and Campus Involvement of Participants by Ethnic Group

Demographic	East Asian			South Asian			Southeast Asian			Multi-ethnic		
	<i>n</i>	<i>Mean</i>	<i>SD</i>	<i>n</i>	<i>Mean</i>	<i>SD</i>	<i>n</i>	<i>Mean</i>	<i>SD</i>	<i>n</i>	<i>Mean</i>	<i>SD</i>
SAT Verbal	113	602.3	106.4	46	635.4	93.3	20	573.0	98.6	22	625.0	71.0
SAT Math	113	684.1	72.6	46	668.0	75.4	20	626.5	72.4	22	679.5	70.0
High School GPA	113	4.16	.45	44	4.07	.38	19	4.18	.39	21	4.15	.39
Total College Credits	129	76.5	37.9	54	74.3	38.5	20	83.2	31.5	25	80.8	38.7
Past Cumulative GPA	127	3.21	.55	53	3.11	.70	20	3.18	.53	25	3.12	.54
Campus Involvement												
Study groups	128	3.1	1.3	54	3.3	1.2	20	3.7	1.1	25	3.8	0.8
Orgs for women	128	1.7	1.1	54	2.1	1.3	20	1.8	1.3	25	2.1	1.3
Racial/ethnic orgs	127	2.0	1.3	54	2.3	1.3	20	3.1	1.7	24	2.6	1.6
STEM orgs	128	2.6	1.4	54	3.2	1.5	20	3.0	1.6	25	3.0	1.5
Other orgs	128	2.9	1.5	54	3.1	1.4	20	3.4	1.6	25	3.0	1.62

Note: Ranges: SAT Verbal (320, 800), SAT Math (380, 800), High School GPA (2.89, 4.88), Total College Credits (6, 161), Past Cumulative GPA (0.21, 4.00), Campus Involvement variables (1.0, 5.0).

American group had the highest cumulative GPA prior to the current semester ($M=3.21$, $SD=.55$), followed by the Southeast Asian American group ($M=3.18$, $SD=.53$). The multi-ethnic group had the highest level of involvement in informal study groups ($M=3.8$, $SD=.8$), Southeast Asian American students had the highest level of involvement in Asian American or other racial/ethnic organizations and other campus organizations ($M=3.1$, $SD=1.7$), and the South Asian American group had the highest level of involvement in organizations related to their major ($M=3.2$, $SD=1.5$).

Group Differences in Academic Development Factors

The statistical significance of ethnic group differences in the nine social cognitive career variables was tested through MANOVA. The analysis was conducted in

conceptually-related sets involving modest correlation, as recommended by Pallant (2003). The four ethnic groups included in the analysis were East Asian American, South Asian American, Southeast Asian American, and multi-ethnic Asian American participants. Statistical significance was set at $p < .01$. Missing data were treated by listwise deletion.

The first MANOVA involved the three dependent variables of the SES index, American acculturation index, and Asian acculturation index. Preliminary tests checked assumptions related to normality, linearity, univariate and multivariate outliers, homogeneity of variance-covariance matrices, and multicollinearity. Serious violations of these assumptions were not found. The overall test of combined dependent variables was statistically significant: Wilks' $\lambda = .834$; $F(9,460) = 3.950$, $p = .000$; partial $\eta^2 = .059$. Between-subjects effects for the separate dependent variables included statistically significant differences among groups only on SES index: $F(3,191) = 6.173$, $p = .001$. Partial $\eta^2 = .088$, indicating that ethnic group membership accounted for 8.8% of the variability of socioeconomic status scores. The Tukey post-hoc test results showed that South Asian American students had significantly higher scores on the SES index ($M = 3.94$, $SD = .93$) than East Asian American students ($M = 3.24$, $SD = .93$). Statistically significant differences were not found with Southeast Asian American students or with Multi-ethnic Asian American students. The means for each ethnic group for SES index, American acculturation index, and Asian Acculturation index are listed in Table 10. The mean for participants on the American acculturation index was 3.39 ($SD = .42$), and for the Asian acculturation index, the mean for participants was 2.85 ($SD = .58$).

Table 10

Group Mean Differences on Background Contextual Factors

Career Factor	Participants N=195		East Asian n=114		South Asian n=42		Southeast Asian n=19		Multi- ethnic n=20	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
SES Index***	3.40	.96	3.24 _a	.93	3.94 _a	.93	3.20	.88	3.39	.95
American acculturation	3.39	.42	3.33	.42	3.48	.37	3.48	.36	3.50	.50
Asian acculturation	2.85	.58	2.79	.62	3.04	.55	2.88	.43	2.80	.48

Note: A total of 33 participants were removed from analysis through listwise deletion. Range for SES index was (1.00, 5.00) and American and Asian acculturation indexes was (1.00, 4.00).

Wilks' $\lambda=.834$; $F(9,460)=3.950$, $p=.000$; partial $\eta^2=.059$. Between-subjects effects for SES Index, $F(3,191)=6.173$, $p=.001$; partial $\eta^2=.088$. Means in the SES Index row that share a subscript were significantly different at $p<.01$ in the Tukey post-hoc test.

*** $p<.001$.

Hypothesis 1a. Asian American ethnic groups significantly differ in socioeconomic status, such that South Asian American students had the highest scores and Southeast Asian American students had the lowest scores on the socioeconomic status index.

Hypothesis 1a was partially rejected. Statistically significant differences in socioeconomic status were found among groups, and results indicated that South Asian American students had significantly higher scores than East Asian American students. However, the mean socioeconomic status score for South Asian American students was not significantly higher than means for Southeast Asian American students and Multi-ethnic Asian American students. Also, mean socioeconomic status scores for Southeast Asian American students were not significantly lower than the means for other groups.

Hypothesis 1b. Asian American ethnic groups significantly differ in acculturation, such that East Asian American and South Asian American students score higher on the

American acculturation index and lower on the Asian acculturation index than Southeast Asian American students.

Hypothesis 1b was rejected since statistically significant differences among groups were not found in the American acculturation and Asian acculturation indexes.

The second MANOVA included the dependent variables of academic peer support, gendered climate, and racial climate. Serious violations of assumptions were not found. The overall test of combined dependent variables for this analysis was not statistically significant, Wilks' $\lambda=.924$; $F(9,414)=1.521$, $p=.138$; partial $\eta^2=.026$, indicating that the mean scores were not significantly different across groups. The means for each ethnic group for academic peer support, gendered climate, and racial climate are detailed in Table 11. The means for participants on these variables were 3.83 ($SD=.75$) for academic peer support, 3.99 ($SD=.63$) for gendered climate, and 3.27 ($SD=.38$) for racial climate.

Table 11

Group Mean Differences on College Environment Factors

Career Factor	Participants N=176		East Asian n=95		South Asian n=45		Southeast Asian n=15		Multi- ethnic n=21	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Academic peer support	3.83	.75	3.73	.75	4.03	.67	3.98	.59	3.76	.98
Gendered climate	3.99	.63	3.99	.63	4.09	.66	3.94	.55	3.77	.62
Racial climate	3.27	.38	3.22	.36	3.38	.44	3.33	.37	3.21	.34

Note: A total of 52 participants were removed from analysis through listwise deletion. Ranges for academic peer support, gendered climate, and racial climate were (1.00, 5.00). Wilks' $\lambda=.924$; $F(9,414)=1.521$, $p=.138$; partial $\eta^2=.026$.

Hypothesis 1c. Asian American ethnic groups do not significantly differ in perceptions of the racial climate, perceptions of the gendered climate, and sense of academic peer support.

Hypothesis 1c was not rejected, based on results from the second MANOVA in which significant differences among ethnic groups were not found for the academic peer support, gendered climate, and racial climate variables.

The third MANOVA involved high school GPA, academic self-efficacy, and semester GPA as the dependent variables. Serious violations of assumptions were not found. Results of the overall test of combined dependent variables was not statistically significant, Wilks' $\lambda=.918$; $F(9, 453)=1.802$, $p=.066$; partial $\eta^2=.028$. The means for each ethnic group for high school GPA, academic self-efficacy, and semester GPA are listed in Table 12. The means for participants on these variables were 4.14 ($SD=.42$) for high school GPA, 7.85 ($SD=1.65$) for academic self-efficacy, and 3.17 ($SD=.64$) for semester GPA.

Table 12

Group Mean Differences on Academic Achievement and Self-Efficacy

Career Factor	Participants <i>N</i> =192		East Asian <i>n</i> =110		South Asian <i>n</i> =42		Southeast Asian <i>n</i> =19		Multi-ethnic <i>n</i> =21	
	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>
High School GPA	4.14	.42	4.17	.45	4.05	.38	4.18	.39	4.15	.39
Academic self-efficacy	7.85	1.65	7.66	1.61	8.26	1.87	8.31	1.54	7.62	1.40
Semester GPA	3.17	.64	3.16	.67	3.12	.70	3.19	.46	3.33	.54

Note: A total of 36 participants were removed from analysis through listwise deletion. Range for high school GPA was (2.89, 4.88), academic self-efficacy was (1.00, 10.00), and semester GPA was (0.50, 4.00).

Wilks' $\lambda=.918$; $F(9, 453)=1.802$, $p=.066$; partial $\eta^2=.028$.

Hypothesis 1d. Asian American ethnic groups do not significantly differ in academic self-efficacy.

Hypothesis 1d was not rejected since significant differences in academic self-efficacy were not found among Asian American ethnic groups.

Hypothesis 1e. Asian American ethnic groups significantly differ in achievement, such that South Asian American and East Asian American students have the highest semester grade point averages and Southeast Asian American students have the lowest semester grade point averages.

Hypothesis 1e was rejected based on results from the third MANOVA in which significant differences were not found among Asian American ethnic groups in semester GPA.

In sum, the above results led to the partial rejection of hypothesis 1a; hypotheses 1b and hypothesis 1e were rejected; and hypotheses 1c and 1d were not rejected. Additionally, since significant differences among ethnic groups were found on only one of the nine primary variables in the study (SES Index), ethnic groups were aggregated in the second phase of data analysis. Thus, data from the full sample of participants were used in path analysis to test hypotheses regarding the relationships among the social cognitive career variables.

Path Analysis

The path diagram (see Figure 2 in Chapter III) specified the hypothesized relationships among the variables in the study, including the relationships from past performance, background contextual factors, and college environment factors to both academic self-efficacy and academic achievement, and the mediating influence of self-

efficacy on the relationships from the exogenous and other endogenous variables to achievement. To analyze the full model simultaneously, path analysis using maximum likelihood (ML) estimation was conducted using EQS 6.1 (Bentler & Wu, 2000).

The path diagram had 12 observed variables, 38 free parameters, and 78 observations; the model degrees of freedom, df_M , was 40, and the model was considered identified. Furthermore, the structure of the model matched that of a partially recursive model with a bow-free pattern; for the purposes of analysis, this type of model was treated as a fully recursive model (Kline, 2005).

First, ML and other path analysis assumptions were evaluated. Ten cases were eliminated from analysis due to univariate outliers that were more than three standard deviations from the variable mean. The final dataset consisted of 218 cases. Missing values for high school GPA and the individual items of the SES index, Asian acculturation index, American acculturation index, racial climate, gendered climate, academic peer support, and academic self-efficacy were estimated through mean substitution using the SPSS 13.0 for Windows statistical package (SPSS Inc., 2004). Less than 2% of values were missing for each of the individual items of the SES index, Asian acculturation index, American acculturation index, gendered climate, academic peer support, and academic self-efficacy scales. Approximately 12% of values were missing for high school GPA, and 12% of values were missing for most items of the racial climate scale. Mean substitution was selected rather than listwise deletion, since it would have reduced substantially the number of available cases for simultaneous analysis of variable relationships, and pairwise deletion is not recommended for path analysis as it may lead to a covariance matrix with mathematical errors that affect statistical analysis

(Kline, 2005). Although mean substitution avoids these issues, the method may misrepresent the distribution of the data (Kline). Univariate skewness and kurtosis based on data from the 218 cases were within reasonable limits, with skewness ranging from -.760 to .068 and kurtosis ranging from -.921 to .155. Mardia's coefficient was -.869, suggesting that serious violations of the assumption of multivariate normality were not found. Furthermore, the 218 cases for 38 parameters in the model exceeded the minimum 5:1 ratio recommended by Bentler and Chou (1987) and Klem (2000).

However, the ratio of the largest to smallest variance of the observed variables revealed that the covariance matrix was ill-scaled (1408.73 to .13), potentially preventing ML iterations from converging. Since ML is scale free and scale invariant (Kline, 2005), a simple transformation of some of the variables by multiplying them by a constant addressed the issue without altering the results. Table 13 provides the original means and standard deviations for each variable, the constant used, and the resulting means and standard deviations. Table 13 also provides the covariance matrix used in data analysis. The correlation matrix is provided in Appendix Q.

The ML solution converged in eight iterations. As reported in Table 14, the model chi-square fit statistic, $\chi^2_M(40, N=218)=105.700, p<.001$, was statistically significant at $p<.05$ indicating that the model was not a perfect fit with the data. The SRMR, RMSEA, 90% confidence interval for RMSEA, CFI, and GFI for this model also are reported in Table 14. Based on Hu and Bentler's (1999) recommended two-index combinational rule, where a model may be retained if $SRMR \leq .08$ and $RMSEA \leq .06$, or if $SRMR \leq .08$ and $CFI \geq .95$, the model was rejected ($SRMR=.082, RMSEA=.087, CFI=.763$).

Table 13

Input Data for Path Analysis: Sample Statistics and Covariance Matrix

	1	2	3	4	5	6
Original <i>Mean</i>	3.168	7.918	3.817	3.979	3.240	47.378
Original <i>SD</i>	.606	1.627	.731	.639	.326	20.648
Constant	1.000	1.000	1.000	1.000	2.000	.100
New <i>Mean</i>	3.168	7.918	3.817	3.979	6.480	4.738
New <i>SD</i>	.606	1.627	.731	.639	.652	2.065
1 Semester GPA	.367					
2 Academic self-efficacy	.495	2.646				
3 Academic peer support	.028	.269	.535			
4 Gendered climate	.044	.250	.116	.408		
5 Racial climate	.035	.182	.053	.087	.424	
6 Percent female in major	-.020	-.215	-.218	-.008	.180	4.264
7 Percent Asian American in major	-.005	.195	.060	.057	-.009	-.040
8 SES Index	.056	.255	.168	.014	.075	.086
9 Asian acculturation	-.017	.143	-.028	-.036	-.014	-.022
10 American acculturation	-.054	-.124	.188	.098	-.007	.242
11 Total college credits	.109	.253	-.020	-.027	.017	-.222
12 High School GPA	.221	.421	.037	.009	-.024	-.180

	7	8	9	10	11	12
Original <i>Mean</i>	23.616	3.473	2.840	3.416	76.854	4.142
Original <i>SD</i>	7.534	.931	.588	.390	37.602	.400
Constant	.100	1.000	1.000	2.000	.033	2.000
New <i>Mean</i>	2.362	3.473	2.840	6.832	2.562	8.283
New <i>SD</i>	.753	.931	.588	.780	1.253	.801
7 Percent Asian American in major	.568					
8 SES Index	.057	.866				
9 Asian acculturation	.083	-.040	.346			
10 American acculturation	-.008	.182	-.162	.609		
11 Total college credits	-.032	-.093	-.002	-.056	1.571	
12 High School GPA	.065	.046	-.036	-.010	.043	.641

Note: N=218.

Table 14

Indexes of Overall Model Fit

Index	Initial Model	Respecified Model
χ^2_M	105.700	69.272
df	40	43
p	<.001	.007
Goodness-of-Fit Index (GFI)	.927	.951
Comparative Fit Index (CFI)	.763	.905
Standardized Root Mean Square Residual (SRMR)	.082	.064
Root Mean Square Error of Approximation (RMSEA)	.087	.053
90% Confidence Interval of RMSEA	(.067, .107)	(.028, .075)

A theoretical and empirical evaluation of the path diagram was conducted to identify potential model modifications (Kline, 2005). This evaluation was exploratory because it was in part dependent upon the data collected, potentially leading to Type I and Type II errors (Hoyle & Panter, 1995; Kline, 2005; MacCallum & Austin, 2000). However, theoretical perspectives and prior research findings were used as guides to determine if changes empirically proposed by the LM and Wald tests would be made.

Results from the LM test identified several parameters that if added to the model would significantly reduce the model chi-square. Five of these parameters were between background contextual factors and college environment variables. For example, the parameter with the greatest change in model chi-square, $\chi^2_D(1)=27.879, p<.001$, was a path between American acculturation index and academic peer support. Social cognitive career theory does not posit a direct relationship between these aspects of the model (Lent et al., 1994) and Byars and Hackett (1998) only specified hypotheses regarding relationships from background context to self-efficacy and career outcomes and from proximal environment to self-efficacy and career outcomes for Asian American women. However, in social cognitive career theory, background contextual factors are

hypothesized to influence proximal environment variables, including college environment factors, indirectly through a feedback loop with person inputs, such as race and gender (Lent et al.). Race and gender were held constant in the current study, and were not included in the path model. The exclusion of relationships from background contextual factors to college environment factors, therefore, was likely a theoretical misspecification.

To analyze this assertion, a parameter that designated a path between background context and college environment was added to the path model. A path from American acculturation index to academic peer support was selected because the largest chi-square difference statistic was associated with this parameter. Leong and Chou (1994) hypothesized that Asian Americans with low levels of American acculturation experience more occupational stereotyping and discrimination. Furthermore, general acculturation literature identifies schools as primary agents of socialization in the dominant host culture (i.e., American acculturation) for immigrant youth (García-Coll & Magnuson, 1997), and college impact literature identifies students' peer groups as potent influences on their college experiences (Astin, 1993; Pascarella & Terenzini, 1991, 2005). A positive relationship between American acculturation index and academic peer support was expected.

The absence of a path from gendered climate to academic peer support had the second largest statistical contribution to model misfit, $\chi^2_D(1)=12.252, p<.001$. The model used by Nora and Cabrera (1996), in their study of the influence of prejudice and discrimination on the academic development of students of color, delimited a direct path between perceptions of discrimination and academic peer support (defined in their study

as *social integration*, and measured with the same instrument), based on theoretical propositions of Tinto (1993) regarding student persistence. In Nora and Cabrera, perceptions of prejudice had significant and negative direct effects on academic peer support for both students of color (-.21) and White students (-.17). Hence, a direct path between gendered climate and academic peer support was added to the model in the current study.

The Wald test provided chi-square difference statistics related to model trimming where paths previously specified would be removed, or constrained to zero. Seven parameters were identified by Wald test results as increasing the model chi-square by less than 1.00 and were considered for deletion from the model. Two of the seven parameters were the paths from racial climate to semester GPA, $\chi^2_D(1)=.129, p=.720$, and gendered climate to semester GPA, $\chi^2_D(1)=.357, p=.550$. There was a discrepancy in the literature regarding the direct or indirect nature of the influence of proximal environment variables on career outcomes, including achievement. As described in Chapter III, social cognitive career theory (Lent et al., 1994) hypothesizes that proximal contextual variables like climate directly influence achievement, and Greenstein (2000) found for Asian American students that the direct relationship from classroom racial climate to academic development was stronger than the indirect relationship through self-efficacy. However, Bandura (1986) and Byars and Hackett (1998) theorized that the relationship is indirect through self-efficacy, and this hypothesis was supported by research evidence as well (Lent et al., 2003; Vogt, 2003). Specifically, Vogt found that the gendered climate (defined in Vogt's study as *perceived gender discrimination*, and measured with the same instrument as in the current study) had an indirect relationship to achievement through

self-efficacy. The Wald test results in the current study provided support for Bandura's and Byars and Hackett's theoretical propositions, and the direct paths from gendered and racial climate to achievement were removed from the model.

Two additional parameters identified by the Wald test were from total college credits to racial climate, $\chi^2_D(1)=.085, p=.771$, and from total college credits to gendered climate, $\chi^2_D(1)=.381, p=.537$. Total college credits was included in the model as a control variable, as Whitt et al. (1999) found that the negative effects of a chilly climate on cognitive outcomes were stronger in the third year than in the first year of college. However, the level of students' perceptions of a chilly climate did not change over the three years of the Whitt et al. study, suggesting that academic level moderated the relationship between climate and cognitive outcomes but did not have a direct relationship with climate. Furthermore, the Wald test results suggested that direct effects from total college credits to perceptions of the racial and gendered climate could be removed from the model. These two parameters were removed from the model.

There were two more parameters involving racial and gendered climate with a chi-square difference statistic less than 1.00: the path from percent female in a major to gendered climate, $\chi^2_D(1)=.340, p=.560$, and the path between percent Asian American in major and racial climate, $\chi^2_D(1)=.421, p=.517$. These hypothesized relationships were consistent with Hurtado et al.'s (1999) conceptualization of campus climate for diversity, Byars and Hackett's (1998) hypothesis regarding the relationship between availability of within-group role models and self-efficacy for Asian American women, and literature regarding the influence of critical mass (Astin & Astin, 1992; Fassinger, 2001). These

parameters were maintained in the model due to a lack of theoretical justification for removing them.

The seventh parameter with a chi-square difference less than 1.00 was the path from SES index to semester GPA, $\chi^2_D(1)=.497, p=.481$. Background contextual factors are hypothesized in social cognitive career theory to indirectly relate to career outcomes, including achievement, through self-efficacy and outcome expectations (Lent et al., 1994). Empirical research suggested a direct relationship between socioeconomic factors and career choice and career goals (Flores & O'Brien, 2002; Tang et al., 1999), but the relationship between socioeconomic status and achievement was not empirically analyzed. Based on social cognitive career theory, then, the direct path from SES index to semester GPA was removed from the model.

In summary, the path model was respecified based on the joint consideration of theory, prior research, and Wald and LM test results obtained from analysis of the initial model. Two paths were added to the model: American acculturation index to academic peer support and gendered climate to academic peer support. Five paths were removed from the model: racial climate to semester GPA, gendered climate to semester GPA, total college credits to racial climate, total college credits to gendered climate, and SES index to semester GPA. The respecified model is depicted in Figure 3 and the initial and respecified models are presented adjacent to each other in Appendix R.

The respecified model was analyzed using data from the current study. The results presented here are exploratory in nature as the results may be due to chance from unique characteristics of data collected in the current study (Hoyle & Panter, 1995; Kline, 2005; MacCallum & Austin, 2000). Since results from this exploratory analysis may be due to

statistical artifact, additional research with another dataset is necessary before conclusions may be made regarding the plausibility of the respecified model.

The respecified model had 35 parameters. The same initial covariance matrix was analyzed using ML estimation; the solution converged in nine iterations. Overall model fit indexes are presented in Table 14. All indexes demonstrated improvements over the fit indexes of the initial model. The model chi-square statistic was statistically significant at $p < .05$, indicating that the model was not a perfect fit with the data, $\chi^2_M(43, N=218)=69.272, p=.007$. Using the two-index combinational rule of $SRMR \leq .08$ and $RMSEA \leq .06$ recommended by Hu and Bentler (1999), the model was considered a good fit ($SRMR=.064$ and $RMSEA=.053$). Thus, the model was retained.

Parameter Estimates

Figure 3 displays the standardized path coefficients for the model which are the direct effects between variables. Standardized estimates of all parameters are presented in text. The statistical significance of a parameter that is presented in text and in Figure 3, however, refers to the unstandardized estimate of that parameter, at $p < .05$. The unstandardized estimates, associated standard errors, and indicators of statistical significance are available in Tables 15, 16, and 17. The variances and covariances of the exogenous variables and the residual error terms are available in Table 15.

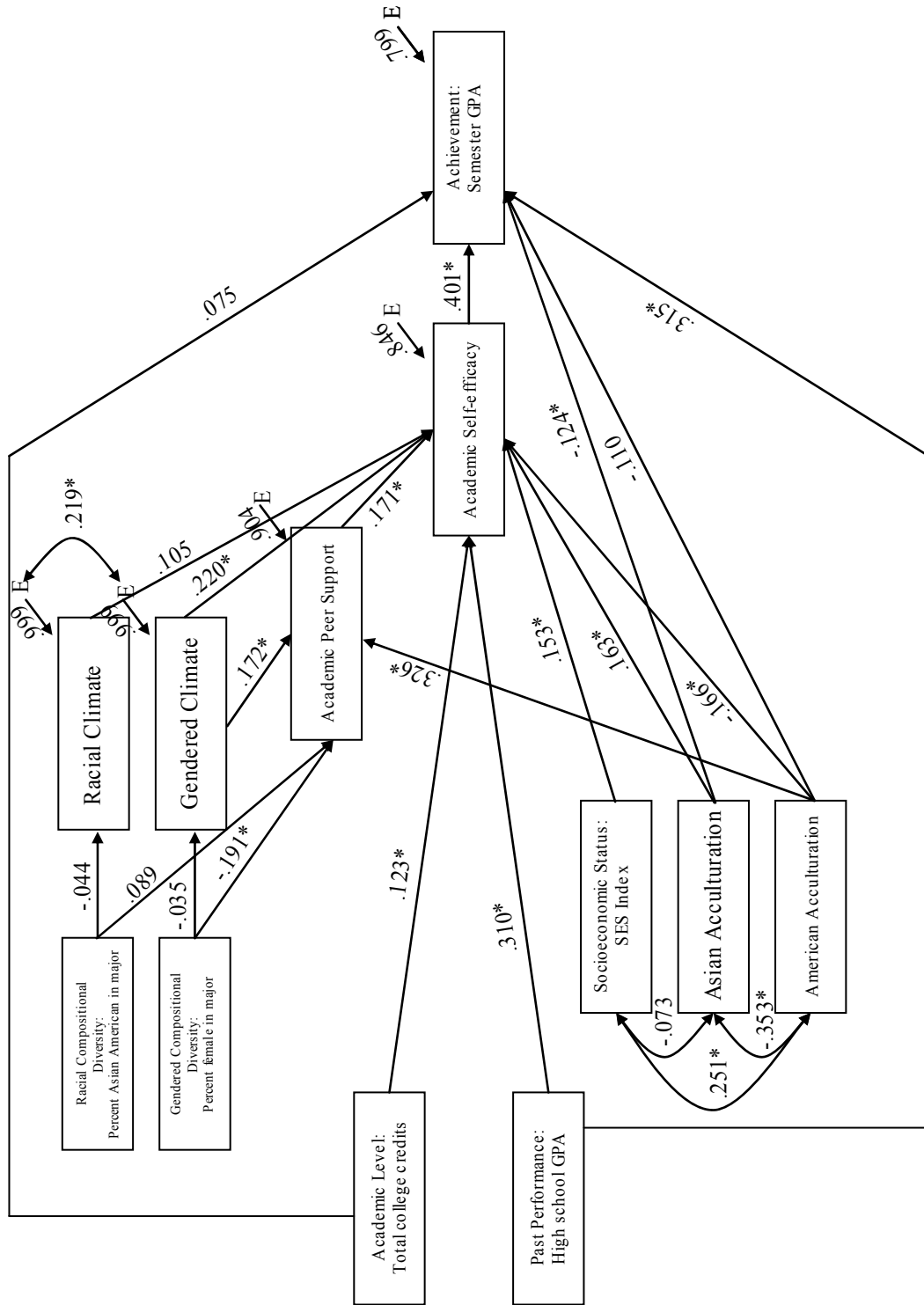


Figure 3. Standardized parameter estimates in respecified model. An (*) indicates that unstandardized parameter estimate is significant at $p < .05$.

Table 15

Maximum Likelihood Estimates for Variances and Covariances

Parameter	Unstandardized	SE	Standardized
Total college credits	1.571 *	.151	1.000
High School GPA	.641 *	.062	1.000
Percent female in major	4.264 *	.409	1.000
Percent Asian American in major	.568 *	.054	1.000
SES Index	.866 *	.083	1.000
Asian acculturation	.346 *	.033	1.000
American acculturation	.609 *	.058	1.000
E (semester GPA)	.231 *	.022	.799
E (academic self-efficacy)	1.879 *	.180	.846
E (academic peer support)	.435 *	.042	.904
E (gendered climate)	.408 *	.039	.999
E (racial climate)	.425 *	.041	.999
SES Index -- Asian acc.	-.040	.037	-.073
SES Index -- American acc.	.182 *	.051	.251
Asian acc. -- American acc.	-.162 *	.033	-.353
E (racial clim.) -- E (gendered clim.)	.091 *	.029	.219

* $p < .05$.

The standardized residual errors (E) are equivalent to the square root of $1-R^2$, where R^2 is the variance explained by the model for that endogenous variable. The residual error coefficient for semester GPA was .799 and R^2 was .362; the model explained 36.2% of the variance of semester GPA. Similarly, the .846 residual error for academic self-efficacy indicated that the model explained 28.4% of the variance of academic self-efficacy, and the .904 standardized residual error for academic peer support indicated that 18.3% of the variance of academic peer support was explained by the model. The standardized residuals for gendered climate and racial climate were both .999; $R^2=.001$ for gendered climate and $R^2=.002$ for racial climate indicating that the model explained a negligible amount of variance for these two variables.

Academic Self-efficacy

Direct effects. The parameter estimates of the paths from variables in the model to academic self-efficacy and semester GPA in Figure 3 are presented in Table 16 in both unstandardized and standardized form and identified as direct effects. Seven of the eight direct paths identified from variables in the model to academic self-efficacy were statistically significant. The path from racial climate to academic self-efficacy (.105) was not statistically significant. The two compositional diversity measures, percent Asian American in major and percent female in major, did not have direct paths to academic self-efficacy in the model diagram (see Figure 3); estimates of direct effects were constrained to zero. Six of the statistically significant paths to academic self-efficacy were positive. The negative path from American acculturation to academic self-efficacy (-.166) indicated that higher levels of American acculturation were related to lower levels of academic self-efficacy. Since standardized values are comparable, results showed that the strongest path to academic self-efficacy was from high school GPA (.310), followed by gendered climate (.220) and academic peer support (.171). The smallest significant direct effect on academic self-efficacy was .123 from total college credits.

Table 16

Effects Decomposition for Academic Self-Efficacy and Achievement Variables

Parameter	Academic Self-Efficacy			Semester GPA		
	Unst.	SE	St.	Unst.	SE	St.
High School GPA						
Direct effect	.626 *	.116	.310	.237 *	.043	.315
Total indirect effects	--	--	--	.093 *	.022	.124
Total effects	.626 *	.116	.310	.330 *	.044	.439
Total college credits						
Direct effect	.159 *	.074	.123	.036	.026	.075
Total indirect effects	--	--	--	.024 *	.012	.049
Total effects	.159 *	.074	.123	.060 *	.028	.124
Percent Asian American						
Direct effect	--	--	--	--	--	--
Total indirect effects	.023	.030	.011	.003	.004	.004
Total effects	.023	.030	.011	.003	.004	.004
Percent female						
Direct effect	--	--	--	--	--	--
Total indirect effects	-.032	.018	-.041	-.005	.003	-.017
Total effects	-.032	.018	-.041	-.005	.003	-.017
Racial climate						
Direct effect	.260	.146	.105	--	--	--
Total indirect effects	--	--	--	.039	.022	.042
Total effects	.260	.146	.105	.039	.022	.042
Gendered climate						
Direct effect	.558 *	.152	.220	--	--	--
Total indirect effects	.075 *	.038	.029	.094 *	.026	.100
Total effects	.633 *	.152	.250	.094 *	.026	.100
Academic peer support						
Direct effect	.380 *	.137	.171	--	--	--
Total indirect effects	--	--	--	.057 *	.022	.069
Total effects	.380 *	.137	.171	.057 *	.022	.069
SES Index						
Direct effect	.266 *	.103	.153	--	--	--
Total indirect effects	--	--	--	.040 *	.016	.061
Total effects	.266 *	.103	.153	.040 *	.016	.061
Asian acculturation						
Direct effect	.448 *	.169	.163	-.127 *	.060	-.124
Total indirect effects	--	--	--	.067 *	.027	.065
Total effects	.448 *	.169	.163	-.060	.064	-.059

Note: Unst. = Unstandardized estimate; St. = Standardized estimate.

* $p < .05$.

Table 16 (continued)

Parameter	Academic Self-Efficacy			Semester GPA		
	Unst.	SE	St.	Unst.	SE	St.
American acculturation						
Direct effect	-.344 *	.138	-.166	-.085	.045	-.110
Total indirect effects	.117 *	.047	.056	-.034	.020	-.044
Total effects	-.228	.133	-.110	-.119 *	.049	-.154
Academic Self-Efficacy						
Direct effect				.149 *	.022	.401
Total indirect effects				--	--	--
Total effects				.149 *	.022	.401

Note: Unst. = Unstandardized estimate; St. = Standardized estimate.

* $p < .05$.

Indirect and total effects. In addition to detailing parameter estimates of direct paths, Table 16 provides estimates of indirect and total effects on academic self-efficacy and semester GPA. There were four indirect effects on academic self-efficacy in the path model, but only two were found to be statistically significant (.029 from gendered climate and .056 from American acculturation index). Six of the ten total effects on academic self-efficacy were statistically significant: from high school GPA (.310), total college credits (.123), gendered climate (.250), academic peer support (.171), SES index (.153), and Asian acculturation index (.163). The total effects of percent Asian American in major and percent female in major on academic self-efficacy were not statistically significant; the total effect of percent Asian American in major was .011 and percent female in major was -.041. The total effect of racial climate on academic self-efficacy (.105) and the total effect of American acculturation index on academic self-efficacy (-.110) were not statistically significant.

Hypothesis 2a. Past performance, academic level, socioeconomic status, American acculturation, Asian acculturation, academic peer support, racial climate, and gendered climate significantly contribute to explaining academic self-efficacy.

Specifically, high school grade point average, total college credits, the socioeconomic status index, the American acculturation index, positive racial climate, positive gendered climate, and academic peer support have significant positive relationships with academic self-efficacy. The Asian acculturation index has a significant negative relationship with academic self-efficacy, such that higher levels of Asian acculturation are related to lower academic self-efficacy.

Hypothesis 2a was partially rejected. As hypothesized, high school GPA, total college credits, SES index, positive gendered climate, and academic peer support had statistically significant positive direct and total effects on academic self-efficacy. However, the positive direct and total effects from positive racial climate to academic self-efficacy were not statistically significant, as was hypothesized. Also contrary to expectations, the significant direct and total effects from Asian acculturation index to academic self-efficacy were positive, not negative as hypothesized. Furthermore, the significant direct effect from American acculturation index to academic self-efficacy was negative, not positive as hypothesized, and the total effect was not statistically significant.

Semester GPA

Direct effects. Six direct paths to semester GPA were constrained to zero in the model. Of five direct paths to semester GPA specified in the model, three were statistically significant. The statistically significant paths were from high school GPA (.315), Asian acculturation index (-.124), and academic self-efficacy (.401). The negative direct relationship from American acculturation index to semester GPA and the positive

direct relationship from total college credits to semester GPA were not statistically significant.

Indirect and total effects. Six of the ten indirect effects on semester GPA were statistically significant: from high school GPA, total college credits, gendered climate, academic peer support, SES index, and Asian acculturation index. All six significant indirect effects were positive and the strongest indirect effect was .124 from high school GPA followed by .100 from gendered climate. Six of the eleven total effects on semester GPA were statistically significant and positive: from high school GPA, total college credits, gendered climate, academic peer support, SES index, and academic self-efficacy. The statistically significant total effect from American acculturation index was negative (-.154). The strongest significant total effect on semester GPA was from high school GPA (.439) followed by academic self-efficacy (.401).

The direct, indirect and total effects of high school GPA on semester GPA were all statistically significant. When the nonsignificant direct effect of total college credits on semester GPA was added to the significant indirect effect (.049), the total effect (.124) was found to be statistically significant.

The indirect and total effects of percent Asian American in major and percent female in major on semester GPA were not statistically significant. Although the indirect and total effects of positive racial climate on semester GPA (.042 each) were not statistically significant, the indirect and total effects of positive gendered climate and academic peer support on semester GPA were statistically significant. The total effect on semester GPA was .100 from positive gendered climate and .069 from academic peer support.

The SES index had positive and significant indirect and total effects (both .061) on semester GPA. The significant *negative* direct effect of Asian acculturation index on semester GPA (-.124) and significant *positive* indirect effect (.065) resulted in a negative but not statistically significant total effect (-.059). On the other hand, when the nonsignificant direct and indirect effects of American acculturation on semester GPA were added, the total effect (-.154) was statistically significant.

No indirect effects were estimated from academic self-efficacy to semester GPA; the statistically significant total effect was the same as its significant direct effect (.401).

Hypothesis 2b. Past performance, academic level, socioeconomic status, American acculturation, Asian acculturation, academic peer support, racial climate, gendered climate, and academic self-efficacy significantly and positively contribute to explaining achievement. Higher scores on high school grade point average, total college credits, the socioeconomic status index, the American acculturation index, the Asian acculturation index, academic peer support, racial climate, gendered climate, and academic self-efficacy are related to higher semester grade point averages.

Hypothesis 2b was partially rejected. High school GPA, total college credits, SES index, academic peer support, positive gendered climate, and academic self-efficacy had statistically significant and positive total effects on semester GPA as hypothesized. These aspects of hypothesis 2b were not rejected.

However, the total effect of racial climate on semester GPA was hypothesized to be statistically significant but was not. Also contrary to the hypothesis, the direct effect of American acculturation index on semester GPA was not statistically significant, and the statistically significant total effect of American acculturation index on semester GPA was

negative, not positive as hypothesized. Furthermore, the significant direct effect of Asian acculturation index on semester GPA was negative, not positive as hypothesized, and the total effect of Asian acculturation index on semester GPA was not statistically significant as was hypothesized. These aspects of hypothesis 2b were rejected.

Hypothesis 3. Academic self-efficacy mediates the relationships from past performance, academic level, socioeconomic status, American acculturation, Asian acculturation, racial climate, gendered climate, and academic peer support to achievement, such that high school grade point average, total college credits, the socioeconomic status index, the American acculturation index, the Asian acculturation index, racial climate, gendered climate, and academic peer support influence semester GPA indirectly through academic self-efficacy.

Hypothesis 3 was partially rejected. There were statistically significant indirect effects on semester GPA through academic self-efficacy from high school GPA, total college credits, gendered climate, academic peer support, SES index, and Asian acculturation index, as was hypothesized. These aspects of hypothesis 3 were not rejected. However, the indirect effects on semester GPA from racial climate and American acculturation index were not statistically significant, and these aspects of hypothesis 3 were rejected.

College Environment Factors

Though they did not directly relate to hypothesis testing, the standardized parameter estimates for the direct paths to racial climate, gendered climate, and academic peer support are available in Figure 3 and Table 17. The direct and total effects of percent Asian American in major on racial climate and percent female in major on gendered

climate were not statistically significant. The values of these nonsignificant effects were small.

Table 17

Effects Decomposition for College Environment Variables

Parameter	Racial Climate			Gendered Climate			Academic Peer Support		
	Unst.	SE	St.	Unst.	SE	St.	Unst.	SE	St.
Percent Asian American									
Direct & Total effect	-.038	.057	-.044	--	--	--	.086	.059	.089
Percent female									
Direct effect	--	--	--	-.011	.020	-.035	-.067 *	.022	-.191
Indirect effect	--	--	--	--	--	--	-.002	.004	-.006
Total effect	--	--	--	-.011	.020	-.035	-.069 *	.022	-.197
Gendered climate									
Direct & Total effect	--	--	--	--	--	--	.196 *	.070	.172
American acculturation									
Direct & Total effect	--	--	--	--	--	--	.305 *	.057	.326

Note: Unst. = Unstandardized estimate; St. = Standardized estimate.

* $p < .05$.

Three of four direct and total effects on academic peer support were statistically significant. The direct and total effects of percent Asian American in major on academic peer support (.089 each) were not statistically significant. The strongest significant total effect on academic peer support was from American acculturation (.326) followed by percent female in major (-.197) and positive gendered climate (.172).

The covariance between the residual error terms for racial and gendered climates is depicted in Figure 3 and presented in Table 15. This covariance (.219) was statistically significant.

Background Contextual Factors

The standardized covariances among the three background contextual variables are depicted in Figure 3 and presented in Table 15. The covariance between SES index

and Asian acculturation index (-.073) was not statistically significant. However, the covariance between the SES index and American acculturation index (.251) and between Asian acculturation index and American acculturation index (-.353) were both statistically significant.

Summary

The purpose of this research study was to examine, for undergraduate women of various Asian American ethnic backgrounds, the influence of background contextual and college environment factors on their sense of academic self-efficacy and achievement in STEM majors. The four ethnic groups of East Asian American, South Asian American, Southeast Asian American and multi-ethnic Asian American female students in STEM significantly differed on one of nine social cognitive career variables (SES index), as determined through three MANOVA tests. Based on results from the MANOVA tests, hypothesis statement 1a was partially rejected, hypothesis statements 1b and 1e were rejected, and hypothesis statements 1c and 1d were not rejected. Also based on MANOVA results, ethnic groups were aggregated in a path analysis testing the relationships among social cognitive career variables.

Overall model fit indexes for the initial model indicated that the model was not a good fit. A respecified model was developed through a process in which paths were added or removed from the model only when compelling theory and evidence from prior research studies provided support for model changes that were suggested by LM and Wald test statistics. In exploratory analysis, two paths were added to the model and five paths were removed. The respecified model was retained as it met a two-index combinational criterion recommended by Hu and Bentler (1999).

Parameter estimation provided evidence regarding hypothesis statements 2a, 2b, and 3. Seven of eight direct paths to academic self-efficacy were statistically significant; the strongest paths were from high school GPA and gendered climate. The direct path from racial climate to academic self-efficacy was not statistically significant. Furthermore, the significant negative direct effect of American acculturation index on academic self-efficacy was offset by a significant positive indirect effect through academic peer support; the negative total effect of American acculturation index on academic self-efficacy was not statistically significant.

Three of five direct paths to semester GPA were statistically significant. The strongest significant direct path was from academic self-efficacy (positive) followed by high school GPA (positive) and Asian acculturation (negative). Six of ten indirect effects and seven of eleven total effects on semester GPA were statistically significant. Only one of the seven significant total effects on semester GPA was negative (from American acculturation). The four total effects on semester GPA that were not statistically significant were from percent Asian American in major, percent female in major, racial climate, and Asian acculturation.

In the respecified model, R^2 was .362 for semester GPA, .284 for academic self-efficacy, .183 for academic peer support, .001 for gendered climate, and .002 for racial climate. The model explained 36% of the variance for semester GPA, 28% of the variance for academic self-efficacy, and 18% of the variance for academic peer support.

Chapter V: Discussion

The purpose of this research study was to examine, for undergraduate women of various Asian American ethnic backgrounds, the influence of background contextual and college environment factors on their sense of academic self-efficacy and achievement in science, technology, engineering, and mathematics (STEM) majors. This chapter provides an overview of the study's findings regarding ethnic group differences in factors related to social cognitive perspectives of academic and career development (Byars & Hackett, 1998; Greenstein, 2000; Hackett et al., 1992; Hall & Sandler, 1982; Hurtado et al., 1999; Lent et al., 1994; Leong & Chou, 1994; Tang et al., 1999). Next, an overview of findings related to path analysis, including fit and respecification of the theoretically derived model of academic and career development, is provided. Following this overview and a discussion of key findings regarding parameter estimates from the path analysis, the study's limitations are presented. To conclude, implications for policy and practice and recommendations for theory and future research are proposed.

Ethnic Group Differences

Results of three MANOVAs of ethnic group differences for nine career development variables indicated that the four ethnic groups in the study (East Asian, South Asian, Southeast Asian, and Multi-ethnic Asian American) differed only on socioeconomic status, where South Asian American students had significantly higher socioeconomic status scores than East Asian American students. Mean scores ranged from 3.20 to 3.94 on a 5-point composite scale measuring parents' occupational status, parents' educational attainment, and perceived family socioeconomic status, suggesting

relatively high levels of these socioeconomic indicators. Partial eta squared for the significant differences indicated that ethnic group membership accounted for 8.8% of the variability of socioeconomic status scores. This result was inconsistent with differences in socioeconomic indicators by Asian American ethnicity reported by Hune (2002), Reeves and Bennett (2004), and Kim et al. (1998). Although South Asian American students tended to have the highest levels of socioeconomic status indicators in prior research, Southeast Asian American students tended to have the lowest levels and East Asian American students tended to have significantly higher socioeconomic levels than Southeast Asian American students (Kim et al.; Reeves & Bennett).

The current literature regarding racism and racialized sexism in the U.S. supports the finding of no differences among Asian American ethnic groups in their perceptions of the college environment (academic peer support, racial climate, gendered climate). Asian American ethnic groups consistently have been perceived and treated as a single racial group due to a presumed cultural uniformity, even though their sociopolitical histories are unique (Espiritu, 1992; Helms & Cook, 1999; Kim et al., 1998; Nomura, 2003; Shah, 1997). Furthermore, the model minority stereotype (Suzuki, 2002; Woo, 2001) applies to all Asian Americans without distinction of ethnic group, and the diversity within the Asian American community is largely ignored in higher education (Hune, 1998). The finding of no differences in college environment perceptions is consistent with a study of Asian American faculty, staff, and students at a large Midwestern university, in which significant differences in perceived prejudice were not found among ethnic subgroups (Sodowsky et al., 1991).

However, Hune (1998) noted that Vietnamese, Cambodian, and Hmong American students, who are more likely to be first generation in college and first generation in the U.S. and therefore face increased language barriers and less heuristic knowledge about college, tend to feel more isolated on college campuses than Asian Americans born in the U.S. It is possible that Southeast Asian American students who major in STEM are less likely to experience this isolation than those who choose different majors, due to the occupational segregation and stereotyping of Asian Americans in STEM fields (Leong & Chou, 1994). Alternatively it may be that Hune's summary of findings was related more to generation in college and generational status in the U.S. than to ethnicity. In the current study, participants were predominantly first, 1.5, or second generation in the U.S. A greater proportion of students in the multi-ethnic group were second-generation than students in the other three groups, but this difference was not tested for statistical significance. An analysis of differences in perceptions of the environment by generational status in the U.S. was not conducted.

Similar gender climate perceptions among ethnic groups were consistent with literature regarding contemporary racialized perspectives of Asian American women, which do not make distinctions among ethnic groups. For example, stereotypes of Asian American women as passive and silent or exotic and demure may be applied to all women with an Asian background, regardless of ethnicity (Hune, 1998). The lack of differences in perceptions of the college environment among ethnic groups suggests that Asian American female students from various ethnic backgrounds perceive similar treatment and support by their peers and faculty with respect to their race and gender. On average, perceptions of the racial and gendered climate were positive. Although both

constructs were measured on 5-point scales, two different instruments were used so the scores may not be comparable. However, it appeared that participants had more positive perceptions of the gendered climate ($M=3.99$) than the racial climate ($M=3.27$).

Participants' perceptions of academic peer support also were more agreeable than disagreeable at a mean of 3.83 on a 5-point scale, indicating that their peer relationships were supportive.

Race has theoretically been linked to self-efficacy through cultural factors (Byars & Hackett, 1998; Fitzgerald & Betz, 1994; Lent et al., 2000) and has been found to indirectly influence career development outcomes through environmental factors of barriers, supports, and opportunity structure (Flores & O'Brien, 2002; Hackett et al., 1992). The only comparative study of self-efficacy for Asian American ethnic groups was Gloria and Ho (2003), in which Chinese American college students had significantly lower Educational Degree Requirements Self-Efficacy than Japanese American, Pacific Islander American, and Vietnamese American students. However, differences were not found among ethnic groups on the College Self-Efficacy scale in their study. In the current study, ethnic group differences in academic self-efficacy were not statistically significant, suggesting that the four groups had similar levels of confidence in STEM educational tasks.

One finding in the analysis of ethnic group differences that was not consistent with prior research was the lack of significant group differences regarding acculturation. Mean scores for participants, regardless of ethnic group, were 3.39 for American acculturation index and 2.85 for Asian Acculturation index. These scores on 4-point scales indicated that students were on average acculturated to both dominant American

and Asian ethnic cultures. The higher score for American acculturation indicated that adherence to dominant American language competency, identity, and behaviors may have been stronger than adherence to their Asian ethnic background along these dimensions. This finding for a population of Asian American students in STEM is somewhat different from past research in which acculturation was measured along a single dimension, rather than with two indexes. In Tang et al. (1999), stronger adherence to dominant American culture than to Asian culture was negatively correlated with “typical” career choice, such that lower American acculturation was related to more typical career fields for Asian Americans (i.e., STEM). Typicality of career fields was based upon Asian American occupational segregation and stereotyping (Tang et al.).

Although differences in acculturation by ethnic group were not found in the current research study, Sodowsky et al. (1991) found some ethnic group differences in acculturation using the Majority-Minority Relations Survey (MMRS), also a one-dimensional measure of acculturation. Vietnamese students, faculty, and staff had lower levels of American acculturation than Korean and Japanese students, faculty, and staff, but individuals of Chinese, Japanese, Korean, and Asian Indian ethnic backgrounds did not significantly differ on level of acculturation to American culture (Sodowsky et al.). The current study measured acculturation to dominant American culture and to Asian culture with two indexes (LIB Acculturation Scale; Birman & Trickett, 2001) so that level of adherence to dominant American culture and level of adherence to Asian culture were not conflated as they were in the MMRS, which may have influenced the inconsistent findings. Additionally, the participants in Sodowsky et al. included faculty and staff at a large Midwestern university as well as students, whereas the current study

focused on undergraduate students at a large east coast university. Although participants in Sodowsky et al. included both men and women, significant differences by gender on the MMRS were not found. Sodowsky et al. noted that the MMRS did not include measures of acculturation germane to an individual's gender, such as gender role socialization or perceptions of masculinity and femininity. The LIB did not address these aspects either, further suggesting that the difference in findings between the two studies were not related to the gender of participants. As Sodowski et al. and the current research study were single institution studies with inconsistent findings, further empirical testing of the relationship between Asian American ethnicity and acculturation is needed to better understand how different Asian American ethnic groups respond to the acculturation process.

A second inconsistent finding in the analysis of ethnic group differences was the lack of significant differences in high school grade point average and current semester grade point average. Kim et al. (1998) found that South Asian American students had the highest and Southeast Asian American students had the lowest 10th grade math performance and educational aspirations. Kim et al. was the only known comparative study that analyzed Asian American ethnic groups' educational achievement, but the sample was 10th grade high school students in 1990 drawn from the first follow up study of NELS:88, a different population from the current study in terms of academic grade level and not limited to students studying STEM. Furthermore, Kim et al. did not use grade point average as the measure of achievement as in the current study. Instead achievement was measured by self-reported math grades and students' educational aspirations. In general, the Asian American undergraduate women in STEM majors

participating in the current study had satisfactory academic grades. The mean high school grade point average was 4.14 and semester grade point average was above a B average at 3.17.

The lack of statistically significant differences on most of the social cognitive career variables, especially when differences were found in prior empirical studies, may have been related to the categorization of ethnic groups for the current study. The categorization of ethnicities into larger groups was precipitated by power analysis regarding sample size required for conducting MANOVAs. However, the four groups in the current study were each dominated by one ethnicity. Furthermore, the method of categorization chosen for the current study may not reflect true commonalities of academic and career-related experiences among individuals of different ethnicities within the categorized groups. Unique aspects of some Asian American ethnicities may have been obscured by this process.

Participants who identified Japanese, Pakistani, Bangladeshi, Cambodian, Indonesian, and Thai ethnic backgrounds had minimal representation in the current study's ethnic groups (see Table 7 in Chapter IV), and their experiences may have been marginalized in the current study. Thus, the results from the MANOVAs were likely more representative of Asian Indian participants (91% of the South Asian American group), Vietnamese American participants (80% of the Southeast Asian American group), and Chinese American participants (57% of the East Asian American group and 76% of the multi-ethnic group) than of Japanese, Pakistani, Bangladeshi, Cambodian, Indonesian, or Thai American participants.

Sociopolitical tensions are inherent in subdividing the panethnic Asian American group. In addition to differences in proportions of ethnicities in each ethnic group, people of various Asian ethnicities may not share a commonality of historical experiences or cultural practices that can be easily categorized (Espiritu, 1992). Differences in current employment, education, and urbanicity patterns exist between Filipina Americans and other Asian Americans, further complicating their categorization (Chan, 1991). Furthermore, ethnicities may differ in their history of colonization, immigration, naturalization, and other prejudicial and discriminatory interactions with the U.S. It is difficult to define subgroups of Asian American ethnicities that account for this complexity.

For example, Filipina Americans are similar to East Asian Americans in patterns of immigration to the U.S. among Japanese and Chinese Americans (Chan, 1991; Espiritu, 1995; Takaki, 1993), in the early 1900s as laborers on Hawaiian plantations and in West coast agricultural industries, and after the 1965 Immigration Act through policies that preferred professional occupations and family reunification. However, different from Japanese and Chinese immigrants, Filipina Americans tended to have a familiarity with dominant U.S. culture, educational system, and English language prior to immigration (Chan, Espiritu). Furthermore, Filipina Americans are similar to Southeast Asian Americans of Malaysian and Indonesian ethnic backgrounds in the geographic location of their country of origin (Nomura, 2003). However, they do not share the refugee immigration history of many Vietnamese, Cambodian, and Laotian Americans in the Southeast Asian category (Nomura). Filipina Americans also are similar to Pacific Islander Americans because the Philippines has a history of U.S. colonial rule, yet the

island group was granted independence by the Tydings-McDuffie Act of 1934 (Espiritu). The Philippines share a history of Spanish colonial rule suggesting Filipina Americans may align with Hispanics and Latinas, but the Philippines are geographically distant from Central and South America (Nomura).

The first research question in the current study was an evaluation of differences among participants of various Asian American ethnicities on social cognitive career variables to check for differences within the panethnic Asian American category. However, the lack of adequate sample size to conduct statistical analysis for each ethnicity individually led to the creation of larger subgroup categories. As a result, Filipina Americans were grouped with Chinese, Japanese, Korean, and Taiwanese Americans, which may have influenced the results such that a different categorization of Filipina Americans may have been more meaningful. Future empirical analysis of the similarities and differences among people of various Asian American ethnicities may provide guidance. Alternatively, future research that focuses on the academic and career development for women in STEM of distinct Asian American ethnicities or with adequate sample sizes from each ethnicity removes the need for creating subdivisions. These approaches avoid the inherent tensions of arbitrary categorization and may potentially uncover unique social cognitive career development patterns for Asian Americans of various ethnicities.

In the current study, significant differences among the four ethnic groups were found on only one social cognitive career variable, and ethnic groups were aggregated for further analysis of academic and career development. The lack of significant differences, other than by socioeconomic status, suggested that the Asian American ethnic groups

could be treated as a single group for path analysis. Prior literature regarding *difference research* or *comparative studies* with respect to gender, race, and other social identity groups supports the notion that similarities are as likely across groups as differences, but differences are more likely to be reported and published even when they are small (Campbell, 2002; Hyde, 1998; King, 1994). Research on group differences provides the opportunity to uncover previously unconsidered phenomena (Hyde). However, when values are placed on difference or when interpretations of difference are culturally biased, difference research then becomes problematic (hooks, 1994; Hyde). The pan-ethnic Asian American category was arbitrarily assigned to a group of people in the U.S., and this categorization may not reflect a true commonality of experience, cultural tradition, language, or behavior (Espiritu, 1992; McEwen et al., 2002; Nomura, 2003). Continued examination of subgroup differences prior to aggregation into a pan-Asian American racial category in future research is critical because it helps determine if unique issues are currently obscured. Although ethnic groups were aggregated in the current study's path analysis, other subgroup factors of acculturation and socioeconomic status were included in the path model.

Overview of the Academic and Career Development Model

Through path analysis, the theoretically derived model of academic and career development (Lent et al., 1994) was tested for its fit with data collected in this research study. Specification of variables in the path model (see Figure 2 in Chapter III) was guided by theoretical and empirical literature regarding the career development of Asian American women in STEM (Astin, 1993; Byars & Hackett, 1998; Greenstein, 2000; Hackett et al., 1992; Hurtado et al., 1999; Leong & Chou, 1994; Pascarella & Terenzini,

1991, 2005; Tang et al., 1999) and included past performance, background contextual factors (socioeconomic status, Asian acculturation, and American acculturation), college environment factors (racial compositional diversity, gendered compositional diversity, racial climate, gendered climate, and academic peer support), academic self-efficacy and academic achievement.

The model presented in Figure 2 was not retained, as the fit indexes did not meet the two-index combination cutoff criteria for good fit (Hu & Bentler, 1999). A theoretical and empirical evaluation of the path model was conducted to identify sources of misfit and potential model modifications (Kline, 2005) to more adequately describe the academic and career development of undergraduate Asian American women in STEM in this study. Post hoc model generation is only recommended when there is a compelling basis for it (Hoyle & Panter, 1995). The path model was derived from theoretical and empirical literature, but there were discrepancies in the literature regarding the direct or indirect nature of relationships from background contextual factors to achievement and from college environment factors to achievement for Asian American women in STEM. Furthermore, hypotheses regarding the relations *within* proximal contextual influences, including aspects of the college environment, were not generated in social cognitive career theory (Lent et al., 1994). The role of contextual factors in social cognitive career theory has been recognized as under-studied and not well understood (Byars & Hackett, 1998; Hackett, 1997; Lent et al., 2000).

Five paths were removed from the model: racial climate to semester grade point average, gendered climate to semester grade point average, total college credits to racial climate, total college credits to gendered climate, and socioeconomic status index to

semester grade point average. Two paths were added to the model: American acculturation to academic peer support and gendered climate to academic peer support. The respecified model is presented in Figure 3 (see Chapter IV).

Theoretical perspectives and findings from prior research studies were used as guides in determining the soundness of these changes which were proposed by statistical test results, and the major theoretical propositions of social cognitive career theory (Lent et al., 1994) were maintained in respecification of the model. One path addition (American acculturation to academic peer support) increased the model's consistency with the theory, in that background contextual factors are hypothesized to indirectly influence proximal environment variables (Lent et al.) but this effect was not delineated in the initial model. The second path addition (gendered climate to academic peer support) and two path deletions (total college credits to racial climate and total college credits to gendered climate) involved relationships among contextual factors not expounded upon in social cognitive career theory; college impact theory and research (Astin, 1993; Nora & Cabrera, 1996; Pascarella & Terenzini, 1991, 2005; Tinto, 1993; Whitt et al., 1999) were used to guide these changes. The remaining three path deletions (racial climate to semester GPA, gendered climate to semester GPA, and SES index to semester GPA) were related to discrepancies between social cognitive career theory and its empirical critiques (Byars & Hackett, 1998; Flores & O'Brien, 2002; Greenstein, 2000; Lent et al., 2003; Tang et al., 1999; Vogt, 2003). The respecified model was analyzed using data from the current study. However, respecification of the model was exploratory since it was in part dependent upon data collected in the current study (Hoyle & Panter, 1995; Kline, 2005; MacCallum & Austin, 2000). Because findings from this

exploratory analysis may be due to statistical artifact, a future research endeavor is required to make any conclusions regarding the proposed new model (Hoyle & Panter; Kline; MacCallum & Austin).

Based on the two-index combinational rule for SRMR and RMSEA fit indexes recommended by Hu and Bentler (1999), the respecified model was considered a good fit and was retained. The respecified model explained 36% of the variance for semester grade point average, the indicator of achievement, and 28% of the variance for academic self-efficacy. The predictive power of the model was an improvement over the regression models utilizing academic self-efficacy and tested by Lent et al. (1986), which explained 22% of the variance in technical course grade point average for science and engineering undergraduates. The model also explained a greater amount of the variance in semester grade point average than the regression model tested by Hackett et al. (1992), which explained 30%. However, the Hackett et al. model explained 34% of the variance of academic self-efficacy for science and engineering undergraduates, 6% more than was explained by the current study's model. The same instrument for academic self-efficacy was used in Hackett et al., Lent et al., and the current study.

The model in the current study also was an improvement over the theoretical model tested by Nora and Cabrera (1996), which explained 19% of the variance in cumulative grade point average for racial minorities, including Asian American undergraduates. Nora and Cabrera's model, based on theories of academic persistence, did not include academic self-efficacy or the background contextual factors of acculturation and socioeconomic status. However, Nora and Cabrera's model did account for several environment measures including perceptions of discrimination-prejudice and

academic peer support, past performance, a measure of academic and intellectual development, and a contextual variable of parental encouragement.

Despite the general improvement in the amount of variance explained by the respecified model in the current study over these prior models, a substantial amount of variance in academic self-efficacy and academic achievement remained unexplained. Although a model cannot account for all possible influences on the academic and career development of Asian American undergraduate women majoring in STEM, embellishing the respecified model with additional variables may increase its explanatory power. For example, the model in Hackett et al. (1992) explained a greater amount of the variance for academic self-efficacy than did the model in the current study. Faculty encouragement (positive), faculty discouragement (negative), and stress (negative) were significant predictors of undergraduate engineering students' academic self-efficacy in Hackett et al. that were not included in the current study. Significant predictors of semester grade point average in Hackett et al. that were not included in the current study included faculty encouragement (positive), strain (negative), and family and friend support (negative). These variables also may explain some of the variance of academic self-efficacy and academic achievement for the current study's population.

In the current study, faculty support (i.e., encouragement/discouragement) was measured in part by the racial and gendered climate scales. However, other aspects of faculty support should be considered for their influence on academic outcomes. College impact theories of involvement and persistence highlight the importance of students' interaction with faculty (Astin, 1993; Tinto, 1993). Furthermore, Asian American

undergraduate women in particular may benefit from faculty support because of the external validation they provide (Byars & Hackett, 1998; Leong & Chou, 1994).

Background characteristics and psychological variables that have been linked to social cognitive career development include stress, strain, coping strategies, and gender role socialization (Byars & Hackett, 1998; Hackett et al., 1992). Although gender role socialization was not included as a variable in Hackett et al.'s model, an accumulation of research has documented the influence of gender role socialization on women's self-efficacy and career outcomes (Betz & Hackett, 1997; Hackett & Betz, 1981). A measure of feminist attitudes had significant positive direct effects on Mexican American high school women's career choice traditionality and career aspirations (Flores & O'Brien, 2002). Variables related to gender role socialization also may influence academic and career outcomes for Asian American women in undergraduate STEM majors. Gender role expectations in Asian culture within the racial context of the U.S. are salient for many Asian American women (Kibria, 1990). Many Asian American women fulfill multiple roles in their families, often traditional gender roles due to Asian American families' concern for cultural preservation, and these roles may conflict with family support for educational achievement (Hune, 1998; Park, 2002).

Family and friend support was a significant and positive influence on academic self-efficacy for undergraduate engineering students in Hackett et al. (1992), and Nora and Cabrera (1996) found that parental encouragement contributed the strongest significant total effect (positive) on academic and intellectual development and a significant positive total effect on cumulative grade point average for the racial minority undergraduate student group in their sample (i.e., Asian American, Hispanic, African

American, and Native American students). However, Hune (1998) suggested that unrealistic parental demands can lead to pressure, stress, and academic departure for some Asian American women. Chung (2001) found that Japanese American students experienced less intergenerational conflict regarding family expectations than Korean American and Southeast Asian American students, and high acculturated Asian American students experienced less intergenerational conflict regarding family expectations, education, and career than low acculturated and bicultural Asian American students. Parent and family support may be an important influence in Asian American women's academic and career development and may explain some of the remaining variance in academic self-efficacy and academic achievement.

In addition, other social identity variables, such as (dis)ability and sexual orientation, are related to academic and career outcomes (Byars & Hackett, 1998) and may explain some of the remaining variance in academic self-efficacy and achievement in the current study.

Evaluation of Model Respecification

Changes to the theoretical model in terms of path deletions were evaluated in light of the current literature. The deletion of direct paths to achievement from the racial and gendered climate variables was consistent with prior empirical research and provided additional evidence that the influence of environment on achievement is indirect through self-efficacy as suggested by prior research and theoretical developments (Byars & Hackett, 1998; Greenstein, 2000; Lent et al., 2003; Nora & Cabrera, 1996; Vogt, 2003). The deletion of the direct path to achievement from socioeconomic status for Asian American women was supported by Lent et al. (1994), Byars and Hackett, and Muller et

al. (2001) but was not consistent with Tang et al. (1999). Although recommended by statistical test results from the initial model, paths from compositional diversity to racial and gendered climate were not removed from the respecified model in the current study due to lack of prior empirical or theoretical justification. The inclusion or removal of these paths should be explored empirically in future studies in order to better understand the dynamics of different aspects of the climate in STEM for Asian American women.

Two changes with new implications for social cognitive career theory were the additions of a path from gendered climate to academic peer support and a path from American acculturation to academic peer support. Relationships among contextual influences and the influence of these relationships on academic and career development are not considered in social cognitive career theory (Lent et al., 1994) or its application to the career development of Asian American women (Byars & Hackett, 1998). However, Gloria and Ho (2003) found a significant positive correlation between friend support and perceptions of the university environment, and Nora and Cabrera's (1996) model of academic development, based on theories of persistence (Tinto, 1993), delimited a direct path between perceptions of discrimination and academic peer support. Results from the current study recommending the addition of a path from gendered climate to academic peer support (and the subsequent significant direct effect in the respecified model, discussed below) were consistent with this prior research and theory of persistence. A path from racial climate to academic peer support, though suggested by Gloria and Ho, Nora and Cabrera, and Tinto, was not added to the respecified model in the current study for statistical and theoretical reasons. Greater manipulation of the theoretical model tested on the same dataset increases the likelihood of capitalizing on chance, and the addition of

a path from racial climate to academic peer support was not identified as a source of model misfit by LM test results (Hoyle & Panter, 1995; Kline, 2005). Theoretically, different processes may be involved in the relationships from perceptions of the gendered racial climates to academic peer support for Asian American women: one form of the climate may have an influence while the other does not. This conclusion is supported by different findings in the current study in the relationships from compositional diversity to academic peer support, such that the effect from gendered compositional diversity was negative and statistically significant, but the effect from racial compositional diversity was positive and not statistically significant. Future research with a new sample should be conducted to support the addition of a path from gendered climate to academic peer support in the social cognitive career model and also explore if the addition of a path from racial climate to academic peer support is reasonable.

The second major change to the social cognitive career model in the respecified model was a significant direct path from American acculturation to academic peer support, which is supported by results from Leong (2001), where Asian Americans with low American acculturation experienced the greatest amount of occupational stereotyping and discrimination in the workplace as hypothesized by Leong and Chou (1994). A direct relationship between background contextual factors and proximal environment factors is not designated by social cognitive career theory (Lent et al., 1994), which hypothesizes an indirect relationship through person inputs, such as race and gender. The addition of this specific path was based on theory and prior research, but it was only one of four recommended statistical additions of paths from a background context variable to a college environment variable identified by the initial model's LM test of model misfit.

Further investigation of the relationship among contextual factors – background with proximal – and the influence of those relationships on Asian American women’s academic and career development is warranted.

It may be arbitrary that a path from American acculturation to academic peer support was respecified but a path from Asian acculturation was not, and that a path from gendered climate to academic peer support was respecified but a path from racial climate was not. Future research can help clarify this dynamic. However, results from the current study may indicate that different processes are involved in the climate related to race and gender and in the Asian and American dimensions of acculturation, supporting the use of multi-dimensional measures of climate and acculturation in social cognitive career research. The findings related to academic peer support also highlight that academic peer support is an essential and interconnected aspect of the academic and career development of Asian American women in STEM. This conclusion rests upon college impact theories of persistence (Tinto, 1993) and involvement (Astin, 1993) and the accumulation of research demonstrating the influence of peers on college outcomes (Astin; Pascarella & Terenzini, 1991, 2005). In addition, the significant relationship from academic peer support to academic self-efficacy found in the current study is consistent with prior research regarding the role of peer support in Asian American students’ sense of educational self-efficacy (Gloria & Ho, 2003) and female engineering students’ sense of self-confidence in math and science (Huang & Brainard, 2001).

Effects on Achievement and Self-Efficacy

In the respecified model, five direct effects on achievement were specified, but only three were statistically significant. The strongest direct influence on achievement

was academic self-efficacy followed by past performance (high school GPA), consistent with the meta-analysis of college achievement predictors by Robbins et al. (2004). Seven of 11 total effects on achievement were statistically significant, but the direction of the effect of American acculturation on achievement (negative) was contrary to expectations (Leong & Chou, 1994). The total effects of racial and gendered compositional diversity, racial climate, and Asian acculturation on achievement were not statistically significant.

Seven of eight specified direct paths and six of 10 total effects on academic self-efficacy were statistically significant. Contrary to expectations, perceptions of the racial climate was not significantly related to academic self-efficacy. Additionally, the direct effect of Asian acculturation on academic self-efficacy was positive, and the direct effect of American acculturation on academic self-efficacy was negative, inconsistent with theoretical propositions of Leong and Chou (1994), but consistent with Tang et al.'s (1999) research study. Total effects on academic self-efficacy from racial and gendered compositional diversity, racial climate, and American acculturation were not statistically significant.

The mediating role of self-efficacy was supported by the finding of six significant indirect effects on achievement, consistent with Hackett et al. (1992), Lent et al. (1986), Nora and Cabrera (1996), Tang et al. (1999), Greenstein (2000), and Vogt (2003). These findings are elaborated below in light of current literature.

Past Performance and Academic Self-Efficacy

The findings of significant direct relationships from high school GPA, the indicator of past performance, to achievement (semester GPA) and from academic self-efficacy to achievement were consistent with prior research, including Hackett et al.

(1992), Lent et al. (1984, 1986), Astin (1993), and Nora and Cabrera (1996). The .401 direct effect of academic self-efficacy on achievement was consistent with a meta-analysis of self-efficacy and performance studies (Multon et al., 1991). In studies with similar designs (college students, average-to-high achieving student population, and classroom-based measures of performance (grades)), overall effect sizes of the relationship between self-efficacy and performance were near .35 (Multon et al.). The moderate effects of past performance (.439) and academic self-efficacy (.401) on achievement also were consistent with a meta-analysis of the influence of both traditional and psychosocial predictors on academic achievement (Robbins et al., 2004). Robbins et al. found true score correlations of .496 between self-efficacy and cumulative college grade point average, and .448 between high school grade point average and cumulative college grade point average.

In the current study, academic self-efficacy partially mediated the relationship from past performance to achievement, consistent with Hackett et al. (1992) and Lent et al. (1986). The positive total effect of past performance on academic achievement (.439) was stronger than the direct effect of past performance (.315). The total effect from past performance was stronger than the total effect from academic self-efficacy on achievement, even though academic self-efficacy had the strongest direct effect on achievement (.401). In addition to supporting the evidence from prior research, these findings extended the literature since they applied specifically to Asian American women in STEM.

Background Contextual Factors

The relationships from socioeconomic status and acculturation to achievement had not been tested in prior studies involving social cognitive career development models. Social cognitive career theory proposed an indirect relationship (Lent et al., 1994), but prior empirical research on other career outcomes, particularly choice (Flores & O'Brien, 2002; Tang et al., 1999), suggested that a direct relationship between background contextual factors and achievement also was viable.

Asian and American Acculturation

In the current study, Asian acculturation was the only background contextual factor with a significant direct relationship to achievement; the relationship was negative. Academic self-efficacy acted as a suppressor in the relationship where the positive and significant indirect effect of Asian acculturation on achievement, when added to the significant negative direct effect, resulted in a negative but not significant total effect. Acculturation was measured using the Language, Identity, and Behavioral (LIB) Acculturation Scale (Birman & Trickett, 2001). The American acculturation index and the Asian acculturation index of the LIB each consisted of three subscales assessing language competence, identity acculturation, and behavioral acculturation. The significant total effect of American acculturation on achievement (-.154) was stronger than the nonsignificant total effect of Asian acculturation (-.059). The negative relationship from American acculturation to achievement indicates that greater adherence to dominant American culture is related to lower semester GPA.

Furthermore, Asian acculturation had significant positive direct and total effects on academic self-efficacy, indicating that greater adherence to Asian culture is related to

a stronger sense of academic self-efficacy. On the other hand, American acculturation had a significant negative direct effect but nonsignificant negative total effect on academic self-efficacy. This result, overall, indicates that academic peer support acted as a suppressor in the relationship where the positive and significant indirect effect of American acculturation on academic self-efficacy, when added to the significant negative direct effect, resulted in a negative but not significant total effect on academic self-efficacy.

Findings in the current study regarding the relationships between acculturation and academic self-efficacy for Asian American women in STEM were contrary to expectations based on Leong and Chou's (1994) theoretical perspectives but consistent with Tang et al. (1999). Leong and Chou hypothesized that higher levels of acculturation to American culture were related to higher career-related self-efficacy in Asian Americans' career-related experiences. However, Tang et al. found a negative relationship between level of American acculturation and career self-efficacy. This study's findings supported Tang et al.'s findings, and extended the prior literature in three ways. First, the study used an acculturation instrument that measured acculturation along two dimensions. Second, the study addressed the relationship between acculturation and self-efficacy in academic achievement, whereas prior literature focused extensively on the role of acculturation in career choice but also interests and goals (Byars & Hackett, 1998; Flores & O'Brien, 2002; Leong & Chou; Park & Harrison, 1995; Prosser, 2001; Tang et al.). Third, the study used a gender lens in the study of Asian American acculturation and self-efficacy, supporting the theoretical perspectives promoted by Byars and Hackett, who hypothesized that low acculturation to American culture and choosing

to major in STEM would lead to higher academic and career related self-efficacy for Asian American women. In the current study, lower levels of American acculturation and higher levels of Asian acculturation were related to higher academic self-efficacy in STEM.

The academic and career literature reflects that gender role socialization, external locus of control, and racial occupational stereotyping are related to the academic and career development of Asian American women (Byars & Hackett, 1998; Fitzgerald & Betz, 1994; Leong, 1985), but acculturation may mediate the influence of these factors on self-efficacy and achievement. In other words, the relationships found in the current study between American acculturation, academic peer support, and self-efficacy leading to a negative total effect of American acculturation on achievement is similar to the social cognitive career dynamics for White women (presumably with high levels of American acculturation) who tend to have lower self-efficacy for STEM tasks leading to a negative effect on achievement (Betz, 1997; Hackett et al., 1992). Furthermore, external locus of control is more common for individuals in Asian cultures than Western cultures (Byars & Hackett) and is connected to higher levels of self-esteem and self-efficacy (Byars & Hackett), supporting the positive relationship found in the current study between Asian acculturation and academic self-efficacy.

The role of gender role socialization in self-efficacy for Asian American women at different levels of acculturation is less clear. The literature suggests that Asian American women have family support for pursuing higher education, but unrealistic parental expectations may lead to stress (Hune, 1998). Asian American women may experience contradictions in being called upon to uphold Asian cultural traditions related

to family, such as arranged marriage, marriage at an early age, and working in the family business, at the same time as being encouraged to attain educational success (Espiritu, 2001b; Park, 2002; Srinivasan, 2001). Chung (2001) found that Asian American students with high acculturation to dominant American culture experienced less parental conflict in their education and career than Asian American students with lower levels of American acculturation. Based on the results of the current study and the research literature, acculturation is a central construct in understanding the academic and career development of Asian American women in STEM.

Measuring Acculturation

This was the first known study of social cognitive career development that measured acculturation along two distinct dimensions through an Asian acculturation index and an American acculturation index. Tang et al. (1999) used the SL-ASIA (Suinn et al., 1987) which measured acculturation on a single scale from low to high, assessing the level of identification with dominant American culture. Flores and O'Brien (2002) used the Acculturation Rating Scale for Mexican Americans (ARSMA-II; Cuéllar, Arnold, & Maldonado, 1995). Although the ARSMA-II has independent subscales (Mexican Orientation Subscale and Anglo Orientation Subscale), Flores and O'Brien used a total score for acculturation level calculated by subtracting one score from the other. The limitation of measuring acculturation along one dimension is that scores do not accurately reflect, for example, the experience of an individual who strongly identifies with both Asian and American cultures (Berry et al., 1986; Cabassa, 2003). Unidimensional models are grounded in a perspective that the dominant culture is not influenced by the culture of origin, and that identification with dominant American

culture necessitates the loss or rejection of Asian cultural identification and adherence (Cabassa).

In a reflective commentary on the state of measuring acculturation, Cabassa (2003) noted that the acculturation process is “interactive, developmental, multifactorial, and multidimensional” (p. 128). Bidimensional models of acculturation attempt to remedy the limitations of unidimensional models by considering maintenance of the culture of origin and adoption of the host culture as independent from each other. In a study of Chinese American college students, Tsai, Ying, and Lee (2000) found that the American and Chinese cultural orientations of U.S. born Chinese American students were uncorrelated or independent, supporting a bidimensional model of acculturation. On the other hand, the American and Chinese cultural orientations of Chinese immigrant students in the U.S. were negatively correlated with each other, suggesting that a unidimensional model applied to immigrant groups. In the current study, the measures of Asian acculturation and American acculturation were negatively correlated with each other at a moderate level, suggesting some dependence. This correlation was not calculated separately for first generation in the U.S. and second generation or more groups.

In the current study, the relationships between acculturation and other variables in the path model were not consistent across the two dimensions. For example, a path from American acculturation to academic peer support was added to the model when it was respecified, but a path from Asian acculturation was not. Also, only American acculturation had a significant (positive) covariance with socioeconomic status. Asian acculturation had significant direct and indirect effects on achievement, but the total

effect was not significant, whereas the direct and indirect effects of American acculturation on achievement were not significant and the total effect was significant. These differences in the role of each aspect of acculturation within the model suggest that the bidimensional model was appropriate for this study. The current study furthers the empirical research regarding the role of acculturation in academic and career development by employing a bidimensional measure (LIB; Birman & Trickett, 2001).

The dynamics of the multifactorial aspect of acculturation, however, were not considered in the current study's model. The LIB has three subscales – language competency, identity, and behavior – but these subscales were combined to create the overall Asian and American acculturation indexes used in the model. Potentially, these aspects of acculturation may have different influences on the academic and career development of Asian American women in STEM, since an individual may maintain some aspects of a culture, such as cultural pride, while rejecting other aspects, such as language use (Berry et al., 1986; Cabassa, 2003). For example, Tsai et al. (2000) found that different aspects of culture predicted identification with being Chinese and being American for three groups: American born Chinese Americans, Chinese Americans who immigrated to the U.S. at age 12 or younger, and Chinese Americans who immigrated after age 12.

The LIB instrument and bidimensional measurements in general do not adequately describe the full range of possible outcomes of acculturative processes. First, the LIB assesses language competency, identity, and behavioral aspects of culture, but does not measure adherence to values, attitudes, or other aspects of culture (Cabassa, 2003). Second, the LIB was designed for an immigrant population (Birman & Trickett,

2001). It may not adequately encompass the acculturative experiences of Asian Americans who are 1.5, second, third, or more generations in the U.S. and may make confusing distinctions between Asian and American cultural aspects that are indistinguishable for Asian Americans. For example, differences in items between the American acculturation index and the Asian acculturation index such as speaking an Asian language with Asian friends and speaking English with American friends (see Appendix B) make a false distinction between Asian friends and American friends propagating the perpetual foreigner myth (Hune, 1998). Furthermore, the LIB may not adequately encompass the experiences of individuals with Asian ethnic backgrounds who are adopted outside of their racial group or those individuals who are multiracial (McRoy & Hall, 1996; Standen, 1996). In the current study, three students self-disclosed in comment spaces on the survey that they were adopted by non-Asian parents, and five students identified that they were both White and Asian American.

A third limitation of bidimensional models is that they do not allow for the possibility of adherence to new cultural elements that emerge as a result of contact between cultures. These “novel phenomena” (Berry et al., 1986, p. 310) may be in any or all realms of language, identity, behavior, attitude, and values. In the current study, the lack of measurement of a distinct *Asian American (or Vietnamese American, etc.)* culture was identified by reviewers of the pilot test and by some participants as a limitation of the study. For example, in an open-ended space for comments on the cultural self-identity item (see Appendix B for item and Appendix P for participants’ comments), one student commented that, “Feeling Asian and American equally...is the same as feeling like I don’t belong to either culture.... I consider myself of Asian-American culture and would

not choose one category of [*sic*] the other.” In a comment space at the end of the survey (see Appendix A for item and Appendix N for participants’ comments), another student noted,

I think there exists a unique culture among Asian Americans that contains parts of both the Asian and the American culture, but also cannot relate entirely to both. For someone like me who cannot speak an Asian language, it is clear how I cannot relate (and vice versa) to immigrants or older generations and some aspects of their culture. At the same time, there are parts about my lifestyle that are very different from the typical American culture that I might not expect the typical American (Caucasian) to fully understand.

A third student wrote,

As second generation kids, it is impossible to ask whether one feels more “American” or more “Asian” because our culture defines us as “Asian American.” Our culture is a mixture of both. When it comes down to it...there are levels of Asian-American culture within the group itself.

As described by these students, Asian American culture is uniquely different from both Asian ethnic cultures and dominant U.S. culture. One pilot test reviewer noted examples of Asian American media, such as magazines, which are culturally Asian American in nature. For example, the music television network MTV recently launched a series of stations geared towards some of these Asian American cultures, such as MTV Desi for South Asian American culture, MTV Chi for Chinese American culture, and MTV K for Korean American culture (Sontag, 2005). These stations are not replicas of MTV’s international stations broadcast in India, China, and Korea, and they have distinct flavors from MTV’s American pop culture stations in the music, commentaries, and other youth cultural expressions offered in their programming (Sontag).

The development of a distinctly Asian American culture is rooted in pan-ethnic political organization in response to racial categorization and presumed cultural uniformity (Espiritu, 1992). A pan-ethnic Asian American female identity is created and

essentialized through the existence of a power hierarchy of race and gender (Shah, 1997). To address pan-ethnic acculturation, Chung, Kim, and Abreu (2004) developed the Asian American Multidimensional Acculturation Scale (AAMAS) that assesses acculturation in reference to culture of origin, European Americans, and other Asian Americans. The AAMAS maintains the independent nature of the bidimensional models but adds a measurement of a third dimension: adherence to a pan-ethnic Asian American culture. The AAMAS also was designed to be used with multiple Asian American ethnic groups. The influence of adherence to Asian American culture in the academic and career development of all Asian Americans, and Asian American undergraduate women in STEM in particular, is an area for future research.

Socioeconomic Status

The current study contributed to the limited literature regarding the role of socioeconomic status in the academic and career development of undergraduate Asian American women. In the current study, socioeconomic status was measured using a composite index of parents' occupational status, parents' educational attainment, and perceived family socioeconomic status, as recommended by Ensminger et al. (2000). The direct effect of this variable on achievement was constrained to zero, but the positive indirect and total effects were significant, suggesting that academic self-efficacy mediated the relationship, as hypothesized in Lent et al. (1994) and Byars and Hackett (1998). These findings build upon the findings of Muller et al. (2001), in which socioeconomic status had a significant positive relationship with 8th grade science achievement for Asian American girls but indirect effects were not evaluated. Furthermore, the significant direct effect between socioeconomic status and academic

self-efficacy was consistent with Byars and Hackett, but was not consistent with the findings of Tang et al. (1999), where the path between socioeconomic status and career self-efficacy was not significant. Socioeconomic status was measured with similar indicators of parent occupational and educational status in Tang et al. and the current research study. However, career self-efficacy in Tang et al. was measured as “typicality” (in reference to other Asian Americans) of Asian American college students’ confidence in different career areas. The participants in Tang et al. included men and women in science, business, social science, art, and other majors at eight Midwestern and east coast universities. Another difference between samples in Tang et al. and the current study was that 7% of participants in Tang et al. reported Hmong as their ethnic background (compared to 0% in the current study), and no participants reported Asian Indian as their ethnic background (compared to 23% in the current study). These differences may have contributed to inconsistent findings.

Another reason for inconsistent findings may be the nature of social class and socioeconomic status as social constructions. Social class is a more nebulous concept than race and gender, particularly for Asian Americans (Inkelas, 2000; Prosser, 2001). It also is more difficult to measure because it is not easily observed, and researchers must rely on indicators such as education level, income, and class-related cultural behaviors (Ensminger et al., 2000). This study involved college students, a population with a higher level of socioeconomic status than those individuals who never attended college. However, the range of scores on the SES index was wide (1.40 to 5.00 out of possible 1.00 to 5.00 range) with a fairly large standard deviation (0.93). Furthermore, the SES index was the only factor with significant differences by ethnic group, suggesting

variability in the SES index scores. The influence of socioeconomic status, or social class, on the academic and career development of Asian American women in STEM should continue to be studied.

College Environment

There were five measures of the proximal college environment in the current study's academic and career development model: racial compositional diversity, gendered compositional diversity, perceptions of the racial climate, perceptions of the gendered climate, and academic peer support. The significant indirect relationships found from some college environment variables to achievement through self-efficacy provided support for Byars and Hackett's (1998) hypotheses which differed from Lent et al.'s (1994) model. The indirect nature of these relationships with achievement also was consistent with the research findings of Vogt (2003), Lent (2003), Greenstein (2000) and Nora and Cabrera (1996), although Greenstein's results included significant direct effects as well. The accumulation of evidence, including findings from the current study, therefore suggests that the relationship from proximal college environment variables to achievement is indirect through academic self-efficacy.

Racial and Gendered Climates

In this study of Asian American women in STEM majors, perceptions of the gendered climate had the second strongest effect, after past performance, of the seven significant direct effects on self-efficacy, such that positive perceptions of the gendered climate were significantly related to higher levels of academic self-efficacy. The variable *perceptions of the gendered climate* was measured by a reverse scored average of items on the Gender Discrimination scale (Vogt, 2003). The Gender Discrimination scale

included items regarding students' academic interactions with male peers and faculty and gendered treatment by peers and faculty. Faculty relationships are considered important to Asian American women because of the external validation they provide (Byars & Hackett, 1998; Leong & Chou, 1994), and peer relationships provide an opportunity for vicarious learning, one of the four sources of self-efficacy information (Bandura, 1977, 1986).

In the current study, when environments were perceived as actively supportive of women, they benefited individual students' sense of academic competence in STEM, aligning with perspectives on chilly and null campus climates for women by Freeman (1979) and Hall and Sandler (1982). The significant positive effect found between gendered climate and academic self-efficacy was consistent with past research documenting reduced self-confidence when women participate in a science major (Astin & Astin, 1992; Seymour, 1995; Sonnert, 1999). The significant positive total effect found between gendered climate and achievement were consistent with Whitt et al. (1999) and Pascarella et al.'s (1997) findings that perceptions of a chilly climate for women had a negative influence on a range of cognitive development outcomes for women in college.

For Asian American women in the current study, the gendered treatment of students by faculty and teaching and lab assistants had a stronger influence on their sense of academic self-efficacy than did either students' perceptions of racialized treatment in STEM or their sense of academic peer support. This finding supports the accumulation of prior research which suggests that the dominant culture of science combined with occupational stereotypes of Asian Americans and women situated Asian American women in a state of both belonging and not belonging in STEM (Chinn, 2002; Leong,

1985; Park, 2002; Rosser, 1997; Sonnert, 1999). Occupational stereotyping places Asian Americans within the center of STEM fields, but relegates women and women's science to the periphery (Betz, 1997; Eisenhart et al., 1998; Hune, 1998; Rosser; Sonnert; Suzuki, 2002). Therefore, affirmation and validation of Asian American women as women may be particularly beneficial to their academic self-efficacy (Byars & Hackett, 1998).

Although in the current study perceptions of the gendered climate were generally positive, the stronger relationship from gendered climate to self-efficacy than from racial climate to self-efficacy may be related to different dynamics in the development of coping strategies for negative gendered environments and those for negative racial climates (Byars & Hackett). Asian American women may be less able in their youth to recognize the nuances of chilly and null educational climates for gender (Freeman, 1979; Hall & Sandler, 1982), so that if they encounter a chilly or null climate in STEM, it negatively affects their self-confidence in successfully completing academic STEM tasks. To counteract the negative influence of academic gender bias on agentic self-efficacy, Ancis and Phillips (1996) recommended preparing women for the possibility of experiencing gender discrimination in college by helping them to develop coping and adaptive behaviors, and providing them with positive learning and interpersonal experiences that increase their agentic self-efficacy.

Nora and Cabrera (1996) suggested that racial minority students were more immune than White students to racial prejudice-discrimination in their academic development because they had more experience with negative racial environments. Congruent with Nora and Cabrera's findings, racial climate did not have a significant direct effect on academic achievement for the Asian American women in STEM in the

current study. The variable *perceptions of the racial climate* was measured using the Faculty and Classroom Behavior scale (Neal, 1992) with items concerning aspects of faculty-student interactions, racial sensitivity of faculty and students in the classroom, and racial diversity of course content. However, prejudice-discrimination had a significant indirect effect for students of color in Nora and Cabrera, but the indirect effect of racial climate on achievement was not significant in the current study. Since Nora and Cabrera aggregated data from Asian Americans with data from other students of color, the nature of this relationship in their study specifically for Asian Americans is unknown. Also, Nora and Cabrera's model was based on theories of persistence (Tinto, 1993) and did not include self-efficacy as a mediator as in the current study.

The current study's findings of generally positive perceptions of the racial climate were inconsistent with past studies in which Asian American students reported negative racial climates and unfair experiences with faculty, which predicted their sense of alienation from their campuses (Ancis et al., 2000; Cabrera & Nora, 1994). Grandy (1997) and Hsia and Hirano-Nakanishi (1989) further documented that Asian American students in STEM as well as other majors were on average less satisfied with their educational environment than any other racial group and were the most critical of their academic experiences overall. However, Grandy observed that Asian American students had positive perceptions of their educational environment, as in the current study, but were the least positive of all racial groups.

The inconsistency with prior research may be related to the gender of participants, as the current study is the only one that accounted for the participants' gender. Another possibility is the instrument used for racial climate which measured positive support for

racial diversity and the absence of prejudice rather than negative attitudes toward a racial group and the presence of prejudice and discrimination (Neal, 1992). Also, the measure had an adequate but modest Cronbach alpha reliability of .71 in the current study, suggesting some random measurement error (Kline, 2005). Measurement error may underestimate causal effects (Kline). Although not statistically significant, the direct effect from positive racial climate to academic self-efficacy was .105, indicating a small effect. Thus, the use of a measure with more reliable scores may have resulted in statistically significant findings regarding the direct effect from racial climate to academic self-efficacy.

Measuring both the racial climate and the gendered climate simultaneously, as in the current study, recognizes the multiple identities a student brings to her learning and development, and that any one of those identities may become more salient in a particular situation or environment, such as within the STEM college environment (Andersen & Collins, 2001; Deaux & Ethier, 1998). The impact of race and gender is not only cumulative but also interactive and interlocking (Andersen & Collins; Weber, 1998), but the measures used in the current study did not attempt to identify the racialized gendered climate (or the gendered racial climate) perceived by Asian American women. Instead, participants were asked to assess the environment for Asian Americans and for women separately. This approach may have hidden the interactive and interlocking processes of race and gender experienced simultaneously by Asian American women in STEM (Chen et al., 1999). As one student described her experience with discrimination in college, “it’s hard to know if it’s because I’m a woman, or because I’m Asian, or both” (Hune, 1998, p. 11).

Compositional Diversity

The lack of significant relationships from the two measures of compositional diversity, percent Asian American in major and percent female in major, to racial and gendered climates, respectively, was not consistent with Hurtado et al.'s (1999) model of institutional climates for diversity and was contrary to theory and research regarding critical mass and role models (Astin & Astin, 1992; Fassinger, 2001; Kanter, 1977). It is possible that compositional diversity has a non-linear relationship with the psychological and behavioral aspects of climate. Kanter's theory of group interaction regarding skewed sex ratios and critical mass indicates that a threshold is needed for changes in interactions, climate, and culture to occur. A threshold suggests the possibility of a stepped, or inconsistent, relationship rather than a linear one between compositional diversity and racial and gendered climates. For example, it may be that climate remains constant up to a certain level of compositional diversity, dramatically changes at that level, and then continues to change as compositional diversity increases, but at a less rapid pace. The lack of significant relationships between the constructs also may be related to the measures used. Compositional diversity measured the proportion of students in a major, but perceptions of the racial and gendered climates addressed interactions and treatment by faculty and lab and teaching assistants as well as by students in their courses. Significant relationships may have been found if compositional diversity measured faculty and graduate student representations, or if the measures of climate perceptions focused exclusively on peer interactions. The significant relationship between gendered compositional diversity and academic peer support in the current study provides some support for this suggestion.

Compositional diversity also did not have a strong influence on the academic and career development model as a whole, with non-significant and nominal indirect effects on academic self-efficacy and achievement as well. The finding was consistent with Kim et al.'s (1998) results in which the percent of White students in a school did not explain educational aspirations for any Asian American ethnic group of 10th grade students. However, critical mass has been shown to influence choice and persistence in a major (Astin & Astin, 1992; Betz, 1997; Tidball et al., 1999). Vicarious learning, one of the four sources of self-efficacy information in Bandura's (1977, 1986) social cognitive theory, occurs through role models. Role models are most likely to be effective when they are similar to the individual along important dimensions, which include social identity groupings and levels of performance mastery (Bandura, 1986). Byars and Hackett (1998) noted that peers and slightly older students are more likely to be effective role models in promoting the academic and career self-efficacy of young women than advanced, highly skilled others who are similar to an individual only by race and gender. The availability of role models, signified by the proportion of similar students by race and major, was hypothesized by Byars and Hackett (1998) to positively influence self-efficacy for Asian American women, but this proposition was not supported by results from the current study.

Access to role models may depend on several other factors besides availability within a student's major, such as academic level, average class size of courses taken, and the number of courses taken in a student's major department. The nominal role of compositional diversity in the current study's academic and career development model raises questions regarding the nature of compositional diversity and the availability of

role models in different aspects of the college environment. It is possible that students' experiences with compositional diversity in their major can not be isolated from their experiences in STEM courses outside of their major, or in courses outside of their college. By measuring compositional diversity at the major level, the current study accounted for differences across STEM fields and considered the potential connection between students who identify with a particular major. However, the influence of compositional diversity may be more complex, and this complexity was not incorporated in the current study's operationalization of compositional diversity. Future research examining the nature of compositional diversity and how students experience compositional diversity in their academic environment is warranted.

Furthermore, it is possible that the mere presence of role models does not influence an individual's academic and career development, but that vicarious learning occurs through interactions with role models. Indeed, Hurtado et al. (1999) stressed that, although the "goal of increasing the numbers of racial/ethnic students on campus...is an important area for institutional effort...other elements of the climate also require attention and constitute key areas for focusing efforts to increase diversity" (pp. 3-4). The study's results, particularly the lack of significant relationships from compositional diversity and the significant contributions of gendered climate and academic peer support, supported Hurtado et al.'s assertion of attending to multiple aspects of climate and diversity in support of the academic and career development of Asian American women in STEM.

Although the compositional diversity measures did not directly affect perceptions of the racial and gendered climate, the proportion of women in a student's major

(gendered compositional diversity) had a significant negative relationship with academic peer support; this relationship was expected to be positive. Furthermore, the positive relationship from proportion of Asian Americans in a student's major (racial compositional diversity) to academic peer support was not statistically significant. The results indicated that students' interactions with their peers were not influenced by the presence of other Asian American students but were negatively influenced by the presence of other women in their major.

One possible interpretation is that in majors with few women, the women tended to stick together and become more supportive of each other. A social identity tends to become more salient within a comparative context, particularly when that identity is in a numerical minority (Oakes, 1987). As a result, gender may become more important for peer relationships for Asian American women in STEM majors with fewer women, but less important for those in STEM majors with greater proportions of women.

Alternatively, the environments in majors with greater proportions of women may have been negatively related to academic peer support for spurious reasons related to the specific majors, rather than the gender composition of the major. The majors with the largest proportion of women (80% or greater) were Agricultural and Veterinary Medicine, Nutrition, Animal Science, and Individualized Studies in Biological Sciences. The majors with the smallest proportion of women (less than 12%) were Mechanical Engineering, Computer Engineering, Computer Science, and Electrical Engineering.

These measures of compositional diversity, by separately considering race and gender, again could not reveal dynamics at the intersection of race and gender (Andersen & Collins, 2001; Weber, 1998), or if the greater presence of other *Asian American*

women in their major provided students with greater or less academic peer support. Furthermore, racial and gendered compositional diversity were each measured by a single item, the proportion of Asian American peers in a student's major and the proportion of female peers in a student's major. A more comprehensive measure of compositional diversity that includes multiple indicators may be more likely to contribute significant effects in the model. For example, multiple indicators may include measures of compositional diversity outside of a student's major and measures that incorporate the compositional diversity of faculty and graduate assistants as well as measures of compositional diversity within a student's major. Additionally, the range for racial compositional diversity (.0% to 34.2% Asian American in major) was smaller than the range for gendered compositional diversity (10.5% to 89.7% women in major). The smaller variance may have limited the finding of significant relationships from racial compositional diversity to racial climate and academic peer support.

Limitations

Some limitations to the research design did exist and should be considered. Although path analysis offered a procedure that addressed the complexity of psychosocial processes, path analysis can not confirm a model as correct; other relationships or the inclusion of other variables actually may depict the correct model (Klem, 2000). This limitation was addressed by employing a model where the variables and relationships among variables were based upon social cognitive career theory (Lent et al., 1994). Furthermore, prior research and theoretical modifications related to the career development of women of color, and Asian American women in STEM in particular,

supported the model structure that was depicted in Figure 2 (Byars & Hackett, 1998; Hackett et al., 1992; Leong & Chou, 1994; Tang et al., 1999).

However, the role of context in social cognitive career theory is not well understood (Byars & Hackett, 1998; Hackett, 1997; Lent et al., 2000), and there were some discrepancies in the prior literature regarding the direct or indirect nature of relationships from background contextual factors to achievement and from college environment factors to achievement for Asian American women in STEM (Byars & Hackett; Flores & O'Brien, 2002; Hackett; Lent et al., 1994, 2000; Tang et al., 1999). Furthermore, hypotheses regarding the relations *within* proximal contextual influences, including aspects of the college environment, were not generated in social cognitive career theory (Lent et al., 1994). Because of these discrepancies and the findings of a poor fit for the initial model, the study involved a secondary process of respecifying specific elements in the model. This respecification process was exploratory because it relied upon statistical results from analysis of the initial model that was subsequently tested using the same data. Although theoretical perspectives and prior research findings were used as guides to determine which changes were made to the initial model, results from this exploratory analysis may have been statistical artifacts rather than accurate descriptions of the population's academic and career development.

A longitudinal design is needed to provide empirical support of causality in a path analysis, but this study employed a cross-sectional design where data for background contextual factors, college environment factors, and academic self-efficacy were collected at the same time. However, the current study focused on the relationships among the variables identified by social cognitive career theory (Lent et al., 1994) rather

than causality, and the direction of influence indicated in the path model was informed by theory.

Furthermore, all possible alternate or external influences may not have been accounted for in the design of this study. Other background characteristics and background contextual factors, such as stress, gender role socialization, and family support, other aspects of social identity, such as (dis)ability and sexual orientation, and the college environment variable of faculty support also may have influenced self-efficacy and achievement (Betz & Hackett, 1997; Byars & Hackett, 1998; Chung, 2001; Hackett et al., 1992; Hune, 1998; Nora & Cabrera, 1996; Park, 2002). In addition, since ethnicities were aggregated into regional groupings (with one multi-ethnic group) for ethnic group analysis, it is possible that important differences related to ethnicity were obscured. Moreover, this study was delimited to a specific portion of the social cognitive career theory model. Variables such as outcome expectations and performance goals and the corresponding paths were not tested. The influences of these constructs on the career development of Asian American women in STEM majors should be considered in future research.

Some general limitations of research using quantitative analysis also applied. Quantitative research tends to take a narrow perspective on individuals' experiences by isolating a few variables and controlling for other potentially confounding factors, rather than taking an approach that allows for a more holistic and realistic representation of the dynamic nature of life experiences (Creswell, 1998; Jayaratne & Stewart, 1991). The potential for finding trends within a larger population and the opportunity to generalize findings to the population of interest required a quantitative research design, with a larger

sample and a less intrusive research method in contrast to the smaller samples and more intrusive methods of qualitative research. However, since participant feedback is not a part of quantitative research designs, interpretations of findings primarily rely upon the researcher's perceptions. My perspective of academic career development for Asian American women in STEM may have been biased by my social identity as a White woman. At the same time, my own undergraduate educational experiences in mathematics and engineering and professional experiences in educational programs for women in STEM provided me with personal insights into the experiences of women in STEM in general. These potential biases (Campbell, 2002) were addressed by requesting a review of a draft discussion of results with three individuals who had first-hand or professional knowledge of Asian American women in STEM and the constructs of academic and career development, and requesting participants' comments on the survey instrument (Appendixes N and P). Notably, many comments provided by participants concerned the meaning of identifying culturally as Asian and/or American (see Appendix B for survey item). Collecting data from "unknown" participants required confidence that their interpretations of the instruments' items matched the intentions of the instruments. To address this limitation, validated instruments were selected for use and 12 individuals involved in testing the online survey instrument were asked to provide feedback on the survey and the meaning of item response options.

A related limitation was the adequacy of the measures used to capture the essence of the constructs in the path model. To minimize the potential impact of this limitation, operationalization of the theory's constructs was based on the theoretical and empirical literature. Instruments with established reliability and validity were selected to measure

the constructs and analysis of Cronbach alpha reliability estimates using data from the current research study provided information about the consistency of the measures. However, the lack of influence of compositional diversity and racial climate on the overall path model may have been related to the measures used. At .71, Cronbach alpha reliability for racial climate, measured by the Faculty and Classroom Behavior scale (Neal, 1992), indicated that the racial climate measure produced the least reliable scores of all the scales used in the current study. This may have indicated measurement error thereby underestimating the relationships between racial climate and other social cognitive variables in the path model (Kline, 2005). Other measures used in the study appeared to be reliable and valid indicators of the social cognitive career constructs they represented.

Limitations related to the sample included sample size, power, missing data, and non-response bias from this single-institution sample. Because a large sample was needed to meet analysis requirements for the current research study, the sample size may have become a limitation, particularly since ethnicity of participants was not known prior to data collection. With a response rate of 51%, each ethnic group met the minimum of 20 participants needed for adequate power for the proposed analyses (Cohen, 1992). However, through listwise deletion, only 15 participants in the Southeast Asian American group were included in one of the three MANOVA tests. Adequate power to observe statistically significant differences related to the Southeast Asian American group on academic peer support, gendered climate, and racial climate may have been lacking. For path analysis, the minimum 5:1 ratio of sample size to number of parameters was met (Bentler & Chou, 1987). However, the respecified model proposed in this study could not

be tested with a hold-out sample due to the sample size. The use of mean substitution for missing data values enabled use of the full data set and was recommended over listwise and pairwise deletion for path analysis, but this method may have distorted the distribution of data for each item (Kline, 2005).

In this single-institution study, close attention to the description of the population under study and the institutional climate is important for determining the applicability of the findings to similar populations at similar institutions. In this study, evidence was found of some bias related to non-response that may affect generalizability. Respondents had fewer college credits and stronger academic backgrounds, as indicated by higher high school and college GPA and higher SAT scores, than non-respondents. As these characteristics are related to academic and career development, these statistically significant differences may indicate that respondents and non-respondents also differed on other social cognitive career variables. Thus, the results may be influenced by non-response bias.

Implications for Policy and Practice

The findings from the current study are relevant for policy-makers and practitioners in higher education and STEM, including faculty, academic administrators, student affairs professionals, advocacy groups, and state and federal organizations, including state education departments and the National Science Foundation. This study provided new information on the academic and career development of Asian American undergraduate women who major in STEM. Results from this study may help bring issues of Asian American women in STEM into consideration for educational and policy decisions.

Results demonstrated that the academic achievement of Asian American women in STEM was related not only to past performance, background contextual factors, and academic self-efficacy, but also to academic support provided by peers and the gendered climate in college. In fact, the college environment factors of academic peer support and gendered climate had some of the strongest effects on self-efficacy in this research study, making them powerful contributors to Asian American women's academic and career development in STEM. Since campus climate is amenable to change, intentional efforts to improve the campus climate is a viable approach for institutions to positively influence the academic achievement of Asian American women in STEM on their campuses (Hurtado et al., 1999). Suzuki (2002), Hall and Sandler (1982), and Hurtado et al. offered comprehensive approaches to improving the climates for gender and racial diversity. These approaches included issuing policy statements; conducting evaluations of the institutional climate as viewed by different groups; increasing awareness and understanding of diversity and multiculturalism through student, staff, and faculty development workshops and training programs; creating structures and processes for collecting and disseminating information, monitoring diversity issues, and addressing grievances; enhancing admissions outreach efforts to under-represented subgroups; and changing teaching and learning processes to more collaborative environments, increased out-of-class interaction with faculty, and open dialogues across difference (Hall and Sandler; Hurtado et al.; Suzuki).

The racial and gendered climate in STEM as perceived by Asian American women is connected to interpersonal interactions with faculty, lab and teaching assistants, and administrators (Hurtado et al., 1999). Centers for women and minorities in science

and engineering can become welcoming spaces for Asian American women, where students may find the positive interactions with others that ultimately will help them succeed academically in STEM. For example, Brainard and Carlin (1998) found that the presence of a Women in Engineering program office was a positive influence on first-year persistence for female engineering students at the University of Washington, even if the students did not participate in programs offered by the office. The environment in STEM also is strongly influenced by interactions with peers (Astin, 1993; Hurtado et al., 1999), and Gloria and Ho (2003) found that peer support from friends was a significant positive influence on the academic persistence of Asian American college students. In the current study, academic peer support had a significant effect on academic self-efficacy and achievement for Asian American women in STEM. Two examples of interventions practitioners can use to increase the self-efficacy and achievement of Asian American women in STEM through peer interaction include (a) offering opportunities for structured interaction, such as peer mentoring programs; and (b) encouraging students to seek out peer support informally or through participation in academically-related student organizations.

Programmatic and research resources are often geared towards the STEM disciplines in which groups continue to be under-represented (e.g., National Science Foundation, 2003b). Since Asian American students are considered over-represented in all STEM fields (Betz, 1997, *Land of Plenty*, 2000), and undergraduate women participate in the life sciences at a rate equitable to men (National Science Foundation, 2004), support for undergraduate Asian American women in the life sciences, in particular, may be neglected. Contrary to hypothesized expectations in the current study,

Asian American women in majors with large proportions of female students, including the life sciences, tended to report less academic peer support than those in majors with smaller proportions of female students. As “one in a crowd” of women, Asian American women may feel more marginalized because they are not identified for support, or because other aspects of their identity, such as race, may become more salient in a predominantly female and White environment (Andersen & Collins, 2001; Deaux & Ethier, 1998; Hurtado et al., 1999). Additional support services for Asian American women who major in life sciences should be considered, particularly since the majority of Asian American women in the current study (61%) majored in the life sciences, and nationally, 46% of Asian American women in STEM are in the biological sciences (National Science Foundation, 2004).

This finding and subsequent implication for policy and practice is a direct challenge to the prevailing diversity discourse in STEM education on the under-representation of social groups (Rosser, 1997). The historical legacy of creating statistical categories of “women and minorities in STEM” and focusing policy and research attention on under-represented groups has limited the study of Asian American students who have been considered over-represented (Lucena, 2000). Continued under-representation over the past 30 years highlights the critical need to understand and address the causes of under-representation so that all individuals interested in STEM have the opportunity to participate equitably (Betz, 1997; Rosser, 1997). Under-representation also affects the quality of STEM research and products (National Science Foundation, 2003b; Sonnert, 1999). However, it also is critical to understand STEM diversity in terms of the experiences and contextual impacts on individuals who are participating in STEM.

Practice and policy, then, can be informed by a broader understanding of diversity in STEM, leading to support and change that is connected not only to under-representation but also to educational needs.

In this research study, a positive climate for gender and greater academic peer support were related to higher levels of academic self-efficacy, which was a conduit for the influence of many other social cognitive career variables on the achievement of Asian American women in STEM. Confidence in one's ability to perform tasks essential to academic success in STEM (Lent et al., 1986), therefore, is essential to academic and career development for these students. Career counselors can work to increase students' self-efficacy by interventions developed through the four sources of efficacy information: performance accomplishments, vicarious experience, verbal persuasion, and emotional arousal (Bandura, 1977; Betz, Harmon, & Borgen, 1996). Examples include providing structured opportunities for successful performance accomplishments, such as enrolling in skill development workshops and enlisting students as peer tutors in STEM courses; introducing students to and encouraging their interaction with successful peer mentors and role models; helping students develop methods for identifying their academic needs; and providing encouragement and support for students' performance and achievement in STEM (Betz, 1992).

As a form of performance accomplishments in the current research study, higher grades in high school were significantly related to higher levels of academic self-efficacy and higher semester grades in college. This finding reinforces the vital contribution of past performance on academic and career development both directly and indirectly through self-efficacy (Robbins et al., 2004). High school achievement appears to help

pave the way to college success for Asian American women in STEM. However, Peng and Wright (1994) found that Asian American students were underperforming in 8th grade reading and math achievement in comparison to their White peers in similar socioeconomic and home educational environments. The prevailing notions of the model minority myth (Suzuki, 2002; Woo, 2001) and the myth that all Asian American students are “good” in math and science (Hune, 1998; Suzuki) obscure this disparity.

Also, Hmong Americans, Laotian Americans, and Pacific Islander Americans have low levels of college participation and completion, especially in STEM (Chinn, 1999; Espiritu, 1997; Hune, 2002; National Science Foundation, 2003a), and students from these ethnic backgrounds were not participants in the current study. Again, the issues and needs of Asian American students who are not attaining successful educational outcomes are obscured by the model minority and “good” in math and science stereotypes (Hune, 1998; Suzuki, 2002; Woo, 2001). Furthermore, these stereotypes ignore within group variance in achievement among individuals of East Asian American and South Asian American ethnic backgrounds that have higher average levels of achievement and ignore disparities between Whites and Asian Americans in the socioeconomic and occupational advancement benefits of education (Muller et al., 2001; Suzuki, 2002). The significant effects of acculturation and socioeconomic status on academic self-efficacy and achievement in the current study also discount the presumption of cultural uniformity of women from Asian ethnic backgrounds (Espiritu, 1992; Kim et al., 1998; Nomura, 2003). Educators should become aware of and continue to explore differences in level of high school academic preparation and self-efficacy among subpopulations of Asian American women to address obstacles that may limit

some individuals and subgroups from entering, persisting, and achieving in STEM programs. A better understanding of how the high school environment supports or hinders the achievement of Asian American women in high school and beyond is needed.

In the current study, students who strongly maintained aspects of their Asian culture were likely to have higher academic self-efficacy but lower achievement. Maintenance of Asian culture may include responsibilities to family, such as marriage, traditional customs, working in the family business, and meeting high expectations of parents (Hune, 1998; Srinivasan, 2001). Expectations from parents for students' persistence and achievement in STEM may provide a source of self-efficacy information that increases their confidence in STEM-related tasks through verbal persuasion (Byars & Hackett, 1998), but family responsibilities also may cause stress related to conflicting messages (Hune; Park, 2002; Srinivasan) and reduce the time available for studying which may limit achievement. Other aspects of Asian acculturation also may influence these dynamics. For example, students with high Asian acculturation may be hesitant to seek assistance, and academic support centers may not be culturally-sensitive to these students needs (Helms & Cook, 1999; Suzuki, 2002).

The relationship between higher Asian acculturation and lower achievement was tempered by higher academic self-efficacy for students with higher Asian acculturation. At the same time, the results demonstrated that lower Asian acculturation was related to higher achievement, and this relationship was tempered by lower academic self-efficacy. The combination of these results suggests that interventions to increase students' self-efficacy can benefit their academic achievement. Interventions that support and nurture students' Asian cultural identity may be quite effective. Furthermore, incorporating a

family perspective may be a deviation from traditional methods of counseling that focus primarily on an individual's problems, preferences, interests, and choice (Brown, 1994; Helms & Cook, 1999), but may be culturally relevant for the academic and career development of many Asian American students and women (Kodama, McEwen, Liang, & Lee, 2002). Counselors or advisors working with an Asian American woman majoring in STEM may encourage this student to explore potential conflicts she may perceive between family expectations and personal interests, and assist her in discovering healthy ways to balance her family and academic responsibilities.

On the other hand, Asian American women with higher levels of adherence to dominant U.S. culture were more likely in the current study to have lower self-efficacy for STEM and lower achievement. However, the significant positive indirect effect of American acculturation on academic self-efficacy through academic peer support that was proposed by results from this research study may have the potential to counterbalance these negative effects. Interventions to increase academic peer support and academic self-efficacy, such as offering opportunities for structured peer interaction and providing encouragement and support for students' performance and achievement in STEM (Betz, 1992), may be particularly powerful for Asian American women in STEM who strongly adhere to dominant American culture.

Recommendations for Theory and Future Research

This study built upon existing theory and research, contributing to the literature regarding gender and race, self-efficacy and achievement, and climate within STEM education. The inclusion of climate and other college environment variables in social cognitive career development contributed to and enhanced the research regarding social

cognitive career theory, as contextual factors have not been considered to the extent that other aspects of social cognitive career theory have been addressed in the research literature (Byars & Hackett, 1998; Hackett, 1997; Lent et al., 2000). Furthermore, this research study assessed the relevance and utility of social cognitive career theory in explaining the processes of academic and career development for Asian American women. Tang et al. (1999) used social cognitive career theory to study the career choices of Asian American women and men, but did not conduct a gender analysis of their data. Vogt (2003) analyzed social cognitive models by gender, but did not include race as a variable in the study's research design even though the sample included a sufficient number of Asian American and White men and women. Byars and Hackett (1998) hypothesized relationships between variables in social cognitive career theory for Asian American women, but the hypothesized relationships had not been empirically researched. The current research study focused on race and gender simultaneously for Asian American women, and also considered differences among Asian American women of different Asian ethnicities, socioeconomic status levels, and levels of acculturation.

The initial theoretical model derived from social cognitive career theory (Lent et al., 1994) was not a good fit for the data in the current research study of undergraduate Asian American women in STEM, but the major theoretical propositions of social cognitive career theory were maintained in respecification of the model. As in Tang et al. (1999), when culturally specific variables, particularly acculturation and environment variables related to discrimination, embellished the social cognitive career model, the process through which self-efficacy relates to career outcomes was found in the current study to have cultural validity for Asian American women in STEM (Leong & Hardin,

2002). The respecified model was considered a good fit, and exploratory results showed that the model explained 36% of semester grade point average and 28% of academic self-efficacy.

The nature of the relationships among culturally specific variables within the model, however, requires further study. Testing the respecified model in the current study would provide new evidence regarding the relationships from background contextual factors to proximal environment variables and the relationships among proximal environment variables that were proposed in the new model. Continued integration of theories of college impact, such as Tinto's (1993) theory of persistence and Astin's (1993) theory of involvement, into models derived from social cognitive career theory (Lent et al., 1994) may provide an even more robust understanding of both the psychosocial and college environment processes involved in the academic and career development of Asian American women in STEM. A new study also may consider alternate measures of the proximal environment to better understand the interlocking aspects of the gendered racial climate perceived and experienced by Asian American women in STEM.

Replication of the study is needed to empirically test the suggested respecified model with a new sample to verify its cultural validity. Studies that evaluate the new model for Asian American ethnic groups separately and involving ethnic groups that were not included in the current study are strongly recommended. By evaluating the social cognitive career model separately, variables that are culturally specific to particular Asian American ethnic groups, but may not apply to all Asian American ethnic groups, may be considered (Leong & Hardin, 2002). Leong and Hardin also recommended

research studying the addition of other culturally specific variables in social cognitive career theory, including values of individualism and collectivism, independent and interdependent behaviors, and filial piety.

Findings from the current study also suggest the need for a better understanding of acculturation and its influence on the academic and career development of Asian American women in STEM. The use of a bidimensional measure of acculturation in the current study was an improvement over the use of unidimensional models, and the relationships from Asian acculturation and American acculturation to other social cognitive variables were found to be quite complex. The use of this measure, however, highlighted the need to better account for the acculturative experiences of Asian Americans in academic and career development. First, a measure designed specifically for Asian American populations and accounts for potential differences in acculturative processes by generation status in the U.S. is recommended. Furthermore, the use of a measure that incorporates acculturation to Asian American culture is recommended. Future research endeavors should consider utilizing the AAMAS developed by Chung, Kim, and Abreu (2004) to assess acculturation in reference to individuals' culture of origin, to European Americans, and to other Asian Americans. The influence of adherence to Asian American culture in the academic and career development of all Asian Americans, and Asian American undergraduate women in STEM in particular, will improve the empirical understanding of the psychosocial processes involved between acculturation and academic and career development.

Another recommendation is to explore the academic and career development of Asian American women in STEM by their major field. In the current study,

compositional diversity measures of the proportions of Asian Americans and women in a student's major were not related to the racial and gendered climates, but the proportion of women in a student's major was significantly related to academic peer support. An evaluation of the social cognitive career model either by college of major (e.g., life sciences, engineering, etc.) or by the proportion of women in the major warrants further study. Furthermore, continued testing of the relationships between compositional diversity measures and other aspects of the climate will make a significant contribution to both the social cognitive career literature and the college impact literature. Understanding how undergraduate Asian American women experience compositional diversity in their STEM academic experiences, at different levels of the STEM environment, is an important area for future study.

Lastly, future research incorporating alternative research designs is recommended. First, results from a multi-institution study may generalize to a broader population. A multi-institution study would provide a larger sample, avoiding some of the sample size limitations in the current study. In a multi-institutional study that included students from institutions in several different geographic locations, ethnic group analysis would not be limited by the ethnic composition of Asian Americans at any one institution. Second, a study of a model that incorporates other social cognitive career variables that were not included in the current study is recommended in order to understand the roles of outcome expectations and performance goals in the academic achievement of Asian American women in STEM. Third, a longitudinal design is suggested in future research to determine causal relations among constructs of social cognitive career development of undergraduate Asian American women in STEM.

This study attempted to infuse the theoretical foundation of social cognitive career theory (Lent et al., 1994) with college environment variables identified in the college impact literature. The initial model in the current study was developed based on social cognitive career theory, its critiques and application to Asian American women in STEM (Byars & Hackett, 1998; Greenstein, 2000; Leong & Chou, 1994; Tang et al., 1999), a framework of institutional climates for diversity (Hurtado et al., 1999), and prior research on peer interaction and college outcomes (Astin, 1993; Pascarella & Terenzini, 1991, 2005). Respecification of the model relied upon college impact theories of persistence (Tinto, 1993) and involvement (Astin). In a meta-analysis of the influence of psychosocial and study skill factors on college outcomes, Robbins et al. (2004) included research studies based upon theories of motivation from the psychology field and theories of persistence from the education field. The conclusions from Robbins et al.'s study supported the benefits of both theoretical perspectives and recommended continued integration of variables in future studies of college outcomes. Continued integration of these theoretical frameworks may lead to greater understanding of the dynamic interaction of psychosocial, interpersonal, contextual, and environment factors in the academic and career development of Asian American undergraduate women who major in science, engineering, and mathematics.

Appendix A: Background Information

Please indicate the extent of your involvement in the following activities and groups.

	Not at all				Very much
	1	2	3	4	5
1. Informal study groups	1	2	3	4	5
2. Support services/organizations for women (e.g. Women in Engineering, Society of Women Engineers, Association for Women in Mathematics, Organization of Multicultural Women, etc.)	1	2	3	4	5
3. Asian American or other racial/ethnic clubs/organizations (e.g., Asian American Student Union, Indian Students Association, STAND (Science & Technology: Addressing the Need for Diversity in CMPS), Asian Engineering Student Association (AESAs), etc.)	1	2	3	4	5
4. Clubs/organizations/societies related to your major (e.g., honor societies, College Park Scholars, Pre-Dental Society, AGNR Student Council, peer mentoring, etc.)	1	2	3	4	5
5. Other campus clubs/organizations/events (religious, sports, sororities, arts/theater, service, etc.)	1	2	3	4	5

1. What is your gender? (select one)

1. Male
2. Female

2. In what year were you born? _____

3. Please indicate your citizenship status. (select one)

1. Born in the U.S.
2. Foreign born, naturalized U.S. citizen
3. Foreign born, resident alien/permanent resident of the U.S.
4. International student, with visa
5. Other (please specify): _____

4. Please select the responses that best apply to your race/ethnicity. (select all that apply)

1. African American/Black (not of Hispanic origin)
2. Asian or Pacific Islander/Asian American (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. Race/ethnicity not included above. Please describe: _____

5. Please indicate the responses that best apply to your ethnic background. (select all that apply)

1. Chinese
2. Filipino
3. Japanese
4. Korean
5. Asian Indian
6. Pakistani

7. Bangladeshi
8. Sri Lankan
9. Nepalese
10. Vietnamese
11. Hmong
12. Lao
13. Cambodian
14. Indonesian
15. Thai
16. Malaysian
17. Singaporean
18. Other Asian or Pacific Islander. Please describe: _____

6. What generation are you? (select the generation that best applies to you:)

1. 1st Generation = I was born in Asia or country other than U.S. (*follow-up Question 6a*)
2. 2nd Generation = I was born in U.S., either parent was born in Asia or country other than U.S.
3. 3rd Generation = I was born in U.S., both parents were born in U.S., and all grandparents born in Asia or country other than U.S.
4. 4th Generation = I was born in U.S., both parents were born in U.S., and at least one grandparent born in Asia or country other than U.S. and one grandparent born in U.S.
5. 5th Generation = I was born in U.S., both parents were born in U.S., and all grandparents also born in U.S.
6. Don't know what generation best fits since I lack some information.

6a. At what age did you first arrive in the United States, either to live or for school? _____

7. Where do you live now?

1. Own a house or condominium
2. Home of parents or relatives
3. Off-campus rental house or apartment
4. Sorority or fraternity housing
5. On-campus in a university apartment or residence hall
6. Other (please specify) _____

8. What is your current academic level?

1. First-year student (Freshman)
2. Sophomore
3. Junior
4. Senior

9. Did you transfer into the University of Maryland from another college or university?

1. No
2. Yes

10. How many semesters have you been at the University of Maryland? _____

11a. Is your major (or one of your majors) in the College of Agriculture and Natural Resources?

1. No
2. Yes

11a. Please indicate your major(s)/degree program(s) in Agriculture and Natural Resources. (select all that apply)

1. Agricultural and Resource Economics
(Business Management, Environmental and Resources Policy, Food Production, International Agriculture, Political Process)
2. Animal and Avian Sciences

- (Animal Sciences, Animal Management and Industry, Equine Studies, Laboratory Animal Management, Pre-Professional Sciences/Veterinary Medicine)
- 3. Biological Resources Engineering (joint program with Engineering)
(Biological Resources Engineering, Natural Resources Management, Land and Water Resource Management, Environmental Education and Park Management, Plant and Wildlife Resource Management)
- 4. Environmental Science and Policy (joint program with Life Sciences & CMPS)
(Environment and Agriculture, Environmental Economics, Environmental Mapping and Data Management, Environmental Restoration, Soil, Water and Land Resources, Wildlife Resources and Conservation)
- 5. Natural Resource Sciences and Landscape Architecture
(General Agricultural Sciences, Landscape Architecture, Natural Resource Sciences, Conservation of Soil, Water and Environment, Horticulture and Crop Production, Landscape Management, Plant Sciences, Turf and Golf Course Management, Urban Forestry)
- 6. Nutrition and Food Science
(Dietetics, Food Science, Nutritional Science)
- 7. Institute of Applied Agriculture
(Equine Business Management, Golf Course Management, Landscape Management, Ornamental Horticulture, Turfgrass Management)

11b. Is your major (or one of your majors) in the College of Computer, Mathematical and Physical Sciences?

- 1. No
- 2. Yes

11b. Please indicate your major(s)/degree program(s) in Computer, Mathematical and Physical Sciences. (select all that apply)

- 1. Astronomy
- 2. Computer Engineering
- 3. Computer Science
- 4. Environmental Science and Policy (joint with Life Sciences & Agriculture)
- 5. Geology
- 6. Mathematics
(including Secondary Education track and Statistics track)
- 7. Meteorology
- 8. Physics
(including Professional Physics track, Meteorology Physics track, Education Physics track)
- 9. Physical Sciences
(including Meteorology Specialization, Science Journalism Specialization)

11c. Is your major (or one of your majors) in the School of Engineering?

- 1. No
- 2. Yes

11c. Please indicate your major(s)/degree program(s) in Engineering. (select all that apply)

- 1. Aerospace Engineering
- 2. Bachelor of Science in Engineering: Engineering option
- 3. Bachelor of Science in Engineering: Applied Science option
- 4. Biological Resources Engineering (joint program with Agriculture)
- 5. Chemical Engineering
- 6. Civil and Environmental Engineering
- 7. Computer Engineering
- 8. Electrical Engineering
- 9. Fire Protection Engineering
- 10. Materials Science and Engineering
- 11. Mechanical Engineering

12. Nuclear Engineering
13. Engineering Undecided

11d. Is your major (or one of your majors) in the College of Life Sciences?

1. No
2. Yes

11d. Please indicate your major(s)/degree program(s) in Life Sciences. (select all that apply)

1. Biochemistry
2. Biological Sciences
(including Individualized Studies, Cell Biology & Genetics, Ecology & Evolution, General Biology, Microbiology, Physiology & Neurobiology, Zoology, with Secondary Education Double Major, and at Shady Grove Center)
3. Chemistry
4. Environmental Science and Policy (joint program with Agriculture & CMPS)
5. Pre-Medicine/Pre-Dentistry/Pre-Professional

11e. Is one of your majors in another college (such as Business, Education, BSOS) at the University of Maryland?

1. No
2. Yes. Please describe: _____

12a. Do you have any comments about any of the questions or topics on this survey?

12b. Is there anything else you want to share?

Appendix B: Language, Identity, and Behavioral Acculturation Scale

We're interested in learning about your perceptions of your language competency in both an Asian language and English. For the following items, please select the response that corresponds with your language ability, speaking, and comprehension.

	Not at all		Very well	
How would you rate your ability to speak <i>the Asian language of your ancestry/heritage</i> (e.g., <i>Chinese, Vietnamese, Hindi, etc.</i>):				
1. with family	1	2	3	4
2. with Asian friends	1	2	3	4
2. on the phone	1	2	3	4
4. with strangers	1	2	3	4
5. overall	1	2	3	4
How well do you understand <i>the Asian language of your ancestry/heritage</i> (e.g., <i>Chinese, Vietnamese, Hindi, etc.</i>):				
6. on TV or at the movies	1	2	3	4
7. in newspapers or in magazines.....	1	2	3	4
8. in songs	1	2	3	4
9. overall	1	2	3	4
How well can you write in <i>the Asian language of your ancestry/heritage</i> (e.g., <i>Chinese, Vietnamese, Hindi, etc.</i>)?	1	2	3	4
How would you rate your ability to speak <i>English</i> :				
10. at school.....	1	2	3	4
11. with American friends	1	2	3	4
12. on the phone	1	2	3	4
13. with strangers	1	2	3	4
14. overall.....	1	2	3	4
How well do you understand <i>English</i> :				
15. on TV or at the movies.....	1	2	3	4
16. in newspapers or in magazines	1	2	3	4
17. in songs	1	2	3	4
18. overall	1	2	3	4
How well can you write in <i>English</i> ?	1	2	3	4

We are interested in learning about your identification with your ethnic background. In this study, "Asian American" refers to all whose ancestry/heritage can be traced to Asia (East Asia, Indian subcontinent, Southeast Asian, the Pacific Islands, etc.). We would like to know the extent to which you consider yourself American and Asian (that is, Chinese, Vietnamese, Indian, Sri Lankan, etc.). We realize that you also may have a background other than Asian. Please answer the questions below concerning your ethnic identity.

	Not at all		Very Much	
1. I think of myself as being <i>American</i>	1	2	3	4
2. I feel good about being <i>American</i>	1	2	3	4
3. Being <i>American</i> plays an important part in my life.....	1	2	3	4
4. I feel that I am part of <i>American</i> culture	1	2	3	4
5. If someone criticizes <i>Americans</i> , I feel they are criticizing me	1	2	3	4

6. I have a strong sense of being <i>American</i>	1	2	3	4
7. I am proud of being <i>American</i>	1	2	3	4
8. I think of myself as being <i>Asian</i> (e.g. <i>Chinese, Vietnamese, Indian, Sri Lankan, etc.</i>).....	1	2	3	4
9. I feel good about being <i>Asian</i>	1	2	3	4
10. Being <i>Asian</i> plays an important part in my life	1	2	3	4
11. I feel that I am part of <i>Asian</i> culture	1	2	3	4
12. If someone criticizes <i>Asians</i> , I feel they are criticizing me	1	2	3	4
13. I have a strong sense of being <i>Asian</i>	1	2	3	4
14. I am proud that I am <i>Asian</i>	1	2	3	4

We are interested in how much you take part in American and Asian (e.g. Chinese, Vietnamese, Indian, Sri Lankan, etc.) activities. Please select the response that indicates to what extent the following statements are true about things that you do.

	Not at all			Very much
How much do you speak <i>English</i> :				
1. at home?	1	2	3	4
2. at school?	1	2	3	4
3. with friends?.....	1	2	3	4

How much do you:				
4. read <i>American</i> books, newspapers, magazine?	1	2	3	4
5. listen to <i>American</i> songs?	1	2	3	4
6. watch <i>American</i> movies (on TV, VCR, etc)?	1	2	3	4
7. eat <i>American</i> food?	1	2	3	4
8. have <i>American</i> friends?	1	2	3	4
9. attend <i>American</i> clubs or parties?	1	2	3	4
10. participate in <i>American</i> community activities?	1	2	3	4
11. participate in <i>American</i> religious services?	1	2	3	4

How much do you speak <i>the Asian language of your ancestry/heritage</i> (e.g., <i>Chinese, Vietnamese, Hindi, etc.</i>):				
12. at home?	1	2	3	4
13. at school?	1	2	3	4
14. with friends?	1	2	3	4

How much do you:				
15. read <i>Asian</i> books, newspapers, or magazines?	1	2	3	4
16. listen to <i>Asian</i> songs?	1	2	3	4
17. watch <i>Asian</i> movies (on TV, VCR, etc)?	1	2	3	4
18. eat <i>Asian</i> food?	1	2	3	4
19. have <i>Asian</i> friends?	1	2	3	4
20. attend <i>Asian</i> clubs or parties?	1	2	3	4
21. participate in <i>Asian</i> community activities?	1	2	3	4
22. participate in <i>Asian</i> religious services?	1	2	3	4

23. The following statements describe how you think of yourself **culturally overall with respect to Asian and American cultures**. Please choose the best description of yourself with respect to these two cultures.

If none apply, please use option “5” and explain how you see yourself.

1. I consider myself more Asian than American overall.
2. I consider myself more American than Asian overall.
3. I feel Asian and American about equally.
4. I feel I don't really belong to either Asian or American culture.
5. None of the above (Please explain) _____

Appendix C: Socioeconomic Status

Please answer the following items about your family.

- 1. Which of the following best describes your mother's highest educational attainment?**
 1. High school or less
 2. Some college
 3. Associate's degree
 4. Bachelor's degree
 5. Master's, Doctorate or professional degree (JD, MD, PhD)

- 2. Which of the following best describes your father's highest educational attainment?**
 1. High school or less
 2. Some college
 3. Associate's degree
 4. Bachelor's degree
 5. Master's, Doctorate or professional degree (JD, MD, PhD)

- 3. Which of the following best describes your mother's current occupational status?**
 1. Unemployed/not working
 2. Manual laborer
 3. Service worker
 4. Skilled worker
 5. Professional or top administrator

- 4. Which of the following best describes your father's current occupational status?**
 1. Unemployed/not working
 2. Manual laborer
 3. Service worker
 4. Skilled worker
 5. Professional or top administrator

- 5. What do you perceive to be the socioeconomic status of your family?**
 1. Lower class
 2. Lower-middle class
 3. Middle class
 4. Upper-middle class
 5. Upper class

Appendix D: Gender Discrimination Scale

Please indicate the degree to which you agree with the following statements regarding your EXPERIENCES IN SCIENCE, MATH, AND ENGINEERING COURSES:

	Not at all true				Very true
1. It seems that my male peers in my science, math, or engineering program respect me as an equal.*	1	2	3	4	5
2. I have been made to feel inferior in science, math, or engineering by a male research/teaching assistant.	1	2	3	4	5
3. I remember a time when I felt discouraged in an interaction with my professor.	1	2	3	4	5
4. The science, math, and engineering faculty is fair in the treatment of all students.*	1	2	3	4	5
5. I have been made to feel inferior in science, math, or engineering by my faculty.	1	2	3	4	5
6. Sometimes, I am uncomfortable asking male faculty about coursework.	1	2	3	4	5
7. Overall, males in science, math, or engineering classrooms have an advantage in their access to faculty for special projects.	1	2	3	4	5
8. In my opinion, my professors have made less time for me outside of class than my male peers.	1	2	3	4	5
9. In general, the male faculty seems supportive of female students in my science, math, or engineering program.*	1	2	3	4	5

Note. Asterisks indicate reverse-scored items.

Appendix E: Faculty and Classroom Behavior Scale

Please indicate your perception of the extent that faculty, teaching assistants, or graduate assistants demonstrate the following actions in the classroom.

	Strongly Disagree			Neutral		Strongly Agree
	1	2		3	4	5
1. Extend deadlines...	1	2		3	4	5
2. Refer students for counseling or tutorial services...	1	2		3	4	5
3. Accept suggestions for changes in course content or teaching style from all students...	1	2		3	4	5
4. Interact well with students of all races/nationalities...	1	2		3	4	5
5. Use objective evaluations...	1	2		3	4	5
6. Use subjective evaluations...	1	2		3	4	5
7. Show personal interest...	1	2		3	4	5
8. In class, call on students of all races/nationalities...	1	2		3	4	5
9. Single out students of all races/nationalities for praise...	1	2		3	4	5
10. Single out students of all races/nationalities for censure...	1	2		3	4	5
11. Provide a clear understanding of what is required to be successful in course work to all students...	1	2		3	4	5
12. Have lower performance expectations for students of my race/nationality...	1	2		3	4	5
13. Have higher performance expectations for students of my race/nationality...	1	2		3	4	5
14. Advise students without regard to race/nationality...	1	2		3	4	5

Please indicate your perception of the extent to which each of the following conditions exists on your campus.

	Strongly Disagree			Neutral		Strongly Agree
	1	2		3	4	5
15. Racial sensitivity and tolerance in the classroom by:						
a) racial minority students...	1	2		3	4	5
b) White students...	1	2		3	4	5
c) racial minority faculty...	1	2		3	4	5
d) White faculty...	1	2		3	4	5
16. Course content and forums which attempt to reflect contributions of all races/nationalities...	1	2		3	4	5

Appendix F: Interactions with Peers Scale

Please indicate the extent to which you disagree or agree with the following statements:

	Strongly Disagree				Strongly Agree
1. Since coming to this university I have developed close personal relationships with other students	1	2	3	4	5
2. The student friendships I have developed at this university have been personally satisfying	1	2	3	4	5
3. My interpersonal relationships with other students have had a positive influence on my personal growth, attitudes, and values	1	2	3	4	5
4. My interpersonal relationships with other students have had a positive influences on my intellectual growth and interest in ideas	1	2	3	4	5
5. It has been difficult for me to meet and make friends with other students*	1	2	3	4	5
6. Few of the students I know would be willing to listen to me and help me if I had a personal problem*	1	2	3	4	5
7. Most students at this university have values and attitudes different from my own*	1	2	3	4	5

Note: Asterisks indicate reverse-scored items.

Appendix G: Academic Milestones Self-Efficacy Scale

How much confidence do you have in your ability to:

	No Confidence At All			Some Confidence			Complete Confidence			
	0	1	2	3	4	5	6	7	8	9
1. Complete the math requirements for your major with grades of B or better	0	1	2	3	4	5	6	7	8	9
2. Complete the chemistry requirements for your major with grades of B or better	0	1	2	3	4	5	6	7	8	9
3. Complete the physics requirements for your major with grades of B or better	0	1	2	3	4	5	6	7	8	9
4. Remain enrolled in your science, math or engineering major over the next semester	0	1	2	3	4	5	6	7	8	9
5. Remain enrolled in your science, math or engineering major over the next <u>two</u> semesters	0	1	2	3	4	5	6	7	8	9
6. <u>Excel</u> in your science, math or engineering major over the next semester	0	1	2	3	4	5	6	7	8	9
7. <u>Excel</u> in your science, math or engineering major over the next <u>two</u> semesters	0	1	2	3	4	5	6	7	8	9
8. Complete the upper level required courses in your science, math or engineering major with an overall grade point average of B or better	0	1	2	3	4	5	6	7	8	9
9. Perform competently in a scientific, mathematical, or engineering career field	0	1	2	3	4	5	6	7	8	9

Appendix H: Invitation to Participate

DATE SENT: Thursday, February 10, 2005

SUBJECT LINE: University of Maryland Survey and Prize Drawing!!!

Dear [FirstName],

You have been selected to participate in a survey at the University of Maryland about the experiences of science, math, or engineering undergraduate students whose ancestry/heritage can be traced to Asia (e.g.: East Asia, Indian subcontinent, Southeast Asia, and the Pacific Islands). It will take about 15 minutes to complete the survey. To participate, please access this website:

[SurveyLink]

The survey will be available until Friday, March 4. As a small token of appreciation for your response to the survey, you can enter a prize drawing for gift cards to the campus bookstore or to IKEA home goods store. Six \$20 gift cards, two \$50 gift cards and one \$75 gift certificate will be given away!

Your participation is very important because your responses will be contributing to research on an important topic. You can help us understand the needs and successes of Asian American students who major in science, math, or engineering. Thank you for helping with this study, which is part of my doctoral dissertation in the College of Education at the University of Maryland. If you have any questions or concerns, please do not hesitate to contact me or my faculty advisor. Our contact information is below.

Sincerely,

Kristen Vogt
Graduate Student
University of Maryland
kvogt@umd.edu
(301) 257-4854

Faculty Advisor
Dr. Marylu McEwen
Department of Counseling and Personnel Services
University of Maryland
mmcewen@umd.edu
(301) 405-2871

Please note: If you do not want further emails about this survey, please click the link below, and you will be automatically removed from our mailing list.

[RemoveLink]

Appendix I: First Reminder Electronic Mail Message

DATE SENT: Tuesday, February 15, 2005

SUBJECT LINE: University of Maryland Survey and Prize Drawing!!!

Dear [FirstName],

Last week, you were sent an e-mail message inviting you to participate in a survey about the experiences of science, math, and engineering majors at the University of Maryland whose ancestry/heritage can be traced to Asia (e.g.: East Asia, Indian subcontinent, Southeast Asia, and the Pacific Islands). Please consider taking about 10-15 minutes to complete the survey by going to this website:
[SurveyLink]

Remember, the survey will be available until Friday, March 4 and when you complete it, you can enter a prize drawing for gift cards to the campus bookstore or to IKEA home goods store. Six \$20 gift cards, two \$50 gift cards and one \$75 gift certificate will be given away!

If you had difficulty accessing the website or completing the survey, please let me know at kvogt@umd.edu or (301) 257-4854.

Please know that your responses are confidential. Your participation is very important because your responses will provide valuable information about the experiences of Asian American students in science, math, and engineering. If you have any questions or concerns, please contact me or my faculty advisor.

Thank you for helping with this research study. Sincerely,
Kristen Vogt
Graduate Student
University of Maryland
kvogt@umd.edu
(301) 257-4854

Faculty Advisor
Dr. Marylu McEwen
Department of Counseling and Personnel Services
3214 Benjamin, University of Maryland
mmcewen@umd.edu
(301) 405-2871

Please note: If you do not wish to receive further emails about this survey, please click the link below, and you will be automatically removed from our mailing list.
[RemoveLink]

Appendix J: Second Reminder Electronic Mail Message

DATE SENT: Tuesday, February 22, 2005

SUBJECT LINE: REMINDER: UMD Survey and Prize Drawing!

Dear [FirstName],

There is only one week left to participate in a survey about your experiences as a science, math, or engineering major and enter the prize drawing for gift cards to the campus bookstore or to IKEA home goods store! Please follow this link:

[SurveyLink]

Remember, it will only take 10-15 minutes.

If you have any questions or concerns, please contact me or my faculty advisor. If you had difficulty completing the survey, please contact me at kvogt@umd.edu or (301) 257-4854.

The survey will be available until Friday, March 4. Thank you for helping with this research study!

Kristen Vogt
Graduate Student
University of Maryland
kvogt@umd.edu
(301) 257-4854

Faculty Advisor
Dr. Marylu McEwen
Department of Counseling and Personnel Services
3214 Benjamin, University of Maryland
mmcewen@umd.edu
(301) 405-2871

Please note: If you do not wish to receive further emails about this survey, please click the link below, and you will be automatically removed from our mailing list.

[RemoveLink]

Appendix K: Third Reminder Electronic Mail Message

DATE SENT: Tuesday, March 1, 2005

SUBJECT LINE: Only 3 days left UMD Survey and Prize Drawing (last reminder)

Dear [FirstName],

There are only 3 days left to complete the survey about your experiences as a science, math, or engineering major! The survey will end after this Friday March 4. For more information, go to:
[SurveyLink]

Remember, you can enter a prize drawing for gift cards to the campus bookstore or to IKEA home goods store. Six \$20 gift cards, two \$50 gift cards and one \$75 gift card will be given away...almost \$300 in prizes!

Your participation is very important because your responses will provide valuable information about the experiences of Asian American students in science, math, and engineering. Thank you for helping with this research study.

Sincerely,
Kristen Vogt
Graduate Student
University of Maryland
kvogt@umd.edu
(301) 257-4854

Faculty Advisor
Dr. Marylu McEwen
Department of Counseling and Personnel Services
3214 Benjamin, University of Maryland
mmcewen@umd.edu
(301) 405-2871

To access your partially-completed survey, use the link in the previous e-mail you used. Otherwise, please follow this link to complete the survey:
[SurveyLink]

Appendix L: Informed Consent

Science, Mathematics, and Engineering Experiences

Welcome!

Before you begin, please review this page. It contains information on your rights as a participant.

- By answering "Yes" to the Consent question below, you state that you are over 18 years of age and wish to participate in a program of research being conducted by Kristen Vogt under the faculty advisement of Dr. Marylu McEwen in the Department of Counseling and Personnel Services at the University of Maryland, College Park.
- The purpose of this research study is to study the academic experiences of Asian American undergraduate students who major in science, math, or engineering. For the purposes of this study, "Asian American" refers to all whose ancestry/heritage can be traced to Asia (e.g.: East Asia, Indian subcontinent, Southeast Asia, and the Pacific Islands).
- If you choose to participate in this research study, you will be asked to complete a survey about your current experiences as a science, math, or engineering major. It will take approximately 10-15 minutes to complete.
- For the purpose of understanding your collegiate experiences as a whole, some of your demographic records and grades will be obtained from the university and merged with your responses to this survey.
- Be assured that all information collected in this study is confidential. Reports and presentations of the study will be based on grouped data and will not reveal your identity or your individual records. Data will be stored on a private computer owned by the student researcher and will be password protected.
- Due to the public nature of the Internet, SSL encryption is used to protect the transmission of your survey responses. But, if you do not exit or close your Internet browser when you have completed your survey, it is possible that another person using your computer at a later time could view your responses. It is therefore important that you exit your browser after you have submitted your survey.
- There are no known risks associated with this research.
- Your participation is entirely voluntary and you are free to ask questions or withdraw from participation at any time.
- The research is not designed to help you personally, but the benefits to participation include contributing to research on an important, understudied topic. This research may help us understand the needs and successes of Asian American students who major in science, math, or engineering.
- If you have any questions about participating in this project, please contact me (Kristen Vogt at kvogt@umd.edu or 301-257-4854) or my faculty advisor, Dr. Marylu McEwen (mmcewen@umd.edu, 301-405-2871, or 3214 Benjamin).
- If you have questions about your rights as a research subject or wish to report a research-related injury, please contact: Institutional Review Board Office, University of Maryland, College Park, Maryland, 20742; (e-mail) irb@deans.umd.edu; (telephone) 301-405-4212

*Consent

- Yes, I wish to participate in this research study and begin the survey.
- No, I do not wish to participate in this research study and want to log out.

[Next >>](#)

Appendix M: Response to Declined to Participate

Logout

You have indicated that you do not wish to participate in this survey. Thank you for your time!

If you have any questions about participating in this project, please contact Kristen Vogt at kvogt@umd.edu or 301-257-4854 or Dr. Marylu McEwen at mmcewen@umd.edu, 301-405-2871, or 3214 Benjamin.

If you have questions about your rights as a research subject or wish to report a research-related injury, please contact: Institutional Review Board Office, University of Maryland, College Park, Maryland, 20742; (e-mail) irb@deans.umd.edu; (telephone) 301-405-4212

Appendix N: End-of-Survey Comments

Survey Content and Participant Responses

1. I thought it was a little too personal.
2. Taiwan should be listed as one of the countries as well!
3. No, but I'm very interested in your dissertation and the nature of this research topic.

Coming to the States at the age of 11, I did go through a phase where I felt like I had conflicting identities and that I had to choose one over the other. However, as I grew older, I realized that the middle ground is the best place to stand and that I'm getting the best from both cultures and now I have a much better sense of exactly who I'm [sic] and my purpose in life. Thus I find your topic to be very interesting. I just want to know what do you expect to conclude from the data you obtain and how will this study be applied to us as Asian students majoring in the sciences and engineering at this university. [sic] If you need further information, I can be reached through my email at XXX.
4. The question: when Americans are criticized, am I offended. When Americans are criticized for arrogance, narrow-mindedness, or for political reasons, I would often agree and feel less American, in a sense. Then the term "American" stands for the ignorant majority, and I become an insightful minority. Some things in life you can only experience in certain situations under certain circumstances. Since everyone is different, we can't all share the same experiences, but some are less inclined to try. However, when Asians are criticized, I feel more Asian and get defensive.
5. I couldn't accurately answer about future enrollment and success since I am graduating.

6. The questions concerning the language of my ancestry/heritage might not show you much; I was adopted when I was three months old.
7. I understand that you are trying to understand the views of Asian students on this campus and how they classify themselves, but I think you are missing questions from the most important category of all--Asian-American. Many of the students you are targeting are most likely second generation men and women (whether we were born in the US [*sic*] or moved here when we were less than five years old, we still consider ourselves second generation). As second generation kids, it is impossible to ask whether one feels more "American" or more "Asian" because our culture defines us as "Asian American." Our culture is a mixture of both. When it comes down to it, if you were to observe us socially, there are divisions among Asian immigrants that have been here for less than 5 years...5-10 years...or grew up in America...there are levels of Asian-American culture within the group itself. I wish you had questioned more about how someone defines themselves, and given a greater range than the "Asian vs. American." You can't quite understand if you just ask questions like "what generation are you and which culture do you feel like you belong to?" Maybe if you added comment boxes throughout, people could explain why they are choosing one over the other and this survey wouldn't lead to more stereotypes.
8. I grew up in China, went to Fiji with my family at 13 years old, came to US [*sic*] at 17 years old.
9. I do have friends of many different backgrounds, yet at times, when I'm in a small classroom setting, and I'm a minority, I feel a bit out-of-place. Although that is so, the other students are kind enough to make me feel comfortable.

10. A lot of my professors and teaching assistants come from all around the world and have various accents when they *[sic]* speak. I enjoy hearing different accents, from Argentina, Switzerland, China, India, Ireland, etc because it gives me a greater feeling of unity in engineering and technology as worldwide advancement. I hate when American students who know only one language complain about a teacher's accent as if the teacher was a bad one. I know they are not as fortunate as I am to be able to catch onto accents as quickly as me, since I have grown up listening to Vietnamese accents, but it isn't fair to criticize someone on a trivial matter such as message delivery, when the message itself is far more important. It creates a very narrow-minded outlook to be reluctant to learn from someone based on the way they speak, and not the wisdom they have to share. I don't like the effect thinking about this has on myself either. Then the word "American" transforms into a picture of a big oafish white *[sic]* guy who thinks he is superior to everyone else. I am currently studying abroad in the U.K. In the U.S. sometimes I felt sort-of American, but here I feel very American. It is interesting to meet people from all over the world at this university and share cultural differences. Sometimes I still get that chain of questions, "Where are you from?" "Where are you really from?" I don't mind so much because I know everyone here is very nice and wants to learn, so I can share about my family history and my parents *[sic]* emigration to the U.S. It also has been interesting for me to meet Vietnamese international students here, because we share language and culture, but we are from different countries with different political backgrounds. My parents fled Vietnam and the communist government after the war, and sought refuge in the U.S. These Vietnamese international students, they are most likely the children of

Vietnamese bureaucrats. I was unsure if any problems would arise, but I don't think they will, because we are getting too far removed from the war to have strong emotions that would get in the way of reaching common ground.

11. The “which culture do you agree with” question... I dunno [*sic*]... seemed unfair to me because I really feel a strong split between my two cultures. I tell people I'm Asian, but when I'm physically in Asia, I feel like I don't belong, but at the same time, I hate it when people say I'm American, because I don't like the stereotypical things that America stands for.
12. It is hard to commute to school just because it is a cultural [*sic*] no-no to live on campus.
13. I believe I am the ideal (or most interesting) “test subject” for something like this. You will not find a more “Chinese” American, who speaks Mandarin, English, & Shanghai dialect fluently.
14. My father passed away, which is why I did not answer the question about what kind of job he currently holds. My mother re-married, but I have lived with my aunt and uncle (my deceased father's sister & brother in-law) since I was 13.
15. My cultural experiences (both Asian and American) may not be common since I usually work long hours and have not actually socialized much. You may need more “common” responses to better reflect the survey.
16. As previously stated, i [*sic*] was adopted as an infant by white [*sic*] parents. My adopted father passed away in 1996. I also have 2 siblings who were also adopted from korea [*sic*] but none of us are blood-related.

17. I am adopted, so I would say that while I feel more American than Asian, I would say that I don't really belong to either culture group.
18. I think there exists a unique culture among Asian Americans that contains parts of both the Asian and the American culture, but also cannot relate entirely to both. For someone like me who cannot speak an Asian language, it is clear how I cannot relate (and vice versa) to immigrants or older generations and some aspects of their culture. At the same time, there are parts about my lifestyle that are very different from the typical American culture that I might not expect the typical American (Caucasian) to fully understand.
19. I plan to minor in Spanish language and possibly American literature.
20. I feel that much of the Asian culture I see (particularly in Taiwan, since it's the Asian country I know the best) is now conforming to Western values (materialism, consumer ideals) as a result of globalization and an improved economy in Asia. That's basically the only reason why I said I didn't feel I belonged to either culture, because I disagree with the spending lifestyle that's become pretty common in both countries. Aside from that, I value the language, customs, and family I have both in America and Taiwan, and I don't want to imply that I'm overlooking that part of my identity. Just a clarification...
21. Parental support for women majoring in engineering is not that great. men definitely have an advantage when it comes to classes, such as ENME371, in engineering because they have worked with projects similar to those done in the class either at home, as a hobby [*sic*] or as a job.

22. Sometimes it was difficult to answer the questions because the questions were irrelevant for my major. For my major, physics and chemistry are not required so the questions were not relevant to me. Also, sometimes I was unsure about my answer or in between some of the options for the answer.
23. I am minoring in math or AMSC and Spanish [*sic*]

Survey Process

1. Too long!
2. some of them [*survey items*] seem vague
3. Do participants receive the final results of the survey?
4. The choices for “COLLEGE ENVIRONMENT PERCEPTIONS” was [*sic*] confusing. I don't think it should have been “strongly disagree, disagree, neutral, agree, strongly agree.” Just thought I'd let you know my experience with the survey, so you can make it better if you agree.
5. some wording was confusing
6. The question about what college my major is in should have been multiple choice.
7. Can you specify some of the questions especially on the racial sensitivity one. [*sic*] I didn't quite understand it.
8. In step #5, the direction was written twice and it was kind of confusing how the five options for disagree or agree came after it. Also, for the step #5 for question #15, it said: “Racial sensitivity and tolerance in the classroom by” and the options for the answers did not have buttons where you could click your answer. I have included the parts of the survey that I am writing about below. [*survey item deleted*]

9. the survey was too long and no option so that you can save the filled up survey and return back to continue.
10. Just some general survey feedback: All of the questions seemed to have an appropriate selection or responses. I never came across a question where none of the responses seemed to apply to me. The question about current academic level seemed unclear. I took it as my level as determined by credits (I'm a second semester sophomore, but a junior by credits). Sometimes it took a while for the survey to load the next page. Other than that, everything else was great. Good luck!
11. this survey was good because there weren't any repetitive questions.
12. very lengthy one

Appendix O: Prize Drawing and Results Information

Prize Drawing and Other Information

Thank you for your responses to this survey!

In appreciation of your participation, you are eligible to enter a prize drawing for gift cards to the campus bookstore and IKEA home goods in College Park!

Six \$20 gift cards, two \$50 gift cards, and one \$75 gift card will be given away to 9 people.

- No, I do not wish to enter the prize drawing.
- Yes, please enter me in the prize drawing. My e-mail address is: _____

Winners will be notified by the e-mail address entered above by Wednesday, March 9.

Would you like a summary of this study's results when they become available?

- No, I do not want a summary of the study's results.
- Yes, please send me a summary of the study's results to my e-mail address:

Appendix P: Cultural Self-Identity Comments

1. When I am with non Asian people, I am considered Asian. While being with my parents and their friends, I am considered American. I never really like to define myself by an ethnic group. I [would] rather be defined by my characters and actions.
2. Well I'm an Indian citizen whose [sic] only been in the United States for about 4 years. I like American culutre but naturally [sic] feel a stronger bond with my own country
3. Parts of me are very Indian, like some of my morals, but at the same time other parts of my morals have bits of what can be described as 'Western' like being for women's rights, but this dichotomy can be found among many Indians because of the British influence in India. I feel like I am caught in the middle of both cultures sometimes. I go to India and feel like I'm really liberal and I come to the US [sic] and feel really conservative.
4. I don't [think] there should be a cut between being American or Asian, I consider myself as an Asian American, because I am from Asia, now living my life in America.
5. I do not feel that my American and Asian parts of me are separate. I was born and raised in Hawaii, and I was not raised to believe that these cultures must be considered separate. I realize that there are differences among people and their respective cultures; however, I am also fortunate to realize that these differences do not have to make people believe that the cultures must remain divided.
6. I consider myself more Asian than Caucasian (I am mixed), but I consider myself all American as I was born and raised here.

7. I am proud to be half caucasian [*sic*] and half Korean, I don't consider Korean as not being American. so I am not half and half, or more so than the other. I'm just me.
8. I am Japanese.
9. I am an 'Americanized Asian'. I associate most closely with the 'American' identity, however, I say I'm Indian and Malaysian. I love being both and have never really experienced a negative experience for being an Asian-American socially or academically.
10. I am adopted and have [a] white [*sic*] parent so I never learned the language or the traditions. However, I am very proud to be asian [*sic*] because I am unique (I like the fact that I look 'different' from the stereotypical american [*sic*]).
11. Feeling Asian and American equally (#3) is the same as feeling like I don't belong to either culture (#4). I consider myself of Asian-American culture and would not choose one category of [*sic*] the other.
12. Although I feel very strongly that I am an American, one who happens to be of Chinese heritage, I sense there are many people who only see me as Asian or foreign. And being perceived in such a way, [I] suppose I am more Asian than American.

Appendix Q: Correlation Matrix

Correlation Matrix of Social Cognitive Career Variables

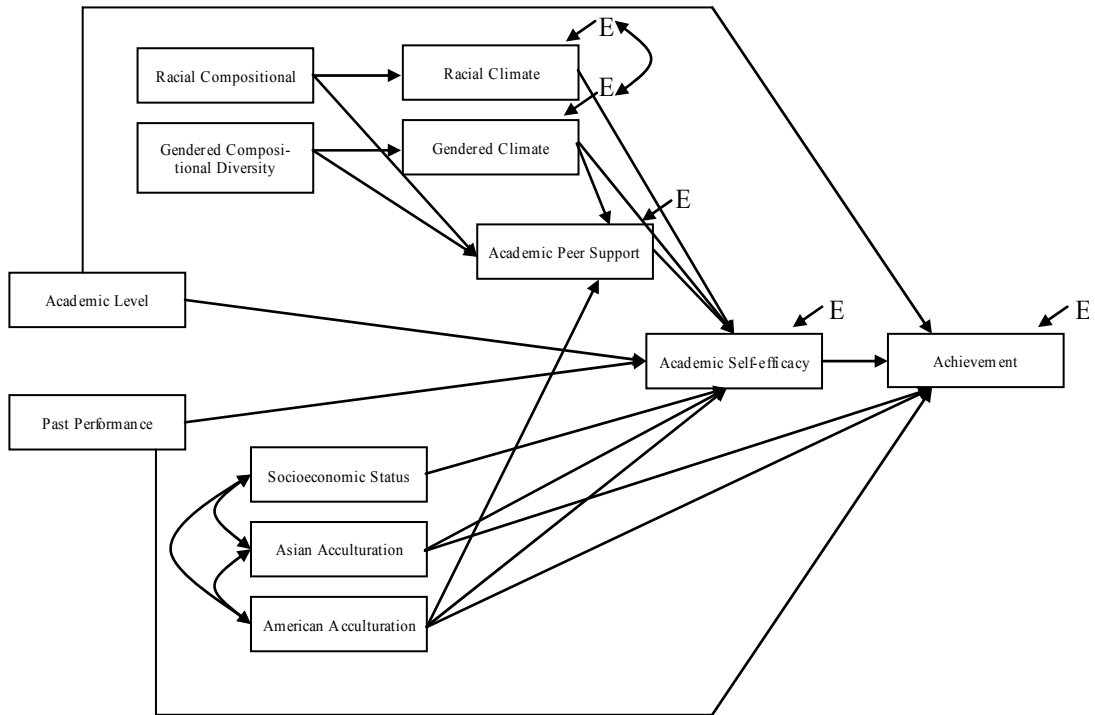
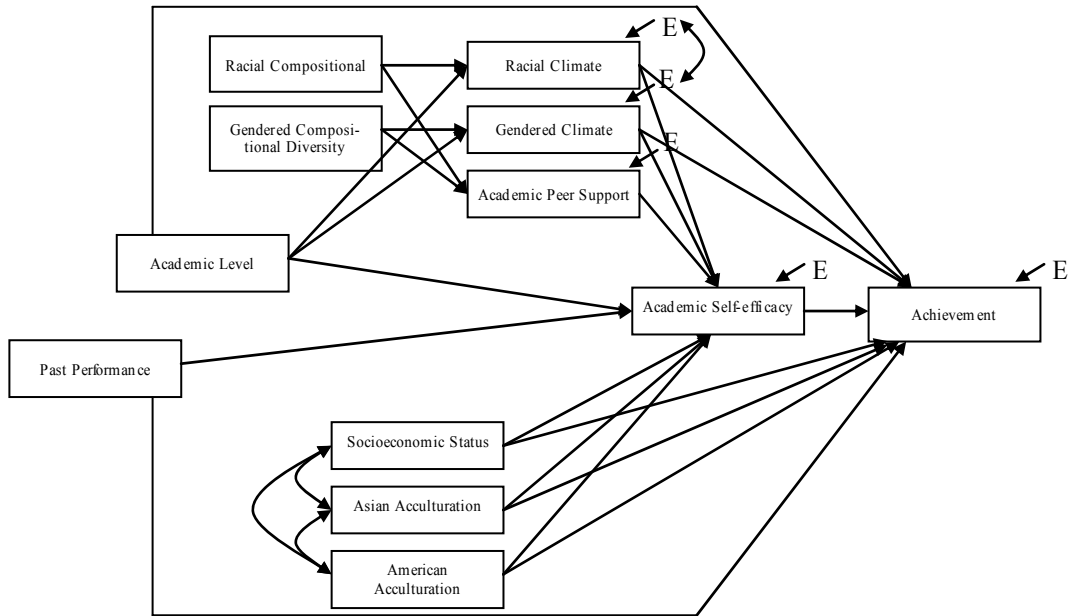
	1	2	3	4	5	6
1 Semester GPA	1.000					
2 Academic self-efficacy	.502 ***	1.000				
3 Academic peer support	.063	.226 **	1.000			
4 Gendered climate	.115	.240 ***	.247 ***	1.000		
5 Racial climate	.089	.172 *	.111	.209 **	1.000	
6 Percent female in major	-.016	-.064	-.145 *	-.006	.133 *	1.000
7 Percent Asian American in major	-.012	.159 *	.110	.118	-.018	-.026
8 SES Index	.099	.169 *	.247 ***	.023	.124	.045
9 Asian acculturation	-.049	.149 *	-.065	-.096	-.037	-.018
10 American acculturation	-.114	-.097	.330 ***	.197 **	-.013	.150 *
11 Total college credits	.144 *	.124	-.022	-.033	.021	-.086
12 High School GPA	.456 ***	.323 ***	.064	.019	-.047	-.109

	7	8	9	10	11	12
7 Percent Asian American in major	1.000					
8 SES Index	.082	1.000				
9 Asian acculturation	.188 **	-.073	1.000			
10 American acculturation	-.013	.251 ***	-.353 ***	1.000		
11 Total college credits	-.034	-.080	-.003	-.057	1.000	
12 High School GPA	.107	.061	-.076	-.016	.043	1.000

Note: N=218.

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

Appendix R: Initial and Respecified Path Models



Note: Top figure is initial model; bottom figure is respecified model.

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