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The Role of Program Climate and Socialization in the Retention of Engineering Undergraduates

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in the Retention of Engineering Undergraduates

by

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Abstract

Increasing women's participation in the fields of science, technology, engineering and mathematics (STEM) can promote a healthy economy by ensuring a diverse and well-qualified STEM workforce, not only in the quantity of females in the workforce, but diversity in thinking and creativity. It will also send a positive message to young women about the breadth of educational opportunities and career choices they have available to them. However, women continue to participate in engineering education in a far lower rate than men. Attracting and retaining female students has become a challenging problem for the academic engineering community. In this study, a classic model of student withdrawal is presented as a theoretical framework for examining the relationships between the environment and the people in undergraduate engineering departments, and how they can influence students' commitment to and persistence in their program.

A sample of 1,369 engineering undergraduates enrolled in eight Florida universities participated in a survey assessing the climate of the engineering department, the socialization process, student commitment and withdrawal intentions. The results of a factor analysis reveal that faculty support, a sense of community, and encouraging and valuing diversity are all important elements of a climate for retention. In general, women perceived the academic climate as being less supportive than men did, reported lower levels of commitment, and greater withdrawal intentions. These climate factors, as well as socialization, also played a significant role in predicting the levels of student commitment to their program, and their intentions to withdraw or persist in their

academic goals. However, there was little evidence for a moderating role of gender in these relationships. This research suggests the importance of having a supportive faculty and fostering a sense of community among students, both of which aid in the successful socialization of engineering students, and ultimately promote commitment and persistence.

Chapter One: Introduction

Over the last thirty years, there has been dramatic growth in women's labor force participation, and with it an interest in examining what makes women a distinct group with unique values, attitudes and career-oriented behaviors. This expanding body of literature reveals the nature of women's educational and career-related choices. Even though women make up over half the work force (National Science Foundation [NSF], 2009), many occupations today continue to be sex-stereotyped. Some are commonly characterized as historically male dominated, such as science, technology, engineering, and mathematics (hereafter referred to as STEM), whereas others tend to be viewed as more female-oriented, like education and healthcare. Ideas about gender-typed occupations are pervasive, and evidence for them can be found in children as young as three years old (Stockard & McGee, 1990). Internalizing these beliefs about gender-typed jobs at such a young age makes it that much more difficult to expand a young adult's view of their own career potential and the options available to them.

Although there is evidence that these stereotypes may be declining among college students (White, Kruczek, Brown, & White, 1989), out-dated conceptualizations of gender-typed jobs continue to play an important role in the development of many career pathways. Women tend to be attracted to fields and occupations that provide an opportunity for social interaction and allow the individual to play a useful role in society. This can include jobs in fields such as healthcare or social services. In fact, when women in traditionally male-dominated fields were asked about their career plans, many reported

they were more likely to consider changing to a career which would allow them to give back to the community in a way that their current field of study would not (Lightbody, Siann, Tait, & Walsh, 1997).

A classic example of how women meet with resistance participating in a male-dominated field can be seen in the engineering discipline. Throughout the most of the 20th century, women studying or working in engineering were generally perceived as going against traditional gender norms. Historically, engineering has had masculine connotations. This can be attributed, in part, to the apprentice-style training most working engineers participated in, as opposed to a formal educational program. The hands-on nature of training engineers was considered unsuitable for women to participate in, because it often involved physically strenuous or dangerous conditions. Other social cues also reinforced the masculine image of engineering. Tool kits and model trains were advertised in a way to spark boys' interest in engineering. Girls who expressed such interests were often encouraged towards more traditional disciplines (Bix 2002; Oldenziel 1999; Purcell 1979; Wajcman 1991).

Women's entry into the engineering workforce coincided with the start of World War II, when our country faced a serious manpower shortage. Women were trained on the job for their new responsibilities, yet the idea of women formally studying engineering in a university setting was still unheard of. Slowly, this attitude began to change, and women were allowed to apply to and participate in undergraduate engineering programs of study, although they were met with an incredible amount of resistance and subject to stereotyping to an alarming degree. There was a great deal of

concern about the consequences of having women study at a technical institution dominated by men (Bix, 2000).

To combat these negative attitudes concerning the sparse number of female engineering students, support groups started to emerge, and in 1952 the Society for Women Engineers (SWE) was created. SWE continues to advocate for women in engineering. SWE plays an important role in the encouragement of female engineering students, by giving women a way to meet each other, and to build a sense of community with a shared purpose (SWE, 2009).

With support for female engineers starting to grow, a new generation of MIT coeds began to band together to consider remedies to emerging workplace challenges. They hosted meetings and conferences to address issues such as employment discrimination. Meanwhile, important changes were underway at the national level. The 1964 Federal Civil Rights Act had included language barring gender-based employment discrimination. Major companies during the 1970s promoted the fact that they were "an equal opportunity employer". To encourage diversity, many companies deliberately marketed their recruitment efforts towards women (Woloch, 1999).

Although we have come a long way from the need for female engineers as a quick fix for wartime labor shortages, women are still alarmingly underrepresented in the field. In 1979, women made up 12.1 percent of undergraduates enrolled in engineering across the United States; currently, that number has risen less than ten percent. In 2006, women represented the majority of college students in four-year institution (56%), yet only 17% of engineering undergraduates. This represents a smaller proportion of students than in the previous decade. Men, on the other hand, have exhibited a steady increase in

enrollment over the past eight years. Graduate school enrollment shows a similar trend for female engineers. Women enrolled in graduate engineering programs increased by 40% from the previous decade, but they still represent only a quarter of all engineering graduate students (NSF, 2009).

Enrollment, however, is only half the picture. Over 68,000 bachelor's degrees in engineering were awarded in 2007, yet less than one quarter of them went to women. Interestingly, an equal number of men and women received bachelor's degrees in STEM fields, but women were vastly overrepresented in a small subset of these disciplines, such as biological science; this discipline often attracts female students as it serves as an entry to the healthcare field. The doctoral degrees awarded mirror the trend seen in undergraduate degree attainment. While women earned half of all the doctoral degrees, men still graduated with a Ph.D. in engineering at a rate five times that of women. The graduation rates for Master's degrees among women are very similar to that of the doctoral degrees.

At the state level, a similar distribution of women in engineering is found. Enrollment in four-year, Florida State University System institutions has increased 40% between 1998 and 2007, significantly higher than the national figures (23% increase nationwide). Of these students, 56% are female, similar to the national rate. Yet in 2007, women made up 17% of engineering undergraduates enrolled and 22% of engineering graduate students enrolled (Florida Board of Governors, 2007). It is clear to see that women's presence in undergraduate and graduate institutions is not lacking, yet they consistently choose to enter and graduate from engineering programs at a fraction of the rate they enter many other STEM program, not to mention non-STEM programs.

It is vital to attract and maintain women's interest in STEM education and careers. In fact, the National Science Board (2007) identified the supply of scientists, engineers, and science teachers as one of the top 10 priorities of the early 21st century. Increasing women's participation in these fields can promote a healthy economy by ensuring a diverse and well-qualified STEM workforce, not only in the quantity of females in the workforce, but diversity in thinking and creativity. It will also send a positive message to young women about the breadth of educational opportunities and career choices they have available to them. However, women continue to participate in engineering education in a far smaller proportion than men. Attracting and retaining female students has become a challenging problem for the academic engineering community. Effective solutions for student retention must be designed in order to increase the retention of qualified and talented female engineers. The reasons for this underrepresentation are complex, but one factor continues to come up in the debate: the discipline's "chilly climate" (Hall & Sandler, 1982, 1984; Heller, Puff, & Mills, 1985; Constantinople, Cornelius, & Gray, 1988; Crawford & MacLeod, 1990; Pascarella, Whitt, Edison, Nora, Hagedorn, Yeager, & Terenzini, 1997; Whitt, Nora, Edison, Terenzini, & Pascarella, 1999, Bix, 2004). After all, individuals do not exist in a social vacuum. The role of organizational conditions in the workplace is important for understanding the outcomes among individuals. Likewise, in understanding the experiences of women in undergraduate STEM programs, we need to consider features of the program in which they study and attend class. These features are influential in student experiences across fields, but can be especially important in scientific fields where there is such gender disparity. Certain groups of people, such as women compared with men, or underrepresented minority students compared to non-

minorities, can have different experiences in these organizational environments, with implications for differences in outcomes, such as persistence.

Students' intention to persist in their major can be especially sensitive to educational experiences in and out of the classroom, and thus be subject to positive intervention, yet they do not receive the necessary attention in the literature. These intentions to persist represent an important component of students' education attainment both while in college and after graduation. Understanding that factors that influences students' intentions to persist in engineering programs could better direct educators' and policy makers' efforts to develop successful intervention programs which maximize the number of students who actually do persist in engineering education (Wyer, 2000).

The most significant contribution this research is to apply established organizational theory and methodology to the study of undergraduate students in engineering, and to delineate the components of an academic climate which support the persistence of its undergraduate engineering students. The proposed research will apply organizational theory to the empirical study of the perceptions of academic climate among undergraduate engineering students, and the relationship between these climate perceptions and undergraduate commitment and withdrawal intentions.

Chapter Two: Review of the Literature

It is clear that women remain underrepresented in engineering and science undergraduate programs and careers. In this chapter, the research on student persistence will be reviewed, with a focus on factors for retention at the undergraduate level. When possible, issues pertaining specifically to women and/or STEM programs will be highlighted. A classic model of student withdrawal developed by Tinto (1975) is presented as a theoretical framework for the study, laying the groundwork for the relationships between the environment and the people in an academic program, and how they can shape students' commitment to their program and intentions to persist or withdraw. The major variables in Tinto's model of student withdrawal will be presented, and discussed in the context of central industrial/organizational constructs.

Much of the contemporary research on persistence in undergraduate science programs has generally focused on pre-college attributes and influences, such as socioeconomic status, parental influence, or high school course taking and achievement. For instance, one study of pre-college students used information about family, school and individual variables to predict success and achievement in college (Hansen, 2000). Another study examined the effect of high school math and science achievement on subsequent college course taking (Wood & Brown, 1997). Yet research indicates that post-matriculation experiences are equally important to pre-matriculation student characteristics when explaining commitment and retention (Terenzini & Pascarella, 1980).

The study of student experiences in higher education begins with a review of the research on student change. Research on student change focuses not on the student's history leading up to college, but on what happens to a student after they enroll. They focus on inter-individual origins of student change, examine the effects of the student's interaction with the environment around him and how this environment reinforces or alters their original goals and plans. The research on student change seeks to answer several critical questions about student experiences in college, such as: a) Can students have different experiences while in the same institutional environment, and b) Does the college experience create different outcomes for various subgroups of students? These models often incorporate factors reflecting academic climate, and can be used to help clarify the undergraduate experience in a STEM program for both men and women. This goal of the current study is to address both of these questions with respect to women in engineering.

Research on student change dates back to the 1970's, with the introduction of Astin's I-E-O Model and Theory of Involvement (1970). This was one of the original college impact models developed, and is based on the now-familiar input -- process (or in this case, environment) -- output model. Astin's work was followed by Pascarella's General Model for Assessing Change (1985), a causal model that specifies the role of both the institution's structural characteristics and its environment in student change. Weidman (1989) created a model of student change to complement Pascarella's. Weidman's Model of Undergraduate Socialization (1989) is focused on predicting non-cognitive changes, such as those involving career choices, attitudes and values, which contrasts Pascarella's model, focused on learning and cognitive development. Weidman's

(1989) model also specifies the role of socialization in much more specific terms. Weidman (1989) believed that socialization develops the students' knowledge of in-college normative ideas, which leads to outcomes such as the alteration of attitudes and values. Although Weidman's (1989) model of student change places the role of student socialization at the forefront, it is limited in its ability to account for a variety of other institutional factors which are also thought to influence student change, such as perceptions of the program climate.

Tinto's model of student withdrawal (1975, 1993) provides a more comprehensive model of the factors associated with student change, with a specific focus on the outcome of retention (see Figure 1). According to Tinto, a student enters college with a set of personal and academic characteristics and skills, which are then modified by the vast array of experiences the student has while in college. These experiences, along with socializing agents, influence the student's intentions to persist or depart from the program or institution. This classic model of student withdrawal has also been modified and applied by a number of subsequent researchers. For example, Bean (2005) applies a similar, model to the phenomenon of student withdrawal as Tinto does. Here, students begin with pre-matriculation attitudes, beliefs and goals. Upon entering college, students interact with the institutional environment, and these interactions help to form the student's attitudes about their academic environment. Intentions to withdraw are based on these attitudes, and a subsequent decision to withdraw can ultimately be traced back to the student's intentions. The following sections will introduce, in detail, the main components of Tinto's model of student departure, and show how these components can be re-interpreted using common constructs industrial organizational psychology.

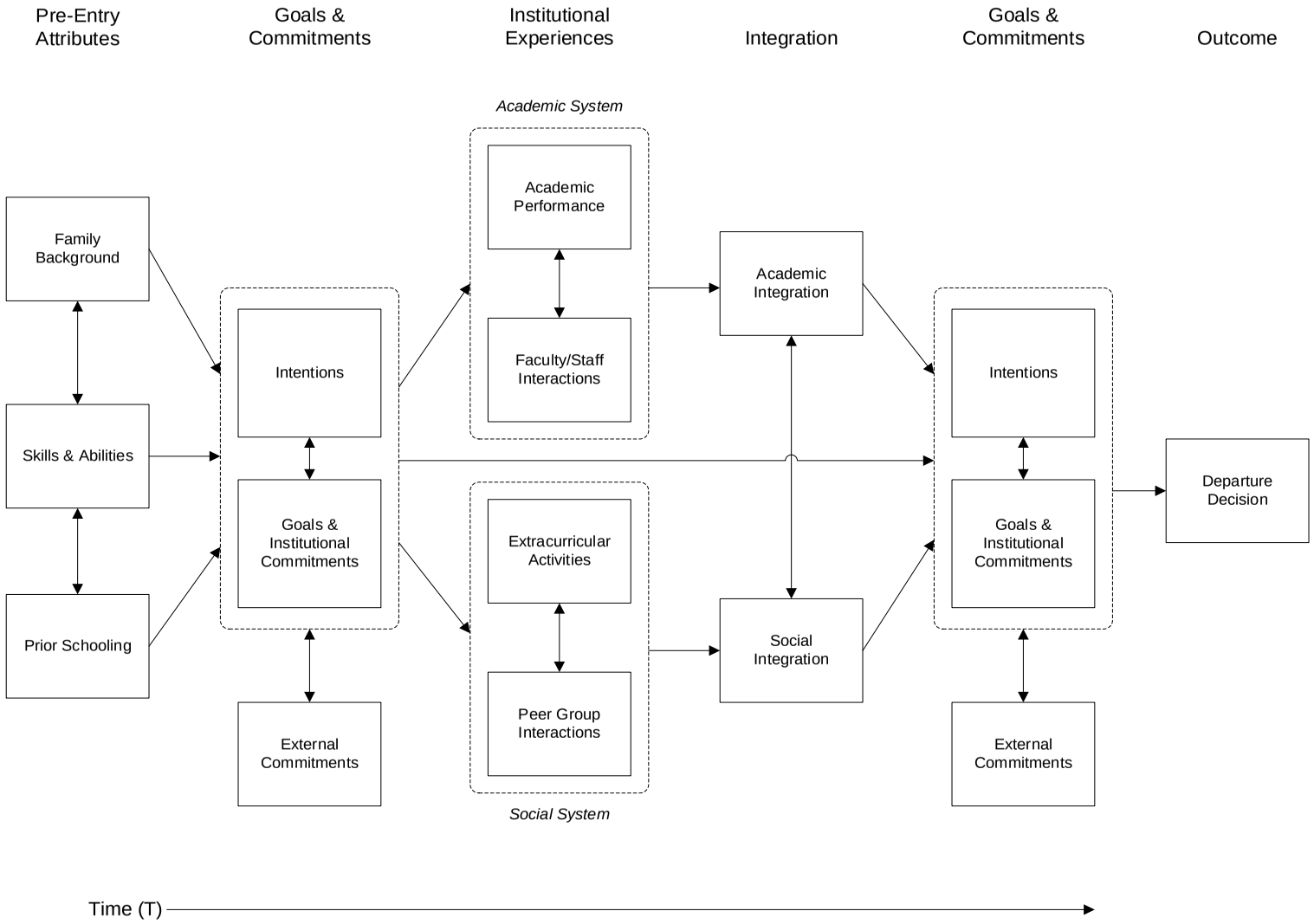

Figure 1. Tinto's (1975) model of student departure

Institutional experiences and organizational climate

The first component of Tinto's model is the student's institutional experiences. Tinto considers institutional experiences to be a combination of a number of components, including objective indicators such as grade point average and participation in extracurricular activities, and subjective indicators like the quality of interaction with faculty, staff, and peers. Studies show that the institutional environment does influences program efficacy (Berger, 2001; Braxton, 2001; Noel, Levitz, & Saluri, 1985; Pascarella & Terrenzini, 2005), and this is an important feature of Tinto's student departure model.

In this context, the concept of organizational climate can be used to illuminate students' perceptions of their environment. Program climate refers to the members' perception of their environment and describes the atmosphere of the program. In other words, program climate refers to the experience of being a member of the program (Ostroff, Kinicki, & Tamkins, 2001, 2003). An academic program can be viewed as an organization with members including faculty, students and staff. Members of this program interact with one another on a daily basis as they would in other organizational environments, creating and communicating the program's goals, values and perspectives. Organizational climate focuses on how organizational participants perceive and make sense of their environments. This research has its roots in the work done by Kurt Lewin (1951) and has been applied to both organizational and educational settings. A distinction should be made between climate and culture; climate can be thought of as a description of what happens, and culture helps define why these things happen. Therefore, climate is a more proximal indicator of an organization than culture, and is more readily accessible upon entry into the organization. The physical appearance of the organization, the

attitudes and values held by its employees and the treatment of newcomers all provide evidence for the climate of an organization. Much of the early research on climate explored the influence of the overall climate on organizational effectiveness and attitudinal outcomes (Schneider, Bowen, Ehrhart, & Holcombe, 2000).

Recently, there has been a trend away from global definitions of climate, and a shift towards more specific climates, such as a climate "for" something (Ostroff, Kinicki & Tamkins, 2003). This strategic definition of climate is gaining popularity and acceptance in the literature, and has been successfully applied to issues such as safety (Zohar, 2000), service (Schneider, 1990), justice (Naumann & Bennett, 2000), and citizenship behavior (Schneider, Gunnarson and Niles-Jolly, 1994), to name a few. Individual-level perceptions of climate have successfully been linked to affective and behavioral outcomes. For example, justice climate has been shown to be related to commitment and helping behaviors (Naumann & Bennett, 2000), and climate for sexual harassment has been linked to reports of harassment incidents (Hulin, Fitzgerald & Drasgow, 1996).

The emerging research on strategic climates has been promising, but only a few examples of climate-for have been given empirical attention. More attention to the climate-for concept is needed to reinforce the nature of this construct. The current research will expand the climate-for literature by introducing and measuring a climate for undergraduate retention.

There has been some debate surrounding the precise nature of climate, and at what level it is most appropriately measured. To resolve the issue of level, a distinction was made between psychological climate, which is operationalized and measured at the

individual level, and organizational climate, which is defined as an organizational variable (Ostroff, et al., 2003). At the individual level, perceptions of climate stem from the individual's interaction in their environment. As such, measures of organizational climate should rely on the individual as the basic unit of measurement. If consensus about climate is reached among individuals in an institution, then these perceptions can be meaningfully aggregated into an organizational level construct. Because similar people are attracted to the similar environments, exposed to similar features of an organization, and are socialized in a similar manner, it is likely that a consensus among climate perceptions of individuals will develop. This distinction between psychological climate as an individual level variable and organizational climate as a group level variable, when appropriately aggregated, is now widely accepted (Schneider et al, 2000).

To further support the distinction between individual-level psychological climate and group-level organizational climate, researchers have given much attention to the variety of methods by which aggregated climate perceptions can be transformed into a meaningful group-level indicator. The most common method is to use a mean score across individuals to represent a higher level climate. In order to justify meaningful agreement on organizational-level climate, two criteria must be met. The first is to show that a sufficient amount of within-group agreement exists, and the second is to demonstrate the degree of between-unit variability. Although the exact definitions of what qualifies as sufficient within group agreement and across group variance is still under debate, if both of these conditions can be reasonably met, a researcher is then able to justify the use of aggregated climate perceptions to reflect a cohesive organizational climate (Klein, Cohn, Smith, & Sorra, 2001).

There are two types of studies which address the impact of climate on the individual: a) individual-level studies, which examine the relationships between psychological climate perceptions and individual outcomes, and b) cross-level studies using aggregated climate scores assigned to individuals, and relationships to individual outcomes are examined. The current research represents the former, in that individual-level perceptions of climate will be used to predict withdrawal intentions and commitment of engineering students.

Several studies have been conducted (i.e., Hall & Sandler, 1982, 1984; Heller, Puff, & Mills, 1985; Constantinople, Cornelius, & Gray, 1988; Crawford & MacLeod, 1990; Pascarella, Whitt, Edison, Nora, Hagedorn, Yeager, & Terenzini, 1997; Whitt, Nora, Edison, Terenzini, & Pascarella, 1999, Etzkowitz, Kemelgor, & Uzzi, 2000, Bix, 2004, Herzig, 2004) that focus on how the climate of undergraduate STEM classrooms, programs, and departments may contribute to a higher level of program efficacy for women and minorities in STEM fields. Yet little is still known about which individual elements of an academic climate best support program efficacy, especially for completion of STEM programs. Jordan and Bilimoria (2007, p.22) add "only the rare study addresses enabling climates and cultures for female academics." Specifically, what are the facets of the program environment that facilitate success in STEM programs and foster positive integration into the program on the part of the student? Researchers have found, for example, that departments or programs that focus on collaboration rather than competition, are collegial rather than bureaucratic, and are student-centered rather than institution-centered, tend to be associated with increased success for all students, particularly female and minority students (Tinto, 1993; Smith, Gerbick, & Figueroa,

1997). However, this research may be just scratching the surface of how STEM program climate affects its students' persistence and success.

Hall and Sandler (1982) originally coined the term "chilly climate" to describe faculty members' often unconscious behaviors that contributed to classroom environments that disadvantage women. These include behaviors such as calling on male students more often than female students, paying more attention when men speak, and focusing more on a woman's appearance than on her accomplishments. Two years later, they expanded this idea beyond the classroom to the "chilly campus climate" (Hall & Sandler, 1984). Prior research suggests that such behaviors and the environment they create often go unnoticed because they reflect socially accepted patterns of communication and the long-held belief that men are more capable of working in the fields of hard science (Sandler, Silverberg, & Hall, 1996; Brady & Eisler, 1999). Seymour and Hewitt (1997) built upon this idea, suggesting that the "chilly climate" has led to increased self-doubt in women, which results in their attrition from engineering fields.

A study of male and female engineering faculty members addresses the role of gender in the perceptions of organizational climate (Fox, 2010). Climate was selected for this study because it can encompass aspects of the perceived atmosphere of an academic department along a variety of dimensions. Responses on perceptions of such dimensions reflect faculty members' characterizations of the "way things are" in their department (Reichers & Schneider, 1990, p. 22), and such characterizations can vary for male and female faculty. This study found marked differences in the perceptions of the organizational climate between men and women. Women's characterizations are

significantly lower than men's for positive aspects of departmental climates (such as helpfulness and excitement) and significantly higher for negative aspects, including stressfulness. Furthermore, they reported lower levels of communication among colleagues, which lead to restricted sense of integration and membership in their work environment. As a result, female faculty may feel excluded from the social networks in which they work (Fox, 2001).

Other research has considered the influence of racial climate on student persistence as well as a climate focused on gender. The underlying assumption of these studies is that under-represented groups of students, whether that refers to their gender, race, or ethnicity, are sensitive to the climate of the institution and its predominantly white male population. One such study (Sidel, 1994) of campus racial climate found that under-represented groups, including racial or ethnic groups and women, were made to feel like outsiders within their institution. These feelings of alienation had a negative effect on the students' sense of belonging and integration within the academic community.

Integration and organizational socialization

The second component of Tinto's model is the student's integration to the institution. Tinto places a great deal of importance on the role of student integration into the academic and social systems of the institution and its influence on student departure. Integration is "the extent to which the individual shares the normative attitudes and values of peers and faculty in the institution and abides by the formal and informal structural requirements for membership in that community or the subgroups of it" (Pascarella & Terenzini, 2005, p. 54). Integration as a process by which students learn the

normative attitudes and values of the program and its members, and act in accordance with the requirements for program membership. Tinto (1978) theorizes that positive encounters with the program environment lead to greater student integration. There is much variability in the ways in which integration is operationalized. Many studies have traditionally relied on objective indicators of integration, such as grade point average, or the degree to which the student participates in socially- and academically-oriented groups or events. There is a lack of emphasis on the psychological conceptualization of integration, and the role of the student's feelings of identification and sense of community with the institution, which the proposed study seeks to address in greater detail. One notable exception is research conducted by Hurtado and Carter (1997). In this empirical test of Tinto's model, the researcher's chose to include a subjective measure of integration they labeled "sense of belonging". This variable sought to measure the individual's perceptions about being a part of the group within their institution.

Feeling socially integrated and connected with other students is an important factor which can affect college students' persistence. College is a time for both intellectual and social growth. Bean (2005) reinforces this point: "Few would deny that the social lives of students in college and their exchanges with others inside and outside the institution are important in retention decisions" (p. 227). Not surprisingly, a person is more likely to meet difficult goals when they are surrounded by people who share a similar goal. It is the same for college students. A major part of the social acclimation process is adapting to the unfamiliar environment and seeking out like-minded peers. Having a social bond with peers in an academic environment can provide some much-needed support as everyone moves towards a common goal: graduation. Having this bond

with peers in the same area of study is especially important, and can be critical in fields such as engineering, where the workload is often intense. These friendships are important because they allow students to participate in academic activities together, such as study groups and team projects. This, in turn, supports the students' goals to be successful in their academic pursuits. It is important for institutions to recognize the importance these social networks have on student persistence. Bean (2005) says "It is important for institutional officials to recognize that social connectedness is important for retention…social connectedness leads to satisfaction, self-confidence, loyalty, and remaining enrolled" (p-228-229).

In this context, Tinto's integration variable can be interpreted as organizational socialization. Organizational socialization refers to the process by which an individual learns and adopts the values, attitudes, and knowledge required of successful members of that organization (Bauer, Morrison & Callister, 1998). Socialization can occur whenever an individual begins a new role, but the greatest degree of socialization is experienced near the time of entry to the organization.

Research on organizational socialization also provides support for the influence of integration in Tinto's student departure theory. Socialization is often linked to important outcomes for both the individual and the organization. Just as Tinto theorizes in his student departure model, organizational research has found that unsuccessful socialization often leads to turnover (Campion & Mitchell, 1986). Conversely, positive socialization of an individual into an organization can have a lasting impact on their values and attitudes. Successful socialization can increase the individual's commitment to both the organization and to their shared goals (Bauer et al., 1998), which parallels

Tinto's theorized relationship between student integration and the student's commitments to their goals and intentions. Finally, the socialization process is a primary vehicle for communicating information about the organizational culture and climate. This is beneficial for both the student and the organization; students are better able to interpret their environment and can predict the consequences of their actions, whereas the organization is able to ensure the continuity of their values and goals (Louis, 1990).

Withdrawal, intent to withdraw and intent to turnover

Although actual student departure is the ultimate outcome of interest in Tinto's model of student withdrawal, there are several more proximal variables in his model that could be considered indicative of a student's desire to withdrawal from their academic program. One such indicator of persistence (or lack thereof) is the student's intention to withdraw. This component of Tinto's model is influenced by institutional experiences and student integration, and is an influence on actual withdrawal. According to Tinto, withdrawal is a longitudinal process that results from interactions between a student and his/her environment. A departure decision is made by the student, which is influenced by the environmental experience, degree of integration within the program, and degree of commitment felt by the student to the program. Negative experiences and integration lead to student departure, whereas positive experiences and integration encourage persistence (Tinto, 1975). Mobley, Griffeth, Hand and Meglino (1979) proposed a model of turnover in the workplace in which various features of the work environment influence the employee's affective orientation (i.e., organizational commitment, job satisfaction), which in turn influences withdrawal cognitions and ultimately ends in employee turnover. This model of employee withdrawal in the workplace is similar to Tinto's model of

student departure, in that a relationship between environment and withdrawal intentions is specified.

The outcome of interest in Tinto's student departure model is (actual) withdrawal from the institution. In this context, withdrawal can be interpreted as turnover from an organization. In certain environments, turnover can be problematic to measure. There is often a low base-rate of turnover occurrences, and is almost always requires a longitudinal design. Furthermore, it may be the case that an intention to do something is interesting in itself, and worthy of investigation. Because of this, researchers often rely instead on a surrogate variable, intention to turnover (Miller & Wheeler, 1992; Mone, 1994; Kirschenbaum & Weisberg, 1994; Rosin & Korabik, 1995; George & Jones, 1996; Sjoberg & Sverke, 2000; Freund, 2005). There are advantages to using a surrogate variable such as intent to turnover, or in this case, intent to withdraw from the program. For example, a dichotomous outcome of withdraw or persist has limited statistical variance, whereas intent to withdraw can be scaled to provide a wider range of data, as well as allow for varied experimental designs that do not include a longitudinal element. Recommendations have been made about when it is appropriate to use surrogate variables, such as intent to turnover. First, the behavioral variable (i.e., turnover) must be unavailable for measurement, due to access or experimental design. Secondly, the surrogate variable is the only way to represent the variable of interest in the study. Finally, researchers suggest that when considering the use of a surrogate variable, its relationship with the actual behavior of interest (whether determined by empirical test or meta-analysis) should exhibit a correlation of approximately 0.50 (Dalton, Johnson, & Daily, 1999). However, these recommendations only apply to the use of surrogate

variables in the place of the behavioral variable. If the surrogate is being modeled as a meditating influence, these recommendations do not apply.

There have been several meta-analytic reviews that provide estimates of the relationship between turnover and intent to turnover in a wide variety of settings. Turnover intentions to actual turnover has been reported as low as 0.32 (Carsten & Spector, 1987), or 0.36 (Hom, Caranikis-Walker, Prussian, & Griffeth, 1992), whereas higher correlations have been estimated at 0.50 (Steele & Ovalle, 1984) and 0.52 (Tett & Meyer, 1993). Based on the recommendations provided for use of the surrogate variable intent to turnover, and the adequate degree of correlation found in the literature between turnover and intention to turnover, it is believed that intentions to withdraw will provide a reasonable replacement for Tinto's ultimate outcome variable, which is actual student withdrawal.

Based on this body of research, it is expected that institutional experiences and student integration will influence intentions to withdraw.

H1. The extent to which students perceive a supportive climate for retention negatively predicts intentions to withdraw. The more supportive a climate for retention is perceived, the less students intend to leave the program.

H2. The relationship between climate and intentions to withdraw will be moderated by gender. Supportive climate perceptions will be more predictive of withdrawal intentions for women than men.

H3. The extent to which students are socialized in their program will negatively predict withdrawal intentions. The more positively students are socialized, the less they intend to leave their program.

H4. The relationship between socialization and intentions to withdraw will be moderated by gender. Socialization will be more predictive of withdrawal intentions for women than men.

Commitment

Another indicator of persistence (or lack thereof) in Tinto's model of student withdrawal is student commitment. This component of Tinto's model is influenced by institutional experiences and student integration, and is an influence on actual withdrawal. Tinto theorizes that positive experiences while in college reinforce persistence by increasing the student's commitment to the institution. Negative experiences and interactions, on the other hand, reduce the student's commitment and likelihood of persisting. Student commitment has been a popular topic in educational literature (Bean 1980, Cabrera, Castaneda, Nora, & Hengstler, 1992). In this context, the construct of organizational commitment used in organizational research can be applied here to contribute to a better understanding of student commitment. Organizational commitment is commonly defined as "the relative strength of an individual's identification with an involvement in a particular organization" (Mowaday, Steers & Porter, 1979). In other words, organizational commitment involves a strong belief in the organization's goals and values and a desire to remain part of the organization. This concept has received a great deal of attention in the literature, and has been evaluated as both an antecedent and a consequence for a variety of work-related variables. Organizational commitment has been conceptualized and operationalized in several ways, yet most share an underlying theme: commitment constitutes a bond or a link to the

organization, and those individuals who have a strong bond are less likely to leave their organization then individuals who have a weak bond (Allen & Meyer, 1990).

The most commonly studied conceptualization of commitment has been that of attitudinal commitment, the type of commitment measured in the current study. Attitudinal commitment has been shown to exhibit a relationship with several work-related variables; personal characteristics, job characteristics, and organizational environment are thought to be antecedents to commitment, while behavioral intentions and turnover have been studied as consequences of commitment. A meta-analysis by Mathieu and Zajac (1990) explores the relationships between such variables. For example, a review of commitment studies showed a small correlation between gender and commitment (r = -0.145), indicating that women tended to be slightly more committed to their organizations than men. Grusky (1966) proposed that women feel more committed to their organizations because they had to overcome more obstacles and barriers in order to gain membership. Although this hypothesis may be a little out of date for working women in general, this theory could apply to environments where women are still the overwhelming minority, such as in academic engineering programs. Attitudinal commitment also showed moderate correlations with perceived competence (r = 0.630); it appears that individuals will become committed to an organization to the degree it provides an opportunity for growth and for individuals to meet their goals.

When considering the consequences of organizational commitment, turnover and turnover intentions are the most commonly studied variables. Commitment positively correlates with attendance (r = 0.102), and negatively correlates with lateness (r = -0.116) and turnover (r = -0.277). However, correlations with turnover intentions are much

stronger than with actual turnover; intention to search of alternative jobs (r = -0.599), intention to turnover (r = -0.464).

The primary antecedents of affective commitment are organizational experiences and individual experiences (Allen and Meyer, 1997). Organizational experiences include factors such as autonomy, inclusion in the decision-making process, supportiveness and fairness. Individual experiences include personal fulfillment, having rewarding experiences, and the nature of organizational practices. The degree of organizational and individual experiences will contribute to the level of a person's organizational commitment. With respect to student commitment to their academic program, Withey (1990) found that the most critical antecedents to affective commitment of an academic program were investment made in education (both in terms of energy expended and finances allocated), and the social environment of the academic program. Most research on the antecedents of student commitment consistently points towards two factors: social integration and faculty-student interaction. These factors are prominently featured in Tinto's (1975) model of student retention, and are also included in the proposed study (Bean, 1980; Pascarella & Terenzini, 1980, Tinto, 1997).

Based on this body of research, it is expected that institutional experiences and student integration will influence commitment.

H5. The extent to which students perceive a supportive climate for retention positively predicts affective commitment to the program. The more supportive a climate for retention is perceived, the more committed students are to their program.

H6. The relationship between climate and commitment will be moderated by gender. Supportive climate perceptions will be more predictive of commitment to the program for women than men.

H7. The extent to which students are socialized in their program will positively predict commitment. The more students are socialized, the more committed they feel to their program.

H8. The relationship between socialization and commitment will be moderated by gender. Socialization will be more predictive of commitment for women than men.

Empirical support for Tinto's model of student departure

Tinto's model received much support in the 1980's (Pascarella & Chapman, 1983; Fox, 1986; Pascarella & Terenzini, 1983) when it was tested in traditional environments, with traditional undergraduate students pursuing an education is a variety of disciplines. Pascarella and Terenzini (1980) tested Tinto's (1975) model. Their research used factor analysis to confirm five variables which play a role in the prediction of student retention: a) peer group interaction, b) interactions with faculty, c) faculty concern for student development, d) academic and intellectual development, and e) institutional and goal commitments. These results supported the existence of and relationships among the major variables proposed in Tinto model. These results also support their previous conclusion that post-matriculation experiences are more important than pre-matriculation student characteristics when accounting for student commitment (Terenzini & Pascarella, 1978).

However, the current landscape of the student population has shifted towards a greater percentage of non-traditional students and environments, and the research needs to progress in order to remain reflective of the current environment of student learning.

Ashar and Skenes (1993) sought to apply Tinto's theory of student retention to a sample of non-traditional undergraduate students in a management program, with an emphasis on the roles of social and academic integration. The researchers here sought to test this model with a sample of students, on average 40 years old. They made assumptions about the level of social interaction based on the student's similarity to the rest of the class, implying that the more alike the students were, the richer the quality of social interaction would be. Academic integration was measured by the degree to which students wanted to satisfy their need for academic achievement. Based on these definitions of Tinto's integration variable, they found that social, but not academic integration was a significant predictor of retention for their sample of non-traditional students. However, this assessment was based on professional homogeneity within classes, an imprecise measure of integration.

Tinto's theory has also been recently tested with graduate students, as well as the traditional focus on undergraduates. Vaquera (2007) applied Tinto's model to a sample of doctoral students at a traditionally Hispanic institution. Like the previous study, Vaquera chose to focus largely on the role of academic and social integration as predictors of attrition. In addition, the departmental climate (here, with an emphasis on racial climate) was also included in the model as a predictor of doctoral student persistence. Results of this study indicate that the more negative the departmental racial climate was perceived, the less likely that students would persist in the degree program. Additionally, the role of academic and social integration was significant in predicting persistence, although academic integration was found to be more important than social integration.

Research by Lovitts (2001) and Golde (2005) also highlight the importance of academic and social integration in the persistence of doctoral candidates. Both studies found that students who completed their degrees perceived a greater degree of integration than their non-completer counterparts. Golde (2005) found that frequent interaction with faculty and advisors predicted persistence in the sciences, which often feature an apprenticeship element to graduate study. This interaction with faculty was a less significant predictor of degree completion among the humanities, which is less centered on the mentor-apprentice relationship.

Research conducted on the retention of students in STEM majors based on on-site intervention programs can offer another glimpse into the undergraduate experiences of students. For example, Seymour and Hewitt (1997) conducted a three-year study that examined the factors affecting undergraduate persistence in STEM majors. Interviews with undergraduate students revealed a number of common themes, such as dissatisfaction with the faculty and a competitive environment among peers.

Beyond the factors that affect all students in STEM, they sought to uncover the specific obstacles faced by women. Women talked about issues such as feelings of alienation from the faculty, uncertainty when asking faculty for help, developing a social network and feeling like part of a community. Women who were successful in STEM programs named the positive socialization with other women in their program as important to their success. This socialization included mentoring programs, relationships with advisors and female study groups. These relationships were found to be more important to the women in the sample than the men. Seymour and Hewitt (1997)

concluded that the existence of support programs specifically geared toward women in STEM would bolster women's involvement and integration in their program.

In another study based on an intervention program, Hyde and Gess-Newsome (1999) described Project Access, a university-based program for women in STEM majors. The found that the relationships with female peers served to encourage persistence, because they had the ability to identify with other women sharing similar experiences.

Finally, a longitudinal study at the University of Washington was conducted to increase the retention of women and identify factors that impacted the retention of women in STEM (Brainard & Carlin, 1998). They found that among upper-division students (juniors and seniors), acceptance by their department, faculty and peers was predictive of persistence. Perceived barriers specific to women included lack of self-confidence, feeling of intimidated and isolated, and having a poor advising relationship.

The results of these studies directly point to the importance of climate and socialization factors in the retention of STEM undergraduates, especially women. This corresponds with the predictions made by Tinto (1975) in his model of student withdrawal.

Tinto's theory of student withdrawal provides the theoretical foundation for the research being proposed. It specifies both the personal and environmental factors associated with voluntary student withdrawal, and highlights the role of institutional experiences, socialization, and commitment in student withdrawal. By conducting the proposed research, I hope to identify some of the reasons behind the disproportionate rates of withdrawal by female engineering undergraduates. It is believed that because

they are in the minority, the social environment, or in this case, the program climate, will have a greater impact on women than men. By examining the program climate, interpersonal environment, socialization processes, and commitment, it is hoped that a better understanding of gender-specific issues will be gained. This has important implications for both colleges and their students, as they can use this information to give well-informed advice and guidance to struggling female students, or focus on encouraging potential female engineers to enter into the sciences. The more that is known about the climate of engineering programs, and the relationship between program climate and a desire to withdraw, the better we can prepare its students for success.

Chapter Three: Method

This study was developed from a National Science Foundation grant entitled "Effects of College Degree Program Culture on Female and Minority Students' Science, Technology, Engineering and Mathematics Participation" (NSF STEM Talent Expansion Program-STEP II Award #0525408) funded by NSF. The purpose of this grant was to investigate the program culture and other environmental conditions that encourage the successful completion of undergraduate degrees in science, technology, engineering and mathematics by undergraduates, with a special emphasis on underrepresented populations, such as women and minority group members. This research project was conducted in two and four-year public institutions of higher education in the State of Florida. An inter-disciplinary, mixed methods approach to data collection was taken, and included classroom observations, interviews, focus groups and surveys. The goals of the study were to contribute to the existing knowledge base concerning education and STEM careers, and to contribute more broadly to the literature on organizational culture and climate and their influence on important higher education outcomes.

One goal of the research grant was to identify the specific factors which create a climate for retention, and to develop a measure that can quantify this climate. In order to create a survey that represented a well-rounded explication of retention climate, research on career decision-making and outcomes conducted by anthropologists, sociologists and psychologists was considered. These perspectives involve different theoretical foundations (person-centered on the psychological side, structural/organizational from

the sociological perspective and cultural from the anthropological perspective) and different research methods. When integrated, they provide complementary sources of information on STEM persistence. Extensive reviews of the literature in the disciplines of higher education, psychology, sociology, and anthropology were conducted. This information, combined with the content of student and faculty interviews completed for this purpose provided the basis for a list of elements thought to reflect a climate for student retention in higher education in general, and specifically a climate for student retention within STEM programs. In total, nine elements of student retention climate were specified: Involvement, Faculty Support, Institutional Support, Helpfulness, Diversity, Integration, Fit, Engagement, and Importance. Items for these elements were written and the climate for retention survey was created and piloted. The result was a 53 item scale measuring nine elements of STEM program climate.

Survey administration

Administration of the climate for retention survey began in January 2007 and ended in May 2008. Data were collected from undergraduate students in Engineering and Chemistry programs enrolled in nine four-year institutions (both public and private) and four community colleges throughout the state of Florida. Students volunteered to take the survey, which took approximately 30 minutes to complete, and were paid $10 for their participation. Surveys were administered as a paper-and-pencil instrument, and responses were recorded on a scantron form. Students were required to complete the survey in person, and response forms were checked for accuracy before the student was awarded their compensation. Concurrently, qualitative interviews and classroom observations were also conducted with students, faculty and key members of the program

administration. However, the proposed study focuses on a subset of these data, specifically data representing Engineering students at four-year institutions.

Participants

Inclusion criteria. In order to qualify for inclusion in the study, participants must be at least 18 years old, enrolled full- or part-time at one of the eight targeted universities, and be a registered engineering or pre-engineering major.

Sample characteristics. This sample contains 1,421 students enrolled as undergraduate engineering or pre-engineering majors. Approximately 22% of the sample was female, and the average age was 22 years old (*SD*=3.4 years). The sample of students was predominantly White (47%), and 24% identified themselves as Latino/Hispanic, 16% Black, and 7% Asian/Pacific. Most of the students in the sample were in their junior or senior year (73.4%) and over one-quarter of the students majored in civil engineering (27.3%; see Table 1, Table 2, Figure 2).

Comparison of the sample characteristics to national enrollment. The distribution of sample demographics closely matches the national enrollment figures for Fall 2007 as reported by the Interactive University Database. The gender and racial/ethnic distributions of undergraduate students at four-year institutions were as follows: 20% female; 55% White, 26% Latino/Hispanics, 18% Black, and 7% Asian. Not only was the sample representative of national enrollment figures, it was also representative of the enrollment figures for the university as a whole. The proportion of females enrolled in each of the institutions in the sample closely approximated the overall enrollment distribution of that school, with the most female engineers enrolled in Florida State University/Florida Agricultural and Mechanical University (FSU/FAMU,

Table 1. Demographic characteristics of the sample

Variable	Overall N	Overall %	Female %
Gender			
Male	1067	77.9	--
Female	302	22.1	--
Age (years)[a]	22.1 ± 3.4		
18	115	8.4	20.0
19	114	8.3	19.3
20	151	11.0	26.5
21	274	20.0	26.6
22	269	19.6	21.6
23	133	9.7	24.1
24	80	5.8	13.8
25	48	3.5	27.1
26-30	97	7.1	19.6
31-35	30	2.2	10.0
36+	15	1.1	20.0
Ethnicity			
Caucasian/White	625	45.7	19.0
Latino/Hispanic	315	23.0	25.7
African American/Black	211	15.4	23.2
Asian/Pacific Islander	93	6.8	25.8
American Indian	8	0.6	37.5
Other	78	5.7	25.6

a. Mean ± *SD*.

Tallahassee – 21.1% female), followed by the University of Florida (UF, Gainesville; 20.7%), Florida International University (FIU, Miami; 18.7%), the University of South Florida (USF, Tampa; 16.7%), the University of Central Florida (UCF, Orlando; 14.9%), and Florida Atlantic University (FAU, Boca Raton; 14.4%). Enrollment figures for Florida Institute of Technology (FIT, Melbourne) and Embry Riddle Aeronautical University (ERAU, Daytona Beach) were not available.

Table 2. Educational characteristics of the sample

Variable	Overall N	Overall %	Female %
University			
FAMU/FSU	232	16.9	22.4
USF	213	15.6	23.5
UF	207	15.1	29.5
UCF	188	13.7	21.8
FIU	180	13.1	22.8
FAU	138	10.1	17.4
FIT	122	8.9	17.2
ERAU	55	4.0	12.7
Grade Level			
1st year	142	10.4	18.3
2nd year	127	9.3	19.7
3rd year	299	21.8	27.4
4th year	420	30.7	22.6
5th year	289	21.1	17.6
Major			
Aerospace	77	5.6	10.4
Civil	380	27.8	24.2
Electrical	177	12.9	11.3
Mechanical	251	18.3	11.2
Chemical	88	6.4	45.5
Computer	128	9.3	16.4
Environmental	21	1.5	47.6
Industrial	73	5.3	45.2
Biomedical	38	2.8	52.6
Ocean	30	2.2	10.0
Other	63	4.6	33.3

Variables

As mentioned, the climate for retention survey contains nine elements of program climate, as well as a measure of socialization, commitment, and questions regarding student withdrawal. Only a subset of the items which best reflect the nature of Tinto's factors for student retention were included in the study, and these are discussed in more detail.

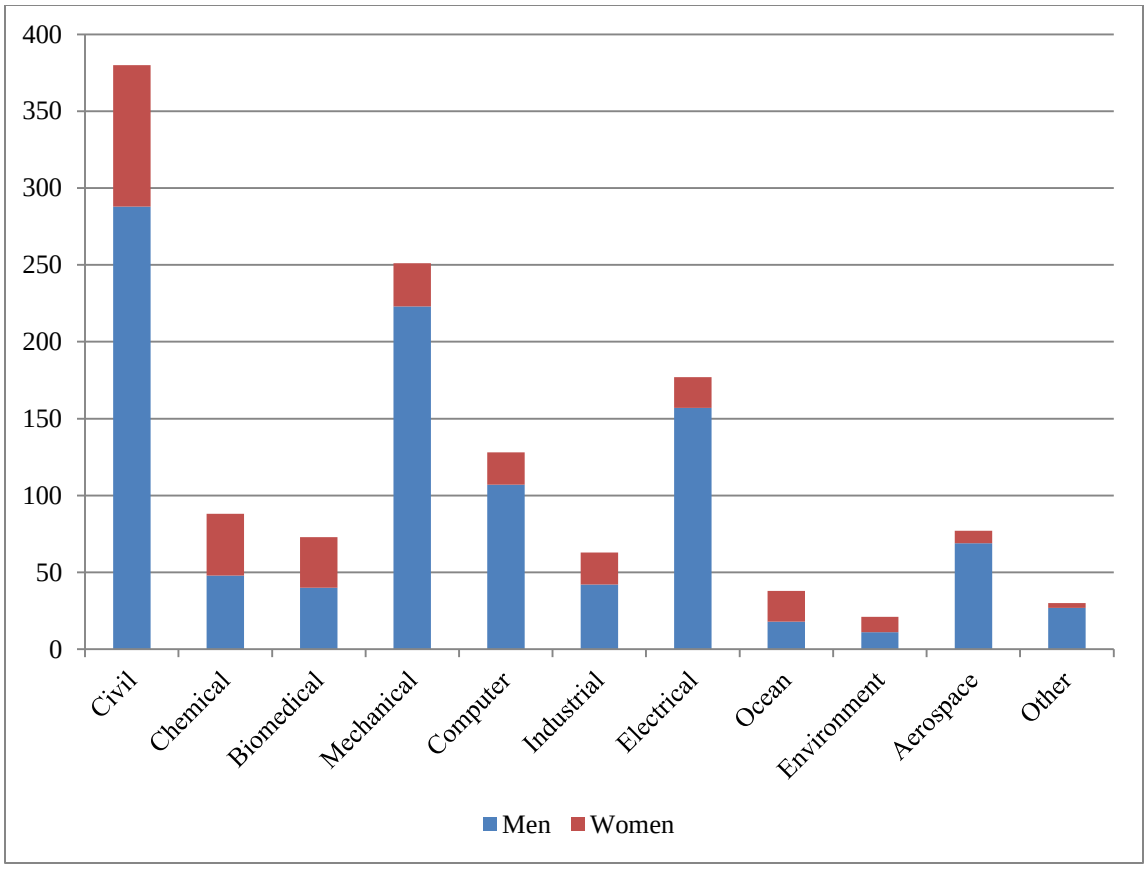

Figure 2. Participant enrollment by major

Involvement. A measure of students' perceptions of faculty involvement in academic life was developed using five items anchored on a 5-point Likert-type scale (1 = strongly disagree to 5 = strongly agree; items 1-5). Students indicated their level of agreement with a set of items capturing faculty availability and help to students, responsibility for students' success, and enthusiasm about teaching. Examples of items included "faculty and staff help students achieve professional goals" and "faculty members are enthusiastic about teaching."

Faculty support. Faculty support was measured with four items for which students were asked to indicate, on a 5-point Likert-type scale (1 = strongly disagree to 5 = strongly agree; items 6-9), their level of agreement with items that captured the types of assistance provided by faculty and staff to help students master knowledge in their

discipline and develop creative capacities. An example of an item in this scale was "faculty and staff provide students with strong academic and professional role models."

Helpfulness. Six items were used to assess the extent to which students perceived members of the department were helpful by indicating their level of agreement on 5-point Likert-type response scale (1 = strongly disagree to 5 = strongly agree; items 10, 15-16, 18, 35, 36) with items such as "people generally care about students' wellbeing," "the interpersonal atmosphere is cold," and "faculty and staff make students feel inferior."

Diversity. The extent to which students perceived members of their department embrace diversity was captured by 9 items. Students were required to indicate their level of agreement on 5-point Likert-type response scale (1 = strongly disagree to 5 = strongly agree; items 11, 14, 21, 25-27, 29-30, 33) to statements regarding what happens in the department with respect to cultural and gender diversity.

Integration. Four items captured the extent to which students perceived they were integrated in their department by having them indicate, on a 5-point Likert-type scale (1 = strongly disagree to 5 = strongly agree; items 13, 19, 22, 31), their level of agreement with items such as "students often work together on team projects," "students share strategies for success with each other," and "students often learn from each other."

Socialization. An adaptation of the newcomer socialization scale by Chao, O'Leary-Kelly, Wolf, Klein & Gardner, 1994) was used to examine the extent to which students' were socialized in their program. Minor alterations were made to the scale's items to better reflect the university environment. For example, the item "I understand the goals of my organization" was adjusted to read "I understand the goals of my academic department". Students responded to 12 items on a 5-point Likert-type scale (1 = strongly

disagree to 5 = strongly agree; items 61-72). The measure includes six dimensions of socialization, and items from three of these factors were included in the climate for retention survey. The three factors chosen (People, 4 items; Organizational Goals and Values, 4 items; Performance Proficiency, 4 items) were selected because they best reflected the nature of Tinto's Integration factor.

Commitment. An adaptation of the affective commitment scale (Allen & Meyer, 1990) was included to determine the extent to which students felt a sense of commitment to their program. Minor alterations were made to the scale's items to better reflect the university environment. For example, the item "my organization has a great deal of personal meaning for me" was adjusted to read "my department has a great deal of personal meaning for me". Students responded to four questions reflecting their degree of commitment on a 5-point Likert-type response scale (1 = strongly disagree to 5 = strongly agree; items 54-57). This set of questions represents the proximal outcome in Tinto's model of student withdrawal, which is student commitment.

Intent to withdraw. Students were asked to respond to the statement, "Given an opportunity to enroll in the same degree program at a different but equally ranked university, I would…" by indicating whether they would (a) definitely maintain enrollment at their university, (b) probably maintain enrollment at their university, (c) don't know—no opinion, (d) probably enroll at the alternative university, or (e) definitely enroll at the alternative university. Responses to this item were coded such that lower endorsed values represent a desire to stay at the current program, and higher endorsed values indicate a desire to withdraw from the current program. This question represents the distal outcome of the Tinto model, which is student withdrawal from the program.

Here, however, the student is being asked about *hypothetical intentions to withdraw*, which allows a response independent of outside constraining factors, such as finances or location of the institution; this encourages the student to only consider factors related to the quality of their experiences within the department when reflecting on their intentions to withdraw.

Background information. In addition to the climate for retention survey, students also completed a background information sheet which contained general demographic questions, as well as information regarding their choice of major, time in school, financial status and housing information. Gender was dummy coded for analyses as male = 0, female = 1.

Chapter Four: Results

The goal of the study was first to examine the climate for retention scale and determine what dimensionality is represented by the scale content. After the dimensions of climate for retention were defined, hierarchical multiple regression was used to determine what relationships exist between the major variables of the study: climate for retention, socialization, commitment, and intent to withdraw.

Preliminary analysis

Data screening. All variables were examined for missing values and accuracy of data entry. In the event of missing data, a determination was made whether to delete a participant from the analysis or replace the missing value(s). Participants who were missing more than 10% of their data points (seven items) were removed from the data set (n=52), leaving a final sample of 1369 students. The remaining missing values were replaced with the participant's response to the item with the highest positive correlation to that of the item with the missing data point. The use of scantron technology reduced the chance of data entry errors, and the range of values for each item was also examined to check for impossible values (i.e., no values of 6 on a five-point response scale). No issues regarding accuracy of data were found. Data from the hand-entered background information sheet was also reviewed to ensure no errors were made during data entry.

Assumption testing. The data were evaluated to determine if they met the assumptions for regression and factor analysis. Regression requires linearity of the relationship between dependent and independent variables, independence of errors,

normality of dependent variables, normality of residuals, and homoscedascticy of residuals. In addition to the assumptions for regression, factor analysis also requires a substantial sample size and adequate factorability among the data.

The relationships specified in all hypotheses are anticipated to be linear in nature, and the literature does not suggest that potential polynomial or other non-linear relationships should be expected. Independence of errors was also not expected to be problematic in this sample of data. Independence was verified by referring to the Durbin-Watson coefficient for each regression equation. For a sample of this size, the desirable values for the Durbin-Watson autocorrelation coefficient should fall between 1.9 and 2.1. In each case, the values fell close to or within this range, generally indicating independence of data. Normality of dependent variables was evaluated by visual inspection of histograms and boxplots, as well as calculating skewness and kurtosis values. The variable commitment appeared to be normally distributed, while the variable intent to withdraw was positively skewed. This is believed to be due to the nature of the variable itself, given that intentions to withdraw from the current academic program are less common than intentions to stay and graduate from the individuals' current institution. Normality of residuals was evaluated by visual inspection of histograms of the standardized residuals. The residuals from regressions predicting commitment were normally distributed, whereas the residuals from regressions predicting intent to withdraw were very slightly negatively skewed. Finally, homoscedasticity of residuals was evaluated by plotting the standardized residuals against the standardized predicted values. The distribution of residuals appears to be random, providing evidence of homoscedastic error. Although not all of the assumptions were completely met,

regression analyses tend to be robust to minor violations of normality (Tabachnick and Fidell, 1996) so the analysis proceeded using the original data.

Factor analysis generally requires a large set of data, and while there is no exact formula for determining what the appropriate sample size should be, several recommendations, or rules of thumbs, have been have been made with respect to the relationship between the number of items to be analyzed and the size of the sample. The number of participants in the proposed study well exceeds 1,000, and it is expected that no matter what rule of thumb is applied, the sample size will be more than sufficient for this type of analysis.

Statistical analyses were conducted to check the factorability of the data. The Kaiser-Meyer-Olkin measure of sampling adequacy (KMO; 0.91) and Bartlett's test of sphericity ($\chi^2 = 10651$, $p<.05$) were calculated. A KMO value of well over 0.5 and large, significant chi square value resulting from the Bartlett test indicate that items share common factors, providing support for factor analysis (Kim & Mueller, 1978).

Factor analysis

The Climate for Retention scale was written with the goal of addressing a number of dimensions theorized to be evidence of a climate for retention. To determine if the climate for retention scale reflects a multidimensional structure or one general factor, an exploratory factor analysis (EFA) was conducted. EFA can be used to identify the underlying structure of a relatively large set of variables. Because the climate scale was written to assess a number of dimensions, but this dimensionality was never tested, there are no justifiable *à priori* assumptions about specific items associated with any predicted factor to be made. The factor loadings found as a result of the EFA guided the factor

structure of the data. The goal of the factor analysis was to determine the dimensionality of the climate for retention scale, and to provide a foundation for creating composite scores for each of the factors.

The EFA was conducted with a principal axis factoring (PAF) extraction, to maximize the variance extracted by the factors. PAF is frequently used to explain the constructs accounting for the variance of a measure, and was selected instead of principle components analysis for this analysis because it is most useful for identifying latent variables rather than simply reducing the number of items (Preacher & MacCallum, 2002). Oblique rotation was chosen to allow for the factors to be correlated with each other, because it is reasonable to believe that the various elements represented in the climate for retention scale would be related to some degree. Tabachnick and Fidell (2006, p. 646) suggest looking to the factor correlation matrix for a confirmation that an oblique solution is appropriate. If the factors show a correlation of 0.3 or higher, there is enough shared variance among the factors to support the decision to use an oblique rotation. If the correlations are smaller, however, it may be better to use an orthogonal rotation instead. The intercorrelation between the factors was moderate (ranging between $r = .39$ and $r = .49$), indicating that the oblique rotation was appropriate.

The factor structure was evaluated using several different indicators, because it is best when the identification of the factors do not rely on any single indicator. Pattern coefficients, eigenvalues and the scree plot were all examined to determine the final factor structure of the climate for retention scale. In the first step of the factor analysis, all 28 of the climate for retention items described above were included, and the Kaiser rule was followed, which recommends retaining all factors with eigenvalues greater than one

(Kaiser, 1960). This resulted in five factors explaining 50.2% of the variance. This factor structure, however, was not interpretable, and had only one item loading on the fifth factor. In the next steps, a four-factor model and a three-factor model were forced on the data, and explained 46.2% and 41.3% of the variance, respectively. These factor structures, however, resulted in problematic cross-loadings and somewhat uninterpretable item distributions among factors. In the final step, five items were removed due to low communalities and low pattern coefficients, and the factor analysis was re-run with the 23 remaining items. A four-factor model was requested from the data, which explained 52.2% of the variance, and resulted in a simple structure with interpretable factors. The final four-factor model had item communalities that were generally strong; no item had a communality below .20, and no items loaded below .35 on their respective factor, or had a multiple factor loading value greater than .30.

The four factors derived from the previous analysis represent four distinct dimensions of a climate for retention. After considering the common themes among items within each factor, the resulting factors were named Faculty Support, Sense of Community, Encouraging Diversity, and Valuing Diversity. The first factor, Faculty Support, contains nine items (survey items 1, 3-9, 18), and accounted for 29.5% of the variance. It reflects ideas about the extent to which faculty seemed supportive of students and encouraging of their educational and professional goals. The second factor, Sense of Community, contains five items (items 10, 13, 19, 22, 31), and accounted for 9.5% of the variance. It represents the degree to which students are perceived to work together and share strategies for success with each other. The final two factors represent behavioral and attitudinal elements of diversity. The factor Encouraging Diversity contains four

items (items 27, 29-30, 33), and accounts for 7.1% of the variance. It represents behaviors which are thought to be evidence of supporting diversity, such as the absence of discriminatory behavior, and the perception that all students are treated equally. The final factor, Valuing Diversity, contains five items (items 11, 14, 21, 25-26) and accounts for 5.9% of the variance. It represents values that are supportive of diversity, such as prioritizing the creation of a diverse environment and respecting cultural differences (see Table 3).

After the factor structure of the scale was defined, factor scores were calculated for use in the subsequent regression analyses. A summative score was calculated to represent the scale score for each of the four climate factors. Faculty Support is represented by nine items, so the range of possible scores on that factor ranges from a minimum of 9 to a maximum of 45. The mean rating was 31.61 (*SD* = 5.62), and the reliability of this factor was the highest of all the climate factors, $\alpha = 0.85$. Sense of Community is represented by five items, so the range of possible scores on that factor ranges from a minimum of 5 to a maximum of 25, with an average rating of 19.66 (*SD* = 3.55). The reliability of this factor was the second highest of the climate factors, $\alpha = 0.80$. Encouraging Diversity is represented by four items, and a range of possible scores from a minimum of 4 to a maximum of 20. The average rating of Encouraging Diversity was 15.62 (*SD* = 3.18) and a reliability of $\alpha = 0.76$. Valuing Diversity is represented by five items, and a range of possible scores from 5 to 25. Valuing Diversity had an average rating of 17.91 (*SD* = 3.21) and a reliability of $\alpha = 0.72$.

Table 3. Pattern coefficients for the climate for retention survey

	Climate for Retention Survey Items	Factor 1	2	3	4
8.	Faculty and staff go out of their way to help students master the knowledge in their discipline	**.758**	-.030	-.134	.012
5.	Faculty are enthusiastic about teaching	**.717**	-.021	.087	-.106
6.	Faculty and staff provide students with strong academic and professional role models	**.694**	.000	.026	-.029
9.	Faculty and staff are generally encouraging towards students	**.635**	.049	.108	-.052
7.	Faculty and staff help students develop creative capacities	**.624**	-.031	-.056	.078
3.	Faculty and staff help students achieve professional goals	**.562**	.019	.012	.064
4.	Faculty and staff seem to take responsibility for students' success	**.550**	-.030	-.061	.062
1.	Faculty and staff are often available for students to see outside of regular office hours	**.496**	.047	-.013	.026
18.	Faculty or staff will offer help to a student who appears lost or confused.	**.402**	.082	.099	.071
19.	Students share strategies for success	-.035	**1.067**	-.044	-.146
13.	Students often work together on team projects (e.g., research projects)	.029	**.712**	-.022	.003
10.	Current students try to make new students feel included	.046	**.659**	-.063	.032
22.	Students often learn from each other	-.080	**.357**	.089	.293
31.	There is an overall sense of community among the students	.129	**.354**	.165	.233
30.	Instructors treat all students the same, both men and women	.009	-.038	**.915**	-.159
29.	Instructors treat all students the same regardless of their race or ethnicity	.013	-.032	**.833**	-.083
26.	Special efforts are made to help racial and ethnic minority students feel like they "belong"	.084	-.054	**.515**	-.022
33.	I have never observed discriminatory behaviors (e.g., words or gestures) directed towards female students	.012	-.055	**.474**	.056
21.	People value diversity	-.038	-.029	-.018	**.782**
11.	It is a priority to create a diverse, multicultural environment	.012	-.016	-.143	**.616**
27.	The perspectives of men and women are equally valued	-.083	.018	.172	**.571**
25.	There is a genuine concern for the needs of students of all races and ethnicities	.102	-.053	.109	**.467**
14.	People show respect for cultural differences	-.039	.125	.266	**.380**

In addition to the four climate factors, two other variables were included in the subsequent analysis: socialization and commitment. Summative composite scores and reliabilities for the socialization and commitment scales were also calculated.

As discussed previously, each of the climate factors were moderately correlated with one another. The largest correlation among climate factors was that of Sense of Community with Valuing Diversity (r = 0.49). Commitment and socialization also exhibited moderate correlations with each of the climate factors, and intent to withdraw displayed an inverse relationship with all other study variables, as predicted. That is, the greater the perceptions of a supportive climate, positive socialization and strong commitment, the less students were inclined to report intentions to withdraw from the program. The correlations among study variables, as well as the psychometric properties of all scales were calculated (see Table 4).

Table 4: Correlations among major study variables

Variable	M	SD	FS	SC	ED	VD	Social	Commit
FS	31.62	5.62	(.846)					
SC	19.66	3.55	.398	(.799)				
ED	15.62	3.18	.410	.390	(.759)			
VD	17.91	3.21	.447	.489	.438	(.715)		
Social	45.26	6.15	.408	.429	.319	.348	(.781)	
Commit	13.48	3.09	.453	.366	.292	.337	.570	(.720)
Withdraw	2.33	1.207	-.276	-.172	-.194	-.164	-.304	-.316

Note: All correlations are significant at p<.01. Scale reliabilities appear in parentheses on the diagonal. FS= faculty support, SC=sense of community, ED=encouraging diversity, VD=valuing diversity, Social=socialization, Commit=commitment, Withdraw=intent to withdraw.

Multiple regression

One of the major goals of this study was to determine what differential effects of program climate and socialization had on men as compared to women. Therefore, before

the regression analyses were undertaken, some preliminary investigations regarding gender differences were done.

Gender differences. Independent t-tests were used to test for gender differences in each of the four climate factors, socialization, commitment, and intentions to withdraw. Regarding climate for retention factors, significant gender differences were found on the climate dimension of faculty support, $t(1367) = 2.70$, $p<.05$, with men reporting higher levels of faculty support (M=31.82, SD=5.72) than women (M=30.88, SD=5.22). Significant gender differences were also found on the climate dimension of sense of community, $t(1367) = 2.63$, $p<.05$ (this alpha level was used throughout the entire analyses), with women perceiving a greater sense of community (M=20.13, SD=3.53) than men (M=19.52, SD=3.55) and on the climate dimension of encouraging diversity, $t(1367) = 3.99$, $p<.05$, with men reporting higher levels of encouraging diversity (M=15.81, SD=3.11) than women (M=14.95, SD=3.32). However, no gender differences were found on the climate dimension of valuing diversity, $t(1367) = -1.15$, ns.

Gender differences on the degree to which students are socialized in their program were also evaluated using an independent t-test. Significant differences between genders were found, $t(1367) = 4.45$, $p<.05$, with men reporting higher degrees of socialization (M=45.67, SD=6.00) than women (M=43.82, SD=6.46). Gender differences in the degree to which students felt committed to their department were found to be significant, $t(1367) = 6.12$, $p<.05$, with men reporting higher levels of commitment (M=13.75, SD=3.04) than women (M=12.52, SD=3.08). Finally, men and women's intention to withdraw from the program were evaluated using an independent t-test. Women reported a greater intention to withdraw from their program (M=2.98, SD=0.96) than men (M=2.15, SD=1.21),

$t(1367) = -12.53$, $p<.05$. Recall that endorsing higher values on this item represent a desire to withdraw from program, while endorsing lower values indicate a desire to stay at the current program (see Table 5, Figure 3).

Table 5. T-tests of major study variables by gender

Variables	*M*	*SD*	*t*	*d*
Faculty Support			2.70**	.172
Men	31.82	5.72		
Women	30.88	5.22		
Sense of Community			-2.63**	.173
Men	19.52	3.55		
Women	20.13	3.52		
Encouraging Diversity			3.99***	.267
Men	15.81	3.11		
Women	14.95	3.32		
Valuing Diversity			-1.15	.075
Men	17.85	3.22		
Women	18.09	3.15		
Socialization			4.45***	.297
Men	45.67	6.00		
Women	43.82	6.46		
Commitment			6.12***	.402
Men	13.75	3.04		
Women	12.52	3.08		
Intent to Withdraw			-12.53***	.760
Men	2.15	1.21		
Women	2.98	0.96		

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

To test for the existence of multicollinearity among the predictor variables, the tolerance statistic was calculated (Morrow-Howell, 1994). Small tolerance values are problematic, and those values below 0.1 are considered to be indicative of multicollinearity among the predictor variables. In each case, tolerance values were between 0.9 and 1.0.

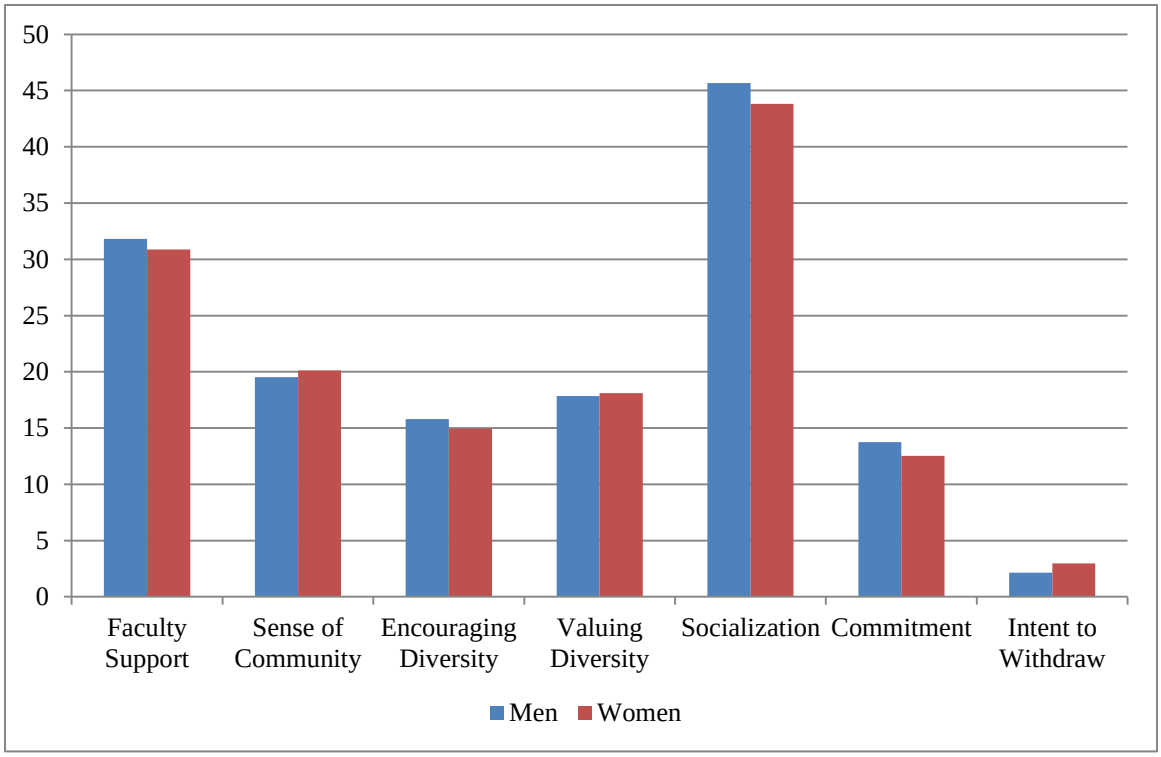

Figure 3. Ratings of study variables by gender

Hypothesis testing. Hierarchical multiple regressions were conducted to evaluate the contribution of climate factors and socialization to student commitment and intentions to withdraw. The same process was followed to test each of the eight hypotheses. In the first step of the regression, the predictor variable(s) of interest were entered as one block. This step addresses hypotheses 1, 3, 5 and 7. Gender is added to the second step of the equation, to determine what influence it has on the prediction of the outcome of interest. The third step of the regression adds the interaction between gender and the predictor variable(s) in one block. The interaction terms were created by multiplying gender and the predictor variable. This step addresses hypotheses 2, 4, 6 and 8.

Hypothesis 1 and 2. To test the first hypothesis that a supportive climate for retention negatively predicts intentions to withdraw, intent to withdraw was regressed on the climate for retention factors. All four climate factors were entered in the first block.

The first step of the regression analyses revealed that the block of climate factors accounted for a significant amount of variance (8.6%) in intentions to withdraw, $F(4, 1364) = 32.09$, $p<.05$. A further inspection of the individual predictors in the first block revealed that faculty support and sense of community significantly predicted intentions to withdraw, in the direction expected. Higher values on faculty support and sense of community predicted lower values on intent to withdraw. The corresponding beta weights revealed that faculty support had more predictive influence on intentions to withdraw than did sense of community. These results provide partial support for Hypothesis 1, indicating that some climate for retention factors negatively predicted intentions to withdraw.

Gender was added to the regression in a second block to understand how it influenced intentions to withdraw after the effects of climate were taken into account. There was a significant increase in the variance accounted for when gender was introduced, ($\Delta R^2=.073$, $p<.05$) and the overall model was significant $F(5, 1363)=51.73$, $p<.05$. The positive beta weight associated with gender indicates that females displayed a greater intent to withdraw than males, holding all other variables constant. In addition to gender, faculty support and sense of community remained significant predictors of intentions to withdraw.

To determine if gender played a moderating role in the relationship between climate factors and intentions to withdraw, the third block of predictor variables were entered in the regression equation, consisting of four gender-by-climate factor interaction terms. To test for significant moderator effects, the significance of the change in R^2 from the equation without the moderators to the equation with the moderator terms was

calculated. Although the third step of the regression model was significant, $F(9, 1359)=29.53$, $p<.05$, there was no significant increase in the amount of variance accounted for ($\Delta R^2=.004$, *ns*). Including gender as a moderator did not significantly increase the ability to predict intent to withdraw, and no support was found for Hypothesis 2 (see Table 6).

Table 6. Regression of intent to withdraw on climate for retention factors

Variables		*b*	*SE b*	*β*	R^2	ΔR^2	f^2
Step 1					.086		.094
	FS	-.047	.007	-.220***			
	SC	-.017	.011	-.050**			
	ED	-.031	.012	-.083			
	VD	-.002	.012	-.005			
Step 2					.159	.073***	.087
	FS	-.042	.006	-.195***			
	SC	-.029	.010	-.086**			
	ED	-.015	.011	-.039			
	VD	-.010	.012	-.027			
	Gender	.830	.074	.276***			
Step 3					.164	.004	.005
	FS	-.035	.007	-.164***			
	SC	-.032	.012	-.095**			
	ED	-.018	.013	-.046			
	VD	-.018	.013	-.047			
	Gender	.711	.531	.244			
	FS x Gender	-.038	.016	-.409			
	SC x Gender	.013	.024	.093			
	ED x Gender	.013	.026	.069			
	VD x Gender	.045	.030	.282			

Hypothesis 3 and 4. To test the third hypothesis that socialization will negatively predict withdrawal intentions, intent to withdraw was regressed on socialization in the first block. The first step of the regression analyses revealed that socialization accounted for a significant amount of variance (9.2%) in intent to withdraw, $F(1, 1367) = 138.86$, $p<.05$. There was a negative relationship between the two variables; higher levels of

socialization predicted lower ratings of intentions to withdraw. These results provide full support for Hypothesis 3.

Gender was added as the second block of the regression to understand how it influenced intentions to withdraw after the effects of socialization were taken into account. There was a significant increase in the variance accounted for when gender was introduced, (ΔR^2=.063, p<.05) and the overall model was significant F(2, 1366)=125.54, p<.05. The positive beta weight associated with gender indicates that females displayed a greater intent to withdraw than males, holding all other variables constant. In addition to gender, socialization remained a significant predictor of intentions to withdraw. Beta weights revealed that socialization was slightly more influential in predicting intentions to withdraw than was gender.

To test the moderating influence of gender on the relationship between socialization and intent to withdraw, a gender-by-socialization interaction term was entered in the third block of the regression. While the overall regression equation was significant, F(3, 1365) = 83.64, p<.05, there was no significant increase in the amount of variance explained (ΔR^2 = .00, *ns*), indicating that gender did not moderate the relationship between socialization and intentions to withdraw. Hypothesis 4 was not supported (see Table 7).

Hypothesis 5 and 6. To test the fifth hypothesis that a supportive climate for retention positively predicts commitment, commitment was regressed on the four climate factors. All four climate factors were entered in the first block. The first step of the regression analyses revealed that climate factors accounted for a significant amount of variance (25.5%) in commitment, F(4, 1364) = 116.45, p<.05. All four of the climate

Table 7. Regression of intent to withdraw on socialization

Variables		*b*	*SE b*	*β*	R^2	ΔR^2	f^2
Step 1					.092		.101
	Social	-.060	.005	-.304***			
Step 2					.155	.063***	.075
	Social	-.053	.005	-.272***			
	Gender	-.053	.073	.253***			
Step 3					.155	.000	.000
	Social	-.053	.006	-.270***			
	Gender	.803	.511	.276			
	Social x Gender	-.002	.011	-.023			

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

factors positively predicted commitment, which was in the direction expected. The corresponding Beta weights revealed that Faculty Support had the most predictive influence on commitment, followed by Sense of Community, with Valuing Diversity and Encouraging Diversity having the least amount of significant influence on commitment. These results provide full support for Hypothesis 5, indicating that each of the climate for retention factors positively predicted commitment, which was in the expected direction.

Gender was added as the second block of the regression to understand how it impacts commitment after the effects of climate were taken into account. There was a significant increase in the variance accounted for when gender was introduced, (ΔR^2=.024, p<.05) and the overall model was significant $F(5, 1363)=105.03$, $p<.05$. The negative beta weight associated with gender indicates that females reported lower levels of commitment than males, holding all other variables constant. With the addition of gender, all of the climate factors except encouraging diversity remained significant predictors of commitment.

To determine if gender had a moderating effect in the relationship between climate factors and commitment, a third block of variables were entered into the regression, consisting of four climate-by-gender interaction terms. The interaction terms

contributed a significant amount of additional variance, (ΔR^2=.005, p<.05), and the overall model was significant, $F(9, 1359) = 59.73$, $p<.05$. Faculty support, sense of community, valuing diversity and gender remained significant predictors. Evidence for the moderating effect of gender on faculty support was also found. The nature of the moderating effect was such that faculty support was more predictive of commitment for women than men. However, there was no evidence of a significant moderating effect for the three remaining climate factors. These results provide partial support for Hypothesis 6, indicating that gender has a moderating effect on one of the four climate factors (see Table 8).

Table 8. Regression of commitment on climate for retention factors

Variables	*b*	*SE b*	*β*	R^2	ΔR^2	f^2
Step 1				.255		.342
FS	.178	.015	.324***			
SC	.153	.024	.176***			
ED	.053	.027	.055*			
VD	.079	.028	.082**			
Step 2				.278	.024***	.033
FS	.170	.015	.310***			
SC	.171	.024	.196***			
ED	.029	.026	.030			
VD	.090	.028	.094**			
Gender	-1.165	.175	-.156***			
Step 3				.284	.005*	.007
FS	.154	.016	.281***			
SC	.152	.027	.175***			
ED	.033	.030	.034			
VD	.110	.031	.114***			
Gender	-3.623	1.258	-.486**			
FS x Gender	.094	.039	.398*			
SC x Gender	.088	.057	.242			
ED x Gender	-.009	.062	-.018			
VD x Gender	-.116	.070	-.287			

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

Hypothesis 7 and 8. To test the seventh hypothesis that socialization will positively predict commitment, commitment was regressed on socialization in the first block of the regression equation. The first step of the regression analyses revealed that socialization accounted for a significant amount of variance (32.5%) in commitment, $F(1, 1367) = 658.07$, $p<.05$. These results provide full support for Hypothesis 7, indicating that socialization positively predicted commitment, which was in the expected direction.

Gender was added as the second block of the regression to understand how it influences commitment after the effects of socialization were taken into account. There was a significant increase in the variance accounted for when gender was introduced, ($\Delta R^2=.009$, $p<.05$) and the overall model was significant $F(2, 1366)=342.26$, $p<.05$. The negative beta weight associated with gender indicates that females reported lower levels of commitment than males, holding all other variables constant. With the addition of gender, socialization remained a significant predictor of commitment.

To test for a significant moderating effect of gender on the relationship between socialization and commitment, a gender-by-socialization interaction term was entered in the third block of the regression. Although the overall regression equation was significant, $F(3, 1365) = 228.79$, $p<.05$), there was no significant increase in variance explained ($\Delta R^2=.001$, *ns*). This indicates that there was no significant moderating effect of gender. Hypothesis 8 was not supported (see table 9)

Exploratory analyses

In addition to testing the formally stated hypotheses presented in Chapter Two, additional analyses were conducted to further investigate the perceptions of climate and persistence indicators among student groups of theoretical and practical interest.

Table 9. Regression of commitment on socialization

Variables		*b*	*SE b*	*β*	R^2	ΔR^2	f^2
Step 1					.325		.481
	Social	.286	.011	.570***			
Step 2					.334	.009***	.014
	Social	.280	.011	.558			
	Gender	-.707	.166	-.095			
Step 3					.335	.001	.002
	Social	.272	.013	.542***			
	Gender	-2.142	1.161	-.287			
	Social x Gender	.032	.026	.193			

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

Independent t-tests were conducted to determine if significant differences existed each of the four climate factors, socialization, commitment, and intentions to withdraw between students in majors with a large proportion of females versus a small proportion of females. Majors were considered to have a high proportion of females if female students made up at least 25% of the students (see Table 2 for the percentage of females in each major). Of all the major study variables, significant differences were only found in two of the climate factors: Faculty Support, $t(1173)=3.91$, $p<.05$ and Sense of Community, $t(1173)=2.13$, $p<.05$ (see Table 10, Figure 4).

A multivariate analysis of variance (MANOVA) was conducted to determine if there were differences in ratings of the climate variables, socialization, or persistence indicators by year in school. Results of this analysis indicate that there were significant differences found among the major study variables, $F(7, 1266)=14357$, $p<.05$. Follow-up univariate analyses revealed differences by year in school on the following study variables: Faculty Support, $F(4, 1277)=4.98$, $p<.05$; Encouraging Diversity, $F(4, 1277)=2.80$, $p<.05$; Valuing Diversity, $F(4, 1277)=4.31$, $p<.05$; Socialization, $F(4, 1277)=11.45$, $p<.05$ and Commitment, $F(4, 1277)=3.13$, $p<.05$ (see Table 11, Figure 5).

Table 10. Climate rating by majors with high and low female participation

Variables	*M*	*SD*	*t*	*d*
Faculty Support			3.91***	.230
≥25% Female	32.35	5.47		
≤25% Female	31.07	5.67		
Sense of Community			2.13*	.127
≥25% Female	19.93	3.42		
≤25% Female	19.48	3.68		
Encouraging Diversity			-0.22	.012
≥25% Female	15.56	3.32		
≤25% Female	15.60	3.12		
Valuing Diversity			0.74	.044
≥25% Female	17.92	3.16		
≤25% Female	17.78	3.26		
Socialization			1.65	.097
≥25% Female	45.67	6.12		
≤25% Female	45.08	6.08		
Commitment			0.46	.029
≥25% Female	13.57	3.18		
≤25% Female	13.48	2.99		
Intent to Withdraw			0.20	.008
≥25% Female	2.31	1.21		
≤25% Female	2.30	1.21		

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

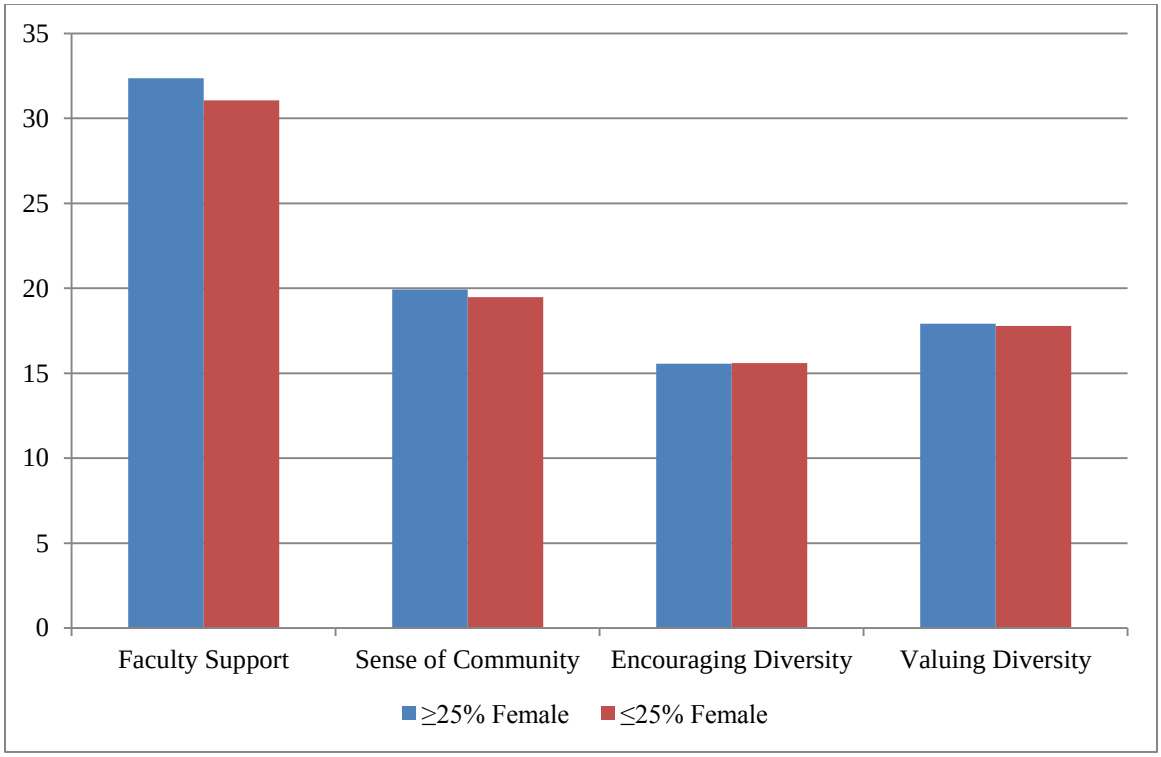

Figure 4. Climate ratings by majors with high and low female participation

Table 11. Ratings of major study variables by year in school

Variable	Year in School	*M*	*SD*
Faculty Support	1ST YR	33.38	5.54
	2ND YR	31.94	5.85
	3RD YR	31.36	5.66
	4TH YR	31.36	5.80
	5TH YR	30.93	5.32
Sense of Community	1ST YR	19.72	3.16
	2ND YR	19.36	4.00
	3RD YR	19.63	3.65
	4TH YR	19.65	3.62
	5TH YR	19.87	3.23
Encouraging Diversity	1ST YR	16.35	2.92
	2ND YR	15.40	3.32
	3RD YR	15.69	3.15
	4TH YR	15.35	3.32
	5TH YR	15.60	3.12
Valuing Diversity	1ST YR	18.85	3.28
	2ND YR	17.92	3.42
	3RD YR	17.94	3.28
	4TH YR	17.70	3.11
	5TH YR	17.58	3.05
Socialization	1ST YR	44.74	5.89
	2ND YR	42.81	6.26
	3RD YR	44.27	5.99
	4TH YR	45.62	6.38
	5TH YR	46.60	5.34
Commitment	1ST YR	14.27	2.98
	2ND YR	13.43	2.99
	3RD YR	13.28	3.08
	4TH YR	13.34	3.17
	5TH YR	13.30	2.89
Intent to Withdraw	1ST YR	2.11	1.09
	2ND YR	2.18	1.12
	3RD YR	2.32	1.14
	4TH YR	2.41	1.27
	5TH YR	2.38	1.26

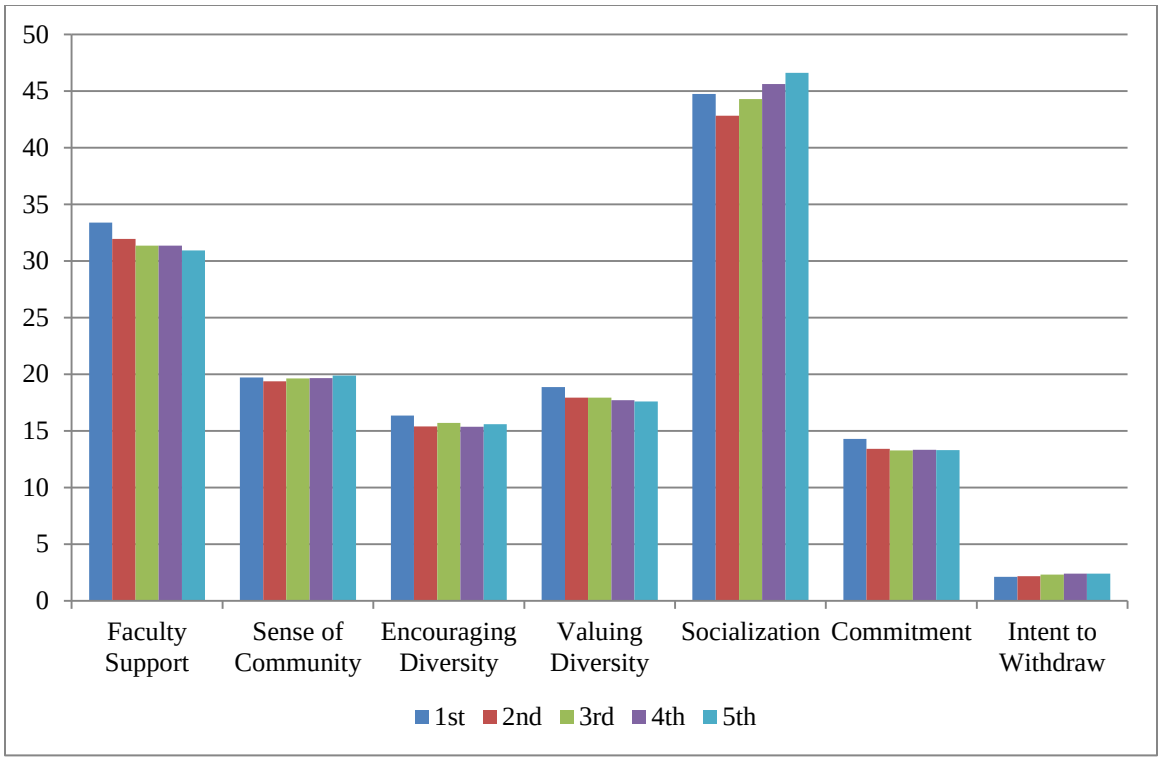

Figure 5. Ratings of major study variables by year in school

Chapter Five: Discussion

As discussed throughout this paper, it is clear that women have historically been underrepresented in engineering and other STEM fields. Beginning in the 1970's, a great deal of significant research has been conducted to determine what factors play a role in student retention in general, in student retention in STEM fields, and specifically the experiences of underrepresented minorities in STEM. This research revealed myriad factors, ranging from role models and peer networks to quality of the instruction. This work has made an increasingly positive impact on the population of students in question.

Although the number of women in STEM is growing, the distribution across majors is uneven and still low overall compared to men. This study focuses on how engineering students' intentions to withdraw are influenced by the perceptions of their academic environment and the people in it, with a specific focus on how these factors impact female students. By understanding these women's experiences, a better understanding of how their gender affects their persistence and success within the science and engineering community can be gained.

Dimensionality of a climate for retention

The first goal of this study was to describe an academic climate which encourages the retention of its students in STEM programs. Tinto theorizes that the role of student experiences is paramount in retention, and while many studies which followed Tinto included variables reflecting student experience, they are varied in nature and inconsistently applied. Some research focuses on objective indicators such as grades and

test scores, others on participation in study groups and academically oriented clubs and organizations. Even those researchers who explicitly study academic climate operationalize it in a variety of ways. An important first step of this study was to give some attention to the ways in which students described the climate of their STEM program, and to use that information to identify the most important factors for retention. Before any conclusions can be drawn about the influence of academic climate on its students, the nature of this academic climate must be better defined.

The factor structure of the Climate for Retention survey indicates that there are four underlying factors associated with a climate for retention: faculty support, sense of community, encouraging diversity and valuing diversity. Overall, these factors accounted for approximately half of the variance in climate scores. While this is not optimal, the information gained does help clarify students' experiences in their program and their perception of the academic environment around them. Each of these factors is discussed in greater detail below.

Faculty support. Items that comprised the faculty support dimension of a climate for retention reflected ideas about faculty being involved with and supportive of their students. This factor includes items about program faculty being enthusiastic about teaching, going above and beyond to help students, acting as role models to help students achieve their professional goals, and being generally encouraging towards students. Faculty support exhibited moderate positive relationships with all other climate dimensions, which indicates some overlap between this factor and other aspects of a climate for retention, while still remaining distinct from the other factors. With respect to the outcomes of interest, faculty support exhibited a moderate positive relationship with

student commitment, and a small negative relationship with intent to withdraw. It is interesting to note that faculty support was the climate factor with the strongest relationship to intent to turnover. Women perceived a lesser degree of faculty support than their male counterparts, indicating that they felt that the faculty was not as supportive, available and encouraging to them as they were to the male students.

It is not surprising that the interactions between students and faculty are important to student success in college. Students can benefit even more by developing individual relationships with faculty members which go beyond the usual classroom or laboratory setting. These student-faculty relationships need to be tended to by both parties, but it helps facilitate the development of the relationship if faculty members are approachable and available to their students (Kuh, Kinzie & Schuh, 2010, p. 208). This openness on the part of faculty can take on many shapes, such as encouraging students to work on research projects with them, collaborating in a non-academic activity like an academic club meeting, or having open and honest discussions about coursework. However, it is most important that faculty make themselves seem available and approachable to students. Interactions with faculty usually happen both inside and outside of the classroom, and neither should be overlooked. Interactions with faculty outside the classroom can encourage a dialogue that normally would not occur during class time, such as conversations about career goals. They also allow for a more individual relationship with faculty by proving important face time with the instructor. Pascarella and Terenzini (2005) believe that time with faculty outside the classroom environment is important because it "appears consistently to promote student persistence, educational aspirations, and degree completion" (p.417). They offer two complimentary explanations

for this: first, building relationships with faculty members help students to learn the norms and values of the institution, which is a critical component to effective socialization. Secondly, these relationships strengthen the student's bond to the institutions, and increase their commitment. Faculty members and other departmental figures maintain a unique perspective to the inner workings of their department, and have witnessed the strategies of successful students and the pitfalls of unsuccessful ones. This is vital information that students are not always privy to unless they begin to engage the faculty outside of class and develop a relationship which would allow for the exchange of this and other helpful information.

Although time with faculty outside the classroom is beneficial, the truth remains that for most students, the majority of exposure to faculty occurs during class time. This is not to say that faculty behavior during class is without impact. Faculty's actions, and their interaction with students, can influence the students' perceptions of the academic environment and their evaluation of instructional quality (Pascarella & Terenzini, 2005). Additionally, faculty behavior during class can set the tone for encouraging or discouraging interactions outside the classroom. Tinto (1993) believes that the positive interactions with faculty outside of the classroom originate with a supportive classroom environment.

Pascarella and Terenzini (2005) believe that student perceptions of faculty support and approachability alone will encourage student persistence. By fostering the sense that faculty is interested in their student's success, a supportive climate for students can be developed. It is important for departments to both encourage faculty-student interaction, and to create a climate that fosters these relationships. In addition to the obvious benefits

of students having a more interactive relationship with their faculty, they will have access to knowledge about the norms and values of the institution from the faculty's perspective, which promotes student socialization. These interactions ultimately improve the likelihood of student persistence (Bean, 2005).

Sense of community. Items that comprised the sense of community dimension of a climate for retention reflected ideas about a collaborative relationship among students who freely share knowledge with one another. This factor included items about whether or not students learn from one another, share their strategies for success, make other students feel included and generally foster a sense of student community in the program. The sense of community factor and the faculty support factor both reflect the personal element of the academic environment; they are both focused on the ways in which other members of the department (whether it be faculty or other students) are welcoming, supportive and encouraging. Sense of community exhibited moderate positive relationships with all other climate dimensions. It also showed a moderate positive relationship to student commitment, and a small inverse relationship to intent to withdraw.

The importance of a sense of community among the students is often mentioned as a critical component to student persistence and success. Tucker (1999) describes his view of sense of community as "any phenomena which made students feel a sense of belonging to the new educational environment" (p. 164). Students with a strong sense of community and a network of peers for social support benefit in a number of ways. They are better able to face academic challenges (Tucker, 1999), to negotiate barriers to their success (Brainard & Carlin, 1998), receive encouragement and develop a sense of deeper

social integration (Berger & Milem, 1999). Departments or programs that are collaborative in nature rather than those which foster a sense of competition among students tend to be associated with increased success for all students, particularly females and other under-represented groups (Smith, Gerbick, & Figueroa, 1997).

Interestingly, women felt there was a greater degree of community among the students than did their male counterparts. This could be due to the fact that women, as members of an underrepresented group, joined together in classrooms, study groups and in academic clubs for support and encouragement. There are also a number of intervention programs targeted specifically for women in engineering programs, which may also foster a sense of community that is more significant to women than it is to men. Men in the program may not perceive the sense of community among students to be as high because it is not a feature that is salient to them, or because they do not feel as much of a need to participate in classroom activities or study groups. In fact, one group of female engineering upperclassmen said the most important piece of advice they could give to women just entering the program would be to join a study group (Vogt, Hocevar, & Hagedorn, 2007).

Encouraging diversity. Items that comprised the encouraging diversity dimension of a climate for retention reflected behaviors that can be interpreted as supportive of a diverse learning environment. This factor included items reflecting the faculty's actions towards and treatment of underrepresented minorities, specifying treatment towards both women and racial or ethnic groups. Encouraging diversity had the strongest positive relationship with the other diversity-oriented factor, valuing diversity, and smaller positive relationships with the remaining climate factors, as well as

commitment. Encouraging diversity also had a small inverse relationship with intentions to withdraw. Similar to faculty support, women perceived their program to be less encouraging of diversity than male students did.

Valuing diversity. Items that comprised the valuing diversity dimension of a climate for retention reflected attitudes of people in the department towards underrepresented groups. These items focus not on overt discriminatory behavior (or lack thereof) but on the underlying values held by department members. This includes items about the degree to which people prioritize the creation of a diverse environment, value everyone's perspectives equally, and show genuine concern for all students, regardless of group membership. The encouraging diversity and valuing diversity factors both speak to the degree that a diverse environment is supported and prioritized, but each express that in a different way. It is important to examine both the attitudes and behaviors regarding diversity, so it can be determined to what degree department members' actions and beliefs align to promote a supportive environment for students of all backgrounds. The valuing diversity factor exhibited similar relationships in strength and direction to the other climate factors, commitment and intent to withdraw as did encouraging diversity. One interesting discrepancy to note is that there were no differences between men and women on their perceptions of the extent to which their programs valued diversity. Recall that women rated their programs to be significantly lower on encouraging diversity, the dimension that reflects behaviors towards underrepresented groups, yet they believe that overall, their program's attitude is supportive of its diverse student population. Perhaps there is a disconnect between the services that are provided for women by their department and individual behaviors of students and other department members. For

example, a female student could value the funding and support provided by her department to open a women's engineering club, but still feel marginalized in the classroom by her fellow male students, or perceive preferential treatment is being given to male students by the instructor. Another explanation could do with the ratings of encouragement given by male students. Because males are not the underrepresented group in engineering, they may be less sensitive to the behaviors of other department members towards women, and be more apt to believe that there is no differential treatment occurring. Women, on the other hand, would be more likely to notice if they felt slighted by a fellow student or instructor, in turn lowering their ratings of equal treatment by department members.

Gender differences in the perceptions of departmental attitudes towards diversity, and the existence of discriminatory behavior towards underrepresented groups are supported by a multitude of studies, especially research focused on women in STEM programs. Vogt, Hocevar and Hagedorn (2007) predicted that women would report more instances in which they felt discriminated against, either overtly or subtly, than men did in engineering programs. In fact, women felt that their male peers did not have as much respect for them as they did other male students, and that male students had an advantage over females in the program. Although explicit discriminatory behaviors and actions taken towards women may not be common, there is evidence that women do experience more subtle methods of discrimination, such as being left out of group discussions, or receiving less encouragement from their peers or instructors than their male counterparts. Seymour and Hewitt (1997) echo this by warning that male students' attitudes can often be covertly derogatory towards women. These attitudes can create a range of negative

situations for female students, from feeling vaguely uncomfortable around classmates to obvious attempts to exclude them. Peers can have a damaging effect on female students if they feel as though their contributions are being marginalized, and such experiences only undermine females' performance and self-confidence. One example of such subtle discrimination can be found in the creation of study groups. When students were allowed to choose their own groups for class assignments, they often gravitated towards groups members that were similar to themselves in race and gender. Because men are the majority of students in engineering and other STEM programs, this tendency often excludes women or other underrepresented groups (Rosser, 1998). Furthermore, women tended to withdraw from group activities if they were the only female group member, and in engineering (and other male-dominated fields) this trend is even more prominent (Vogt, et al., 2007).

However, it is not just peers that can discourage female participation in STEM programs. Faculty and other departmental staff can also be influential in the female student experience. Instructors are a main component in establishing the classroom environment. This can exert a great deal of influence on women's choice to pursue an engineering degree, and subsequent interactions in and out of the classroom can impact their willingness to persist in their field, especially if it is in STEM (Zeldin & Pajares, 2000). Unfortunately, faculty may or may not be aware of the crucial role they play in women's decisions to pursue and persist in engineering. Many faculty members reject the notion that they are discriminatory towards their female students, but subtle biases are perceived by female students, often with discouraging consequences.

For example, one study found that 84% of women who switched out of STEM cited a lack of adequate advising by faculty and staff as a major factor in their decision to switch majors. Conversely, when faculty members were perceived to be interested and invested in the goals of their students, this had a far greater positive impact on female students than it did male students (Seymour & Hewitt, 1997). Similarly, Vogt, et al. (2007) noted that female engineering students recalled more interactions with faculty who were discouraging than did male engineering students.

There is both statistical and theoretical support for the four dimensions of a climate for retention described above: having a supporting faculty (faculty support), feeling a sense of community among students (sense of community), witnessing equal treatment of all students (encouraging diversity), and perceiving that the academic department values its diverse student population (valuing diversity). Of course, there are many other elements responsible for fostering a supportive climate for student retention which were not featured in the current study, but the information presented here certainly sheds light on some major areas in which an engineering program can help support its students through their journey towards graduation.

Predicting indicators of persistence among engineering undergraduates

The first goal of the study was to describe the dimensions of a climate for retention, and examine the similarities and differences between male and female students' perspectives on these dimensions as they apply to their undergraduate engineering department. The second goal of this study was to take this four factor model of climate that was described above, and use it within the framework of Tinto's model for student withdrawal to examine the role these factors, among others, play in the prediction of

student commitment and intent to withdraw. Tinto theorizes in his model of student withdrawal that institutional experiences (which are operationalized here as the dimensions of climate) and student integration (which is operationalized here as socialization) ultimately predict student withdrawal. However, in his model, there are also proximal indicators of student persistence (of lack thereof) that are important consider, including the student's commitment and their intentions to withdraw. The current study considered the predictive influence of a climate for retention and socialization on commitment and intentions to withdraw, as well as the role of gender as a both a predictor and as a moderator of climate and socialization.

Climate and intentions to withdraw. It was hypothesized that each of the climate for retention factors would negatively predict withdrawal intentions, based on Tinto's theory that positive institutional experiences lead to student persistence (Hypothesis 1). If positive perceptions of a climate for retention predict student persistence, which is a positive outcome, then it follows that the same climate perceptions would have an inverse relationship with withdrawal intentions, which is a negative outcome. This is generally the pattern of results that was found. Higher ratings on faculty support and sense of community significantly predicted lower ratings of withdrawal intentions among engineering students, with faculty support having a greater influence on withdrawal intentions than sense of community. However, the factors encouraging and valuing diversity were not significant predictors of withdrawal intentions.

The role of gender was also of central interest in the prediction of withdrawal intentions. Adding gender to the model after the effects of climate were established approximately doubled the amount of explained variance in withdrawal intentions.

Although not formally hypothesized, it was expected that gender would be a significant predictor of withdrawal intentions, based on the retention literature and on the pattern of t-test results discussed previously, and that female students would have higher reports of withdrawal intentions than male students would. This was the pattern of results found. Also, with the addition of gender, the original two climate factors remained significant.

Finally, the role of gender as a moderator of the climate-withdrawal intentions relationship was examined (Hypothesis 2). There was no evidence of a moderating effect of gender on any of the climate factors, although the original predictors from the second step of the model remained significant. This indicates that while climate factors such as faculty support and sense of community predict withdrawal intentions, these relationships do not differ for male and female students.

Socialization and intentions to withdraw. In addition to the climate for retention factors which represent Tinto's institutional experiences, the role of socialization in the prediction of withdrawal intentions was also examined. Socialization plays an important role in the integration of a student to the academic department, because socialization represents the degree to which that student has gained knowledge about the people, the work and performance expectations, and the norms and values represented in that department (Chao, et al., 1994). It was hypothesized that socialization would negatively predict withdrawal intentions, based on Tinto's theory that student integration would lead to student persistence (Hypothesis 3). If positive socialization predicts student persistence, which is a positive outcome, then it follows that the same degree of socialization would have an inverse relationship with withdrawal intentions, which is a negative outcome. This is precisely what the results indicated. Socialization was a

significant negative predictor of intentions to withdraw, and accounted for a small percentage of the variance. When gender was entered into the model, even more variance in withdrawal intentions was accounted for. However, there was no evidence of an interaction between gender and socialization in the prediction of withdrawal intentions (Hypothesis 4). Although socialization did significantly predict withdrawal intentions, the strength or direction of this relationship did not differ between male and female engineering students.

Climate and commitment. It was predicted that each of the climate for retention factors would positively predict student commitment, based on Tinto's model in which positive institutional experiences lead to persistence (Hypothesis 5). This relationship was expected to be in the positive direction, unlike the proposed relationships with withdrawal intentions, because as perceptions of climate and socialization increase (become more positive in valence) so should the student's level of commitment. The data supported this hypothesis. Each of the four climate for retention factors were significant predictors of commitment, in the direction expected. Furthermore, these climate factors accounted for a far greater proportion of variance in commitment (approximately 25%) than they did in withdrawal intentions. When compared to each other, faculty support had the most influence on commitment, just as it did in the model for withdrawal intentions. Sense of community also had a comparatively large impact on commitment scores.

Adding gender to the model as a predictor of commitment slightly increased the amount of explained variance, with female students reporting lower levels of commitment than male students. It also rendered encouraging diversity an insignificant

predictor of commitment, but the other three climate factors (faculty support, sense of community, valuing diversity) remained significant.

Finally, the moderating role of gender in the climate-commitment relationship was tested, and one significant interaction was found (Hypothesis 6). Although it added little to the amount of explained variance in commitment, there was evidence for the moderating effect of gender on the relationship between faculty support and commitment. This relationship was such that faculty support was more predictive of commitment for female engineering students than it was for male students.

Socialization and commitment. It was hypothesized that socialization would positively predict commitment, based on Tinto's theory that student integration would lead to student persistence (Hypothesis 7). Similar to the relationships between climate factors and commitment, this relationship was predicted to be in the positive direction, because greater levels of integration should lead to greater levels of commitment. The results of this analysis support this prediction. Socialization was a significant predictor of commitment in the direction expected, and accounted for almost a third of the variance in commitment. When gender was entered into the model, additional variance in withdrawal intentions was accounted for. However, there was no evidence of an interaction between gender and socialization in the prediction of commitment (Hypothesis 8). Although socialization did significantly predict commitment, the strength or direction of this relationship did not differ between male and female engineering students.

There are several points that can be made about the pattern of results found in this study. First, there are multiple dimensions of an academic climate which encourage retention. These climate dimensions represent interactions with faculty and peers, both

generally and specifically in regard to encouraging and valuing diversity among the student body. The climate factors, along with socialization, played a significant role in predicting the indicators of persistence among engineering undergraduates, specifically, commitment and withdrawal intentions. These relationships mirror the model of student withdrawal described by Tinto. Second, some dimensions of climate are more important in predicting indicators of persistence than others. Perceiving the faculty to be supportive of their students was the most influential climate factor in predicting both commitment and withdrawal intentions. Feeling as though there is a sense of community among students was also influential in predicting persistence indicators, while factors representing beliefs about diversity played the smallest role in student outcomes. Third, there was a general lack of evidence for the moderating role of gender. Although female students perceive the faculty in their department to be less supportive, and feel socialized to a lesser extent than their male counterparts, this does not seem to account for gender differences in the indicators of persistence. One notable exception to this is the interaction of gender and faculty support in the prediction of student commitment. Finally, both the climate factors and socialization played a larger role in the prediction of commitment than they did on intentions to withdraw.

Theoretical and practical implications

One of the goals of this study was to describe which aspects of an undergraduate engineering environment foster a climate for retention. Results of this study provide evidence for the importance of faculty support, a sense of community among students, and the perception that a diverse student body is valued and encouraged by all members of the department. This research brings a greater degree of specificity regarding the

individual components of an academic climate in a way that previous research has not. Hall and Sandler (1982) introduced the term "chilly climate" to describe a constellation of situations which may discourage female participation in the sciences. Since then, the idea of a chilly climate has been conceptualized in a variety of ways, such as discouraging women's participation in classroom discussions and activities, making inappropriate comments about female students, or suggesting that female students are less committed, less prepared or less able to complete the coursework (Morris & Daniel, 2008). However, there has been no systematic examination of what factors interact to create this chilly climate. Once a clear definition of what a climate for retention is (or alternatively, a "chilly climate" not supportive of women's persistence), it can be used to evaluate and compare a broader range of STEM and non-STEM departments and programs. An obvious advantage of this is the ability to compare programs with different proportions of women or other underrepresented minorities, and programs with various levels of success in attracting and retaining women and minorities to see how they differ on the dimensions of climate. Defining the dimensionality of a climate for retention would also focus the development of intervention programs targeted at retention efforts. For example, from this research it is clear that faculty support plays a critical role in both student commitment and withdrawal intentions. An intervention designed to generate more opportunity for relaxed, extra-classroom interactions between faculty and students could foster the development of informal mentoring or advising relationships, provide access to information about the department's norms and values (thus aiding socialization), and generally support student persistence.

Limitations of the study

The cross-sectional design of this study does not allow for a causal interpretation of the relationships between climate, socialization, commitment and withdrawal intentions. In Tinto's model of student withdrawal, he specifies that there is a longitudinal component. The assimilation of institutional experiences and integration into an academic department are phenomena that occur over time, not all at once upon entry into the program. Therefore, a longitudinal design would allow for an examination of this development as it occurs, and would also provide a way to measure changes in student perceptions over time. Nevertheless, even a cross-sectional design such as this is an important first step towards an understanding of student experiences in STEM, because it first identifies what the important variables are, and can focus the efforts of subsequent, and often more expensive longitudinal research.

In addition, the way in which student withdrawal was approximated and operationalized did not reflect the ultimate outcome of interest, which is actual student withdrawal from the program. This study relied on intentions to withdraw as an approximation of actual withdrawal, and the survey item reflecting this was designed in such a way that students were asked to respond to a hypothetical situation of withdrawal. The intention of designing the question this way was to isolate the influence of program experiences in the decision to intend to withdraw, so that other confounding factors could be ruled out, such as geographic or financial restrictions. Therefore, the conclusions about students' intentions to withdraw must be interpreted with this in mind.

Although the climate for retention survey was grounded in actual student interviews as well as reflecting current literature on retention, there may be a variety of

other variables that interact to create a climate for retention that were not reflected in the survey. A broader conceptualization of a climate for retention could have accounted for more of the variance in persistence indicators than what was found in the current study.

Finally, the sample of students included in the study does not represent the entire population of undergraduates in STEM programs. Only engineering undergraduates in four-year Florida universities were included in the sample, so the results of this study cannot be interpreted and applied to other STEM majors. In addition, students for this study were recruited in classrooms, in academic club meetings, and around campus in locations where engineering students can commonly be found. Although efforts were made to target females and other underrepresented minorities so a more demographically representative sample could be assembled, these recruitment strategies may have missed other populations of students, such as those who work off campus, commute, or for whatever other reason do not spend much time on campus outside of attending class. Recruiting in academic clubs may have also disproportionately encouraged the participation of students who are highly involved in the social aspects of the program, and represent a different perspective on the climate of the program, or be more committed because of their engagement in extracurricular academic activities.

Directions for future research

Although significant progress has been made in women's STEM participation over the last few decades, continued research is needed to identify the factors that may influence a student's persistence in STEM majors, how these factors differ by gender, what barriers to persistence exist for students, and what intervention programs and policies can be implemented to encourage women's success in STEM. In general,

research should continue to focus on women's representation in STEM throughout the entire educational pathway, from elementary school to post-baccalaureate study. However, Clewell and Campbell (2002) warn researchers that "we must not only look backward to pre-K–12 experiences and influences but also forward to undergraduate and graduate education…for female scientists and engineers" (p. 278).

Research building on the current study should seek to address the longitudinal component to student persistence, and examine the unfolding processes by which students become acclimated to their program, learn the norms and values of the department, develop relationships with faculty and peers, and then track their progress through graduation to capture those students who graduate and those who withdraw.

The population of interest should also be expanded to include universities in other geographic regions, other STEM majors in addition to engineering, and other underrepresented populations besides gender, such as racial or ethnic minorities. In addition, these results could be compared to a sample of non-STEM majors, to disentangle the reasons behind student withdrawal from STEM and reasons behind withdrawal from any undergraduate program.

Finally, this line of research should examine retention factors at the program and departmental level, as well as at the individual level. By aggregating individual-level climate data, the degree of consensus among students about the academic climate of their department can be assessed. Program-level information about the factors that encourage persistence can help guide policy and direct the efforts of intervention programs for successful retention of STEM students.

Conclusion

At the beginning of this paper, two critical questions were posed about student experiences in college: a) Can students have different experiences while in the same institutional environment, and b) Does the college experience create different outcomes for various subgroups of students? This goal of this current study was to address both of these questions within the framework of Tinto's model of student withdrawal while using key concepts from industrial/organizational psychology applied to the undergraduate engineering environment. Overall, the answer to both of these questions is yes. Male and female engineering students do have different perceptions of their academic environment, and these experiences can lead to different outcomes for men and women.

Promoting gender diversity in STEM fields remains a key concern for our educational system, and research in this area provides an opportunity to further tease apart the reasons for these gender differences. The research presented here is a response to efforts towards increasing women's participation in STEM. Having a more proportional distribution of women in STEM promotes women in general, and also has broader implications for the global competitiveness of the American workforce. By understanding the reasons for student persistence in STEM, especially women's persistence, we can better ensure the success of our future scientists and engineers.

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Appendix:

Effects of College Degree Program Culture on

Female and Minority Student STEM Participation:

Student Survey

Appendix

Effects of College Degree Program Culture on Female and Minority Student Science, Technology, Engineering and Mathematics (STEM) Participation: Student Survey

The purpose of this survey is to learn about the academic department, college, and university that you currently attend. There are no right or wrong answers. We want to know your experiences, opinions, attitudes, and impressions. Participation is voluntary. Your answers will be kept completely confidential, and combined with responses from others to provide an overall description of your department. This survey will take approximately 30 minutes to complete.

As you answer these questions, please keep the following definitions in mind:

> Department refers to the division with in your college, through which you are working to fulfill the requirements for your bachelor's degree (e.g., Department of Psychology, Department of Civil Engineering, Department of Physics, etc.).
>
> College is a division within your university that contains multiple departments, including your department (e.g., College of Arts and Sciences, College of Engineering).
>
> Faculty refers to any tenured or non-tenured professors, lecturers or adjunct instructors teaching courses or conducting research in your department.
>
> Staff in your department includes the any staff and administrative personnel, such as advisors and office personnel.

Filling Out the Answer Sheet

In order to complete this survey, you have been supplied with a green answer sheet. Please turn to side 1 of the answer sheet and then complete the following steps:

1. Ignore the "NAME" section of the answer sheet.
2. Bubble in the "SEX" and "GRADE or EDUC" sections.
3. For the Grade or EDUC section, please use "13" if you are a first year college student, "14" if you are a second year college student, "15" if you are a third year college student and "16" if you are in your fourth year. Please also use "16" if you have completed more than four years of higher education (for example you are a fifth year senior or are a graduate student).
4. Bubble in the "IDENTIFICATION NUMBER" section with your Identification number located on your Student Background Information Sheet. Fill in the first number under column "A" on the green answer sheet.
5. For each question on the survey, match the survey question number in this booklet with the corresponding set of response bubbles on the answer sheet. For example, to respond to question #1, use the bubbles for response #1 on the answer sheet.
6. Remember to use ONLY a #2 Pencil and fill in your bubbles completely. Please, DO NOT WRITE ON THIS SURVEY PACKET.
7. Questions 61-73 will use side two of the green answer sheet.

Please turn the page to begin the survey.

Using the scale below and the provided green answer sheet, please indicate your level of agreement with each of the following sentences:

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
A	B	C	D	E

In my department…

1. Faculty and staff are often available for students to see OUTSIDE OF regular office hours.
2. Faculty and staff provide opportunities for students to work on research projects.
3. Faculty and staff help students achieve professional goals.
4. Faculty and staff seem to take responsibility for students' success.
5. Faculty are enthusiastic about teaching.
6. Faculty and staff provide students with strong academic and professional role models.
7. Faculty and staff help students develop creative capacities.
8. Faculty and staff go out of their way to help students master the knowledge in their discipline.
9. Faculty and staff are generally encouraging towards students.
10. Current students try to make new students feel included.
11. It is a priority to create a diverse, multicultural environment.
12. Students are encouraged to develop critical, evaluative, and analytical qualities.
13. Students often work together on team projects (e.g., research projects).
14. People show respect for cultural differences.
15. Faculty and staff genuinely care about students' well-being.
16. The interpersonal atmosphere among students is cold.
17. I feel like I fit in well.

18. Faculty or staff will offer help to a student who appears lost or confused.
19. Students share strategies for success with each other.
20. Students have to study very hard to succeed.
21. People value diversity.
22. Students often learn from each other.
23. The courses provide state-of-the-art information about our field.
24. I sometimes feel out of place.
25. There is a genuine concern for the needs of students of all races and ethnicities.
26. Special efforts are made to help racial and ethnic minority students feel like they "belong".
27. The perspectives of men and women are equally valued.
28. Students are highly engaged in coursework.
29. Instructors treat all students the same regardless of their race or ethnicity.
30. Instructors treat all students the same, both men and women.
31. There is an overall sense of community among the students.
32. Students are well prepared to obtain very good jobs when they graduate.
33. I have never observed discriminatory behaviors (e.g., words or gestures) directed towards female students.
34. There is an emphasis on developing vocational and occupational competence.
35. Faculty and staff make students feel inferior.
36. Students are often too concerned with their own success to help each other.
37. The research conducted by our professors and students is some of the best in our field.
38. The degree I am working on is in an exciting field.
39. Individuals getting a degree in my major are respected by most people.
40. My future occupation makes an important contribution to society.

Below is a list of supports and services your institution may provide to help you succeed in school. If you participated in any of the following, please indicate how helpful you found this service. If you did not participate in the service, please indicate so.

Very Unhelpful	Unhelpful	Neither Helpful nor Unhelpful	Helpful	Very Helpful	I didn't participate in this service but it is available	My institution does not offer this service.
A	B	C	D	E	F	G

41. Pre-college outreach or training (i.e., summer programs for high school students).
42. College transition support (i.e., bridge programs for entering freshman or programs to assist transfer students).
43. 1st or 2nd year introductory courses offered by your department.
44. Advising support.
45. Tutoring support.
46. Real-life training or applied classroom project.
47. Off-campus training opportunities (i.e., internships).
48. Career guidance or job search support.

Using the scale below and the provided green answer sheet, please indicate your level of agreement with each of the following sentences:

Never	Occasionally	Sometimes	Often	Very Often
A	B	C	D	E

Since coming to the department, how often have you done the following:

49. Worked in small, ethnically diverse groups with other students in the department.
50. Participated in an ethnic or racial-oriented student organization.
51. Socialized with someone of another race or ethnic group.
52. Studied with other students in your major
53. Spent time with students in your major doing non-academic activities

Using the scale below and the provided green answer sheet, please indicate your level of agreement with each of the following sentences:

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
A	B	C	D	E

54. I enjoy discussing my department with the people outside it.
55. I do not feel like "part of the family" in my department.
56. I do not feel "emotionally attached" to my department.
57. My department has a great deal of personal meaning to me.
58. My department has a great deal of personal meaning to me.
59. I am satisfied with my department.
60. I do not like my department.
61. I do not consider any of my fellow students as my friends.
62. I would be a good representative of my department.
63. I have not yet “learned the ropes” of being a student here.
64. Within my department, I would easily be identifiable as “one of the gang”.
65. I understand the goals of my department
66. I have mastered the knowledge required to function well as a student in this department.
67. I am usually excluded in informal networks or gatherings of people within my department.
68. I would be a good example of a student who represents my department’s values.
69. I have not fully developed the appropriate skills and abilities to perform successfully as a student.
70. I believe most of my fellow students like me.
71. I support the goals that are set by my department.
72. I understand what I need to do to be a successful student.

73. Given the opportunity to enroll in the same degree program at a different but equally ranked University, I would:

a. definitely maintain enrollment at this University.

b. probably maintain enrollment at this University.

c. I don't know - no opinion.

d. probably enroll at the alternative University.

e. definitely enroll at the alternative University.

END.

Thank you for participating in this study.

About the Author

Heather Ureksoy received a Bachelor of Arts in Criminology and a Bachelor of Science in Psychology from the University of Florida in 2004. She received a Master's degree in Industrial/Organizational Psychology in 2008 and a Ph.D. in in Industrial/Organizational Psychology in 2011, both from the University of South Florida. Heather is employed as a project manager in the research and development department at Psychological Assessment Resources, Inc., a prominent test developer in Lutz, Florida. She primarily studies the educational and career pathways of individuals in science, technology, engineering, and mathematics, with a special emphasis on women's barriers to persistence. Heather and her husband currently reside in Valrico, Florida with their cats and dog.