Mentoring Women in STEM: A Collegiate Investigation of Mentors and Protégés

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Abstract of the Dissertation

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Science, technology, engineering and mathematics (STEM) education in the United States lags behind that of other industrialized nations. Despite national efforts to enhance the quality of STEM education for students, progress remains elusive. Underperformance is evident in measures of outcomes, participation, and retention. In particular, inequity persists in the attraction and retention of women to STEM fields. Mentoring is heavily cited as a means to improve our national efforts to fortify STEM education. This research explores mentoring styles, gender preferences, and differential impact on outcomes. The results challenge conventional wisdom that women prefer and benefit from a style of mentoring that is different from the preferred style of men. This study found that male and female protégés do not desire different types of mentoring. In fact, male and female protégés desire task-oriented mentoring when compared to relationship-oriented mentoring styles. However, female protégés prefer to be mentored by female mentors and male protégés prefer to be mentored by male mentors. In addition, with respect to gender, mentors do not differ in the type of mentoring they employ. Additionally, results of the study indicate that task-oriented mentoring style may bring incremental explanatory power with regard to intention to pursue STEM careers. This research implicates STEM program design in university settings. Gender-focused STEM programs are advised to focus on preferences and mentoring style, but not in the conventional way. This research indicates that women in STEM disciplines are not expressing a preference for relationship-oriented mentoring type and do benefit from task-oriented mentoring styles.

Dedication Page

This work is dedicated to my family; my husband for his unremitting patience and encouragement, my parents and sister that supported me in my education always, and for my daughter Grace, who has allowed me to appreciate the joy and beauty in every day.

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The Context

STEM Performance

The performance of students in the United States, in science, technology, engineering and mathematics (STEM) education lags behind that of other industrialized nations. The World Economic Forum ranks the United States 51 of 142 countries with respect to the quality of its math and science education (Sala-i-Martin, 2011). When compared to industrialized nations, the U.S. is ranked 25th in mathematics and 17th in science out of 34 developed countries (U.S. Department of Education, 2010). Within the U.S. only 16 percent of graduating American high school seniors are considered to be proficient in mathematics and interested in a STEM career (U.S. Department of Education, 2010). In addition to performance, attrition is an issue, especially in post-secondary environments and among women, a phenomenon that has been referred to as a “leaky pipe” or “gender filter” (Blickenstaff, 2005). The U.S. is lagging at the very top and also overrepresented at the very bottom.

Lagging at the Very Top

Perhaps surprisingly, even U.S. students that excel nationally are below average on a global scale. According to the Organization for Economic Co-operation and Development (OECD), the U.S. is below average globally in its share of top performers in mathematics (OECD, 2013).

For example, average mathematics PISA scores in 2012 were not significantly different from previous years comparison (2003, 2006 and 2009) (National Science Foundation, 2015). A new report from the U.S. Chamber of Commerce acknowledges the nation’s lagging among top performers. In the U.S., across all states, on average, only 20 percent of high school graduates pass advanced placement (AP) exams nationwide (U.S. Chamber of Commerce, 2014). Additionally, while the report recognized Massachusetts as the highest performing STEM state, only 16 percent of Massachusetts' graduates passed STEM AP exams (U.S. Chamber of Commerce, 2014). According to the National Assessment of Educational Progress (NAEP), amongst the highest performing states (those states that ranked highest in the U.S., including Massachusetts, New Hampshire and Minnesota) only half of students were deemed proficient on a combined 4^{th} and 8^{th} grade reading and math metric (U.S. Chamber of Commerce, 2014).

Overrepresentation at the Very Bottom

At the other extreme, despite the attention and resources dedicated to STEM achievement, the United States' performance remains average overall while other nations continue to improve. STEM educational challenges become very apparent as students enter high school environments. According to NAEP, in 2015, the majority of 8^{th} grade students were deemed not proficient in mathematics and science (only 33 percent of students in 8^{th} grade were identified as proficient in mathematics and 32 percent were proficient in science) (National Center for Education Statistics, 2015).

The U.S. has more low achievers in mathematics than the average OECD country (OECD, 2013). U.S. high school students outperformed only 5 of 34 OECD countries with regard to mathematics literacy (National Science Foundation, 2015). Year after year the U.S. achieves little advancement in global rankings. In 2011, 60 countries participated in The Trends in International Mathematics and Science study (TIMSS) (a benchmark across countries on math and science achievement) and only 10 percent of U.S. 8^{th} graders met this international benchmark (National Research Council, 2011). Between the years 2003 and 2012, other countries, such as Mexico, Turkey and Germany improved their mathematics performance and levels of equity in education whereas, during this time period, the U.S. remained stagnant in its improvement (OECD, 2013).

Investments in STEM

The lack of progress in the United States' standing in science, technology, engineering and mathematics education is motivating government, higher education, the private sector and non-profit organizations to devote time and resources toward the advancement of STEM education. This focus reflects both K-12 and post-secondary education environments.

Government

In 2014, in order to address the United States' lackluster performance in STEM, the federal government allocated $3.1 billion to STEM education programs; this represented an increase of 6.7 percent over 2012 national funding levels. Of these dollars, $123 million were dedicated to improving undergraduate education by enhancing teaching, learning and retention within STEM disciplines (White House Office of Science and Technology Policy, 2013). The Howard Hughes Medical Institute (HHMI) echoes this emphasis on improving undergraduate education. HHMI professors proposed seven initaitives to improve undergraduate science. These initiatives all focus on emphasizing teaching, teaching methods and teaching excellence for faculty promotional purposes, rather than solely research as is common practice (Howard Hughes Medical Institute, 2011).

The President's "Educate to Innovate" campaign has resulted in $1 billion (total) in financial support for STEM programs. As part of the Educate to Innovate campaign, The

Department of Education alone is launching $25 million in grant competitions, specifically to support science and literacry themed media, with the goal of inspiring children in low-income environments (Office of the Press Secretary, 2015).

Higher Education

In addition to federal efforts, universities across the country are also making significant investments in STEM education. The President and First Lady called for action, at the university and college level, to increase completions of STEM college degrees (especially among women and minorities) (Handelsman & Carnival, 2015). In response to this call to action, more than 140 colleges and universities have committed to launch programs, scholarships and outreach all aimed at encouraging completion of college degrees (Handelsman & Carnival, 2015).

In an effort to train engineers, in particular, over 120 universities (specifically, 120 deans of engineering programs at American universities) have committed to training more than 20,000 engineers to tackle "grand challenges" of the 21^{st} century (Office of the Press Secretary, 2015). Individual educational institutions are also dedicating resources: for example, MIT is increasing financial aid by $8.4 million for underrepresented STEM students and Wellesley College is committing $20 million to support women in STEM from pre-college through graduate school training.

Private Sector

A set of private-sector organizations have also committed resources under the "Educate to Innovate" campaign, their contributions total more than $240 million. Their focus is on preparing girls and boys, with special attention to underrepresented groups, to excel in STEM study (Office of the Press Secretary, 2015). These dollars support a number of initiatives focused not only on STEM programming but also STEM awareness through media efforts. One such programmitc initiative is a CEO coaltion called, “Change the Equation”, which is committed to expanding effective STEM programs to 1.5 million students in 2015 (Office of the Press Secretary, 2015). Another collaborative exists in a partnership between CA Technologies and the Boys and Girls Clubs of America. Together they will host STEM workshops aimed at encouraging young women to pursue STEM careers. In addition, a multi-sector coalition of funders, inclusive not only of corporate funders, but also higher education, is contributing $90 million to support the “Let Everyone Dream” campaign. These funders are focused on expanding STEM opportunities to underrepresented youths (Office of the Press Secretary, 2015). Other large organizations such as 3M and Motorala are also focusing resources on programming. 3M is providing $15 million to STEM programs specifically aimed at women and underrepresented groups and Motorola Solutions is providing $4 million for STEM programming, specifically targeting underserved students.

Not only are resources dedicated toward direct STEM programming, but also on increasing awareness around the importance of STEM education. Microsoft is raising awareness by creating a documentary called, “Big Dream Movement,” which follows seven young women all pursuing STEM disciplines in an effort to raise awareness. Additionally, As part of the “Let Everyone Dream Campaign” many media companies are investing in STEM awareness campaigns. Elevisa, a Mexican multimedia company, will invest $4 million toward a national television campaign focused on Latinas in STEM. Additionally, EPIX, an American media company is investing $4 million in a STEM documentary series.

Not for Profit

A number of non-profit organizations are increasing their efforts to provide programming to encourage STEM participation among students, especially serving those from underrepresented backgrounds. Four of the nation's largest youth organizations, Boys & Girls Club of America, Girls Inc., National 4-H Council and YMCA, will in total reach over 18 million youths by partnering together. They will have a five-year collaboration to provide community based STEM programming, with special attention paid to underrepresented groups (Office of the Press Secretary, 2015). Additionally, $150 million from philanthropic sources will be utilized to help scientists early on in their career stay on track (Office of the Press Secretary, 2015). Other non-profit efforts include a partnership between the Teen Choice Awards, the National Science Teachers Association, and the National Center for Women and Information Technology to launch a nationwide multi-media campaign aimed at closing the female engagement gap in STEM education. Another foundation, The Victor Cruz Foundation, is partnering with the Boys and Girls Club of America to create STEM activities that build off student interest in sports (e.g. football) and make connections to materials science, basic physics, and kinesiology (Office of the Press Secretary, 2015).

Women Underrepresented in STEM

In realization of a gender inequity, many of the aforementioned investments are focused on women. These programs and interventions are important because a gender gap becomes significant as students enter post-secondary educational institutions (Office for Civil Rights, 2012). This gender gap in post-secondary environments has significant, lasting consequences for female representation within the STEM workforce both occupationally and academically (Beede, Julian, Langdon, McKittrick, Khan,& Doms 2011).

Despite past devoted resources to STEM education, achievement is lacking in general and more specifically inequitable by a gender basis. Women are not attracted to and do not experience the professional benefits of STEM education relative to men in the United States. According to the National Science Foundation's 2014 indicators, in the U.S., women earning bachelor's degrees in the fields of computer science, mathematics, physics, engineering and economics declined between the years of 2000 and 2011 (National Science Foundation, 2014).

Higher Education

Sixty percent of all students who arrive at college intending to major in STEM subjects switch to other subjects, often in their first year (Office of the Press Secretary, 2015). Of the diminishing number of students that are choosing to pursue a college degree in a STEM field, only half will decide to work in a related career. Women, in particular who obtain a STEM degree, regardless of level of educational attainment (undergraduate, masters, doctorate), are less likely than men to work in a STEM occupation; according to the U.S. Department of Commerce, men represent 76 percent of STEM jobs while women represent 24 percent (Beede, Julian, Langdon, McKittrick, Khan, & Doms, 2011; U.S. Department of Education, 2010).

Unfortunately, there is a tendency for young women to leave the STEM discipline in post-secondary environments. The fact that women drop out of STEM education programs at a concerning rate has been referred to as a "leaky pipe." It is referred to as a leaky pipe because there are many different points at which women drop out (Blickenstaff, 2005). Women lose interest prior to enrolling in, or during their post-secondary STEM study, or they drop out upon graduation, before they ever enter the STEM workforce. This attrition is seen throughout the education process. At college, many students, especially women, lose interest, leave the major and choose to study non-STEM disciplines. The inadequate pre-college preparation to study STEM, the failure to attract women (and men) to study STEM, and the filtering by gender that occurs when STEM study begins, is an unproductive and unsettling situation for higher education in general and STEM disciplines in particular.

In fact, though females constitute the majority of higher education students, they are a minority when it comes to STEM majors. Consider the fact that in the 2009-2010 school year, female students represented 57.4 percent of all students receiving a bachelor's degree and 62.6 percent of students receiving a master's degree (U.S. Department of Education, 2010). However, in the 2008-09 school year females represent only 31 percent of students achieving a degree or certificate in STEM (Office for Civil Rights, 2012). Although this number represents a 5.9 percent increase over the past decade, there is still a significant gap in achievement when compared to men.

Between 2000 and 2013 bachelor's degrees in science and engineering fields (compared to all fields) remained stagnant (National Science Foundation, 2016). Within this same period, degrees awarded to women in computer sciences, mathematics, physics, engineering and economics declined (National Science Foundation, 2016). Building the STEM pipeline for women requires both attracting women and helping them persevere all the way through to a STEM career (Blake-Beard, Bayne, Crosby, & Muller, 2011).

STEM Workforce

In the general workforce (inclusive of both STEM and non-STEM occupations), female workers constitute 48 percent of all workers; however, of STEM workers, women represent a mere 24 percent (D. Beede et al., 2011). The female workforce breakdown is: computer science and math occupations (27 percent female), engineering (14 percent female), physical and life sciences (40 percent female[1]) and STEM managers (25 percent female). In addition to being underrepresented in the workforce, women in science and technology fields experience lower salaries, lower status, greater social isolation, poorer prospects for promotions, and decreased opportunity for leadership when compared to men (Acker & Oatley, 1993; Campbell & Skoog, 2004; Fried & MacCleave, 2009; Morrell, 1991; Settles, Cortina, Stewart, & Malley, 2007). Long-held popular misconceptions that STEM is not female friendly are often confirmed by peers, discrimination and the media portrayal of such bias (Coger, Cuny, Klawe, McGann, & Purcell, 2012).

Academia

If the rate of attrition among women in education remains high then the STEM workforce, including academia, will suffer. Male and female faculty positions in academia mirror that of the general workplace. Specifically, in academia there are more men than women in senior positions (Chesler & Chesler, 2002; Packard, 1999). In science and engineering fields, women are a minority in achieving professional ranking. Women hold 42 percent of Instructor or Assistant Professor ranks, 34 percent hold the rank of Associate Professor, and 19 percent hold the rank of Professor (NSF, 2008; Trower & Chait, 2002).

There is not only a gap in roles but also in resources. Gender differences are found when comparing tangible resources available to men and women. It has been found that women acquire less lab space and are awarded smaller grants than men with equivalent records (Campbell & Skoog, 2004). In STEM academic departments there is often a lack of female

[1] This large percentage includes occupations in medicine

presence in student and faculty populations, as the above statistics illustrate. This lack of presence (and resources) leads to the marginalization of female faculty. In such environments, women are often ostracized and students, inclusive of females, choose not to engage with them (Chesler & Chesler, 2002). Sadly, these women are seen as outsiders and therefore are less appealing departmentally, a socio-academic dynamic that also requires attention (Chesler & Chesler, 2002).

The marginalization of women translates into a lack of power and influence (Rackham School of Graduate Studies, 2000). Needless to say, the plight of women in STEM is a circumstance that requires immediate attention. Higher education needs to attract, retain and develop STEM women.

Consequences for Women

If women continue to choose disciplines other than STEM then their access to high quality and high paying jobs will be limited. As of May 2013 the annual average wage for STEM occupations was $79,640, this represents 1.7 times the national average wage for all occupations, $44,440 (Jones, 2014). Additionally, women who choose to pursue STEM careers earn 33 percent more than those that pursue non-STEM jobs. This is a considerable difference when compared to the premium that exists for men (see Figure 1 in Appendix for average hourly earnings by gender and occupation) (Beede, Julian, Langdon, McKittrick, Khan, & Doms, 2011). Women apparently still struggle to receive equitable pay compared to their male counterparts. When women leave STEM study or choose to pursue a different area of study, women limit their earning potential.

Consequences for Society

The need to increase the number of women who study STEM disciplines has attracted attention from many federal organizations (e.g., National Research Council, 2011; White House Office of Science and Technology Policy, 2013). However, progress is compromised if promising women decide not to take the step to study STEM. The National Research Council, an arm of the National Academies acknowledges the pertinent issues facing the study of STEM by women. This agency established a national objective of expanding the STEM-capable workforce by broadening the participation of women and minorities in that workforce and this goal has attracted attention from the White House (e.g., National Research Council, 2011; White House Office of Science and Technology Policy, 2013).

If women do not engage in STEM education and persevere toward STEM careers, then the STEM capable workforce's potential will be limited. STEM occupations help solve global problems; science, technology engineering and mathematics allow the United States to serve as a leader in innovation, education and research (U.S. Department of Education, 2010). Without female representation, the potential for research and discovery in fields such as mathematics, computer systems analysis, medical science research and biomedical engineering (to name a few) are limited because the talent pool entering those professions is constrained. Increased female representation in STEM is necessary to remain competitive in the global marketplace (Committee on Equal Opportunities in Science and Engineering, 2004; National Science Foundation, 2006a, 2006b).

Mentoring as an Intervention

Educational institutions employ a number of interventions throughout students' educational careers to encourage commitment to STEM study. One intervention that is commonly used in the K-12 and undergraduate levels is mentoring. Mentoring is widely held to be key to increasing STEM perseverance; a consensus for which there is solid evidence (Ambrose, Dunkle, Lazarus, Nair, & Ritter, 2006; Chesler & Chesler, 2002; Downing, Crosby, & Blake-Beard, 2005; Ghosh-Dastidar & Liou-Mark, 2014; Kendricks, Nedunuri, & Arment, 2013).

A simple Google® search of "mentoring and universities" populates millions of results of various programs, trainings and initiatives. Another indicator of the high regard mentoring holds in educational environments is the grant application requirements at the National Science Foundation (NSF). If you are applying for an NSF grant and choose to allocate resources for post-doctoral personnel, the grant application must include a mentoring plan for that individual. Indeed, a grant application at NSF will not be considered for funding without a mentoring plan.

What is Mentoring?

Research indicates that mentors impact persistence in the pursuit of STEM careers. This is true for both male and female genders. On these grounds, many universities are investing in mentoring programs. However, the predominance of research over the last twenty-five years reflects a focus on mentoring in the workplace and much less so higher education. Higher education faces the challenge of improving the effectiveness of mentoring programs because it does so with less high quality, empirical investigations. Higher education often has a weed-out mentality.

Challenges in the Mentoring Literature

Operational Definitions. A review of the literature on mentoring in both workplace and university settings triggers concerns. There is no singular, accepted definition in the literature. There are many. In fact, there is much debate about how best to operationally define mentoring (Jacobi, 1991; Merriam, 1983; Mertz, 2004; Murrell, Crosby, & Ely, 1999). Consequently, the study of mentoring as a body of literature poses challenges for empirical analysis. The lack of a standardized operational definition of mentoring makes the task of comparing research a difficult one. Mentoring is a fluid interaction between people as is its operational definition in the literature.

As an additional concern and further muddying the waters for terms are used interchangeably and can be misleading. For example, the term protégé is often used interchangeably with apprentice or intern while the term mentor is often substituted by advisor or role model (Turban, Dougherty, & Lee, 2002). Without consistent operationalization, those words may imply very different things. This lack of consistency in operational definitions leads to difficulties in comparing findings and interpreting results.

Directionality. Another challenge speaks to the issue of directionality; that is, mentoring is typically studied as a one-way street. The mentoring literature, to a large extent, focuses on a single perspective – that of the protégé. Surprisingly, the literature often disregards the perspective of the mentor (Johnson, Rose, & Schlosser, 2007). For example, research often surveys or interviews the protégés and makes conclusions about the relationship as a whole based simply on the perspective of the protégé. There is no good reason to limit the study of mentoring to only the influence of a mentor onto a protégé. Mentoring relationships are not unidirectional. Although the mentor is more experienced than the protégé, each individual gains experiences from the other. There is interplay. Mentoring is a growth relationship where everyone involved brings the potential for development.

Common Characteristics

Mentoring relationships share characteristics. One characteristic is the dyadic nature of the mentoring relationship. Traditional mentoring consists of two individuals. Within the mentoring relationship and across related literatures, the mentor is usually an older and more experienced individual that helps develop the protégé in whatever context the relationship exists. Rhode's work (2002, 2005) highlights the commonality of an age discrepancy as well as the offering of guidance and instruction (Rhodes, 2002).

Models of Mentoring

There is general consensus that different types of mentoring exist but as to what these types are and how many actually exist, that is still up for debate. Over time there have been many definitions, variations and extensions of mentoring types (as new mentoring models emerge), and researchers explore multiple types of mentor roles (Ragins & McFarlin, 1990). There are those that suggest that more complex models are necessary to capture the mentoring relationship (Ragins & McFarlin, 1990). Rose (2003) suggests that students value mentoring relationships on three dimensions: integrity (i.e., reflecting emulation), guidance (i.e., task oriented) and relationship (personal) (Rose, 2003). However, the more established theories echo the same few mentoring types as being integral to the mentoring relationship. The most cited definition comes from the work of Kathy Kram (1985). In her seminal work, she defined mentoring as an intense relationship where a more knowledgeable individual provides two purposes for a protégé, 1) advice regarding career development, and 2) personal or psychosocial support (Kram, 1985).

Kram reports that, “A mentor relationship has the potential to enhance career development and psychosocial development of both individuals” (Kram, 1983 p. 613). According to this definition, mentoring is an intense relationship where a more knowledgeable individual provides these two elements (i.e., career direction and psychosocial development) for a protégé. Kram (1983) defines each of the two key elements compromising the mentoring relationship. Career development includes, “…those aspects of the relationship that primarily enhance career advancement” (Kram, 1983, p. 614). Psychosocial support reflects “…those aspects of the relationship that primarily enhance a sense of competence, clarity of identity and effectiveness in the managerial role” (Kram, 1983, p. 614).

Career development and psychosocial support are broad categories. Career development includes coaching of the protégé, exposure, visibility and challenging him or her with regard to content or knowledge. This mentoring type is task-oriented as it focuses on career development and how best to activate a path toward a profession (and a job). Psychosocial support is more relationship-oriented and elements include counseling and support, where the emotional nature of the interaction is emphasized.

This two dimensional model (i.e., career development and psychosocial support) is widely supported empirically (Ensher & Murphy, 2011; Noe, 1988; Tepper, Shaffer, & Tepper, 1996). Kram’s (1985) model remains integral as connecting and defining the literature as a whole (Bozeman & Feeney, 2007). In educational environments, both graduate and undergraduate students receive direct training and instructional advice along with support and encouragement and assistance as they echo the two-dimensional model of Kram, 1985 (Baker, Hocevar, & Johnson, 2003; Clark, Harden, & Johnson, 2000).

Importance of Mentoring to STEM Representation and Success

Mentoring is often viewed as the strategy of choice to engage women in STEM studies and occupations (Office of Science and Technology Policy, 2015). Mentoring is the focus of many programs and initiatives aimed at increasing female representation in STEM. Students concur this finding and cite the feedback of their mentors and the value of the relationship as positive influences in their lives (Lentz & Allen, 2007). The pervasiveness of formal mentoring backed by institutions and non-profit organizations best illustrates this success.

The Evidence: Mentoring Matters

In both formal and naturally occurring relationships, mentoring has been shown to attract and retain students in STEM (Wilson, Iyengar, Pang, Warner, & Luces, 2012). There have been a number of case studies exploring the impact of mentoring in higher education institutions (Gilmer, 2007; Perna, Lundy-Wagner, Drezner, Gasman, Yoon, Bose & Gary, 2009; Wilson, Iyengar, Pang, Warner, & Luces, 2012). These studies all conclude that mentoring is an effective way to enhance knowledge acquisition and to sustain the pursuit of STEM professionally. One example of this was explored by looking at historically black colleges and universities.

These universities were focused on attracting African American women to STEM fields. Researchers collected data specifically describing institutional culture, interactions among faculty and students, and support for students' educational and career goals. They did this by collecting documents and observing and conducting 5 focus groups with students and faculty over a two-day period. Results of the case study found that the negative barriers to STEM attainment (namely academic, psychological and financial) were all mitigated by instituting a cooperative culture in which faculty encourage and support student success. The approach involved supporting students by promoting their academic achievements and psychological readiness to pursue advanced degrees or careers (Perna et al., 2009). The study stressed the importance of mentor processes based on focus groups conducted with faculty and students.

Bowling Green State University implemented a program entitled "Academic Investment in Math and Science (AIMS)." It was a four-year undergraduate program that utilized mentoring (Gilmer, 2007). In this research, mentoring was implemented during all four years of undergraduate study and during summer sessions as well. Students were matched with a faculty member of similar interest and program success was measured using grade point averages and continued STEM study (Gilmer, 2007). Twenty students each year were accepted into the program (36 percent male and 64 percent female). The AIMS cohort earned on average .5 higher GPAs than the control group and AIMS students graduated in an average of eight semesters while the control group graduates in nine semesters (Gilmer, 2007). Students in the study specifically report enjoying mentors, as one student noted, "I like the mentor program. By getting paired with a professor in your major, you get advice on the do's and don'ts from someone who has already gone through the process," (Gilmer, 2007, p. 17).

Louisiana State University was among the universities executing Computer Science, Engineering, Mathematics Scholarship (CSEMS), an NSF program for economically disadvantaged students, not only to provide financial support, but also to increase persistence in graduation. Additionally, starting in 2004, they also implemented "Scholarships for Science, Technology, Engineering and Mathematics" (S-STEM) (Wilson et al., 2012). These programs showed particular success at LSU and an important pillar of LSU's success was the application of their mentoring program (Wilson et al., 2012).

One university that illustrates an anomaly in regard to gender mix of both faculty and students in STEM departments is Stevenson University. According to the National Science Foundation, in academia 31% of full time STEM faculty are female and 27 percent of STEM deans and department heads are female. By comparison, at Stevenson University, 84 percent of full-time school of science majors are female, additionally, each of the four departments in the school of science as well as the Office of Research are led by female faculty (Gorman, Durmowicz, Roskes, & Slattery, 2010). Through case study analysis, one reason for this anomalous finding is the mentoring networks at play throughout this school. It was concluded that formal and informal mentoring networks were integral to sustaining the prevalence of women within their scientific schools (Gorman et al., 2010).

Biographies of Successful Women in STEM. Investments in STEM and case study analysis indicate the prevalence of mentoring in today's efforts to increase participation. Yet another indication of the importance of mentoring may be seen through the lens of exemplary women throughout history. There is evidence to suggest that mentoring has been important historically to high achieving women. The Nobel Prize has been awarded to 949 people and organizations between the years 1901 and 2015 (nobelprize.org). A total of 874 individuals have been awarded the prize but only 49 of them were women, comprising a little more than 5 percent of the total population of winners. This population includes Nobel prizes in all areas. Nobel Prize winners in the STEM fields (the areas of physics, chemistry, and physiology/medicine) have been awarded to 583 people only 18 of which were women. Therefore the amount of women awarded a Nobel Prize in STEM disciplines represents just over 3 percent of total recipients (nobelprize.org). This is strikingly low.

Women comprised the minority of Nobel laureates among this elite population of the world's top performers. This researcher performed an analysis of Nobel Prize winning women[2]. It was uncovered, through case analysis that relationships were indeed critical to success. Specifically, the case analysis revealed the value of holding close relationships with people in professional STEM fields and occupations. Though not labeled as a mentor, many prizewinners cited psychosocial support and emotional guidance from elders. Often, these were parents.

For instance, 72 percent of female winners reported looking up to their parents as a guide. Their parents' occupations ranged from university professors to electrical engineers to mathematicians. Marie Curie's biography describes receiving training from her father, "She received general education in local schools and some scientific training from her father" (nobelprize.org). To exemplify the influence of a parent, Marie Curie's daughter, Irene Joliot-Curie is also a Nobel Laureate, in chemistry.

Another female Laureate's biography, Maris Goeppert Mayer, a Nobel Laureate in Physics (1963) reports, "On her father's side, she is the seventh generation of university professors. In 1910 her father went as Professor of Pediatrics to Gottingen where she spent most of her life until marriage." Yet another Laureate, Elizabeth Blackburn, Nobel laureate in Physiology reports in her biography of the scientific nature of her family, "My parents were family physicians. My grandfather and great grandfather on my mother's side were geologists." Linda B. Buck is another example of a female Laureate coming from a scientific parent, a Nobel laureate in physiology she reports in her biography, "My father was an electrical engineer who,

[2] This researcher analyzed the winners' biographies provided by nobelprize.org and discovered that 13 of the 18 winners had parents who held occupations within STEM fields.

at home, spent much of his time inventing things and building them in our basement."   One more example of a female Laureate with scientific parental influences is Rita Levi-Montcalcini, a Nobel laureate in physiology, she reports that, "Our parents were Adamo Levi, an electrical engineering and gifted mathematician…"

Those parents that did not have STEM occupations were praised for their commitment to their child's education and the sacrifices they made to ensure their children's continued education. Ada E. Yonath, a Laureate in Chemistry expresses this, "However, despite the poverty of my parents and the lack of formal education, they went out of their way so that I could obtain a proper education in a very prestigious secular grammar school, called 'Beit Hakarem'." The importance of a strong, supportive presence in their young lives is a testament to the impact of a mentor.

Gendered Assumptions

While mentoring overall is important, indeed, little is known about which type of mentoring really does have the most impact.   Mentoring is being used to encourage participation, but it is often being done with a gendered approach. Often, these approaches are shaped by an emerging normative argument, that women need more psychosocial mentoring—, which as yet lacks supporting evidence. Many gendered assumptions are made in the application of STEM mentoring. These assumptions sometimes impact the type of mentoring provided by the mentor and other times, they involve the gender pairing of the mentor and the protégé.

Gendered Types of Mentoring

The importance of social support and relationships among women is widely studied (Boyce et al., 1998; Komproe, Rijken, Ros, & Winnubst, 1997). It is often suggested that support and guidance in the form of mentoring may enhance a young women's sense of self-confidence in general and provide her the assurance she may need to pursue science. The relationship needs of women have been differentiated from that of men (Tannen, 1990; Dean, 2009; Chesler, 2002). Growth-fostering connections are viewed as critical to the development of women (Jordan, 1997). It is these aspects of women's relational skills that empower them (and their relationships) by increasing their self-worth and desire for connection (Jordan, 1997; Westkott, 1997). However, there is little quantitative evidence to suggest that relationship-oriented mentoring is preferred by women in comparison to desire for task-oriented mentoring. Furthermore, there is a paucity of evidence suggesting that this particular type of mentoring leads to STEM success and perseverance.

Little is known about which type of mentoring, task-oriented or relationship-oriented, impacts students' perseverance in STEM education and commitment to pursue a career in STEM. Advice on building the STEM student pipeline for women emphasizes gender-specific approaches to mentoring. The assumption behind this is that relationship-oriented mentoring will follow. As a reminder, this type of mentoring falls under the "psychosocial support" dimension as identified by Kram (1985).

There are many programs designed specifically for women in STEM. Some of these make an appeal to women by emphasizing the psychosocial dimension of mentoring. These programs highlight the relationships that can be nurtured by engaging in STEM work and the overall social impact one can make by pursuing a STEM occupation (stressing communality and personal relationships). These programs are then shaped by an emerging normative argument—that women benefit from relationship-oriented mentoring, a position that lacks supporting evidence.

Gendered Mentor Pairing

Student gender may not only prescribe the type of mentoring employed (i.e., task or relationship) but it can also prescribe the preferred gender of the mentor as well. Many STEM mentoring programs stress the importance of female-to-female gender pairing between the protégé and mentor. There is currently an expanse of STEM programs focused on pairing female professionals with female students. They are gendered in their emphasis, assuming that it is advantageous to connect female students with female faculty and female professionals.

Gendered approaches to mentoring relationships imply that female protégés require or at least disproportionately benefit from female mentors. There is, however, little empirical support for this approach. The literature does not support the general assumption that female faculty have positive effects on the percentage of females studying STEM (Blake-Beard et al., 2011; Canes & Rosen, 1994). Other researchers have found little gender effects, (Clark, Harden, & Johnson, 2000; Tenenbaum, Crosby, & Gilmer, 2001).

In fact, some research indicates that while female students report having more female guides, their most influential guides were identified as men (Downing et al., 2005). This is an interesting dilemma for program policy makers and mentoring program designers.

Despite the lack of empirical support for gender pairing, programming continues to stress gender in mentoring relationships, through gendered approach (focus on relation and emotional support) and through gender of the mentor. There are numerous programs facilitated by private organizations, universities and non-profits focused on gender pairing. Ohio State's Women in Engineering (WiE) program explains: "Professional female engineers are welcome to join WiE Connect to serve as mentors to our WiE students." NASA has a website dedicated to women on which female employees share how they came to work at NASA in their current roles (NASA, 2015). Another gendered STEM program is the National Girls Collaborative Project. This organization created FabFems, "The FabFems directory is a national database of women in science, technology, engineering and mathematics (STEM) professions who are inspiring role models for young women" (National Girls Collaborative, 2015).

Yet another organization connecting young women to professional women is Girls Advancing in STEM (GAINS). This is a scholarly network that connects high school females and your women with an interest in science to female leaders across STEM fields, including universities, labs and organizations (GAINS, 2015). The Carnegie Science Center also facilitates a STEM program focused on gendered pairing. This center employs a program called "Tour Your Future." "This program gives girls ages 11-17 the opportunity to meet female professionals who work in the fields of science, technology, engineering and math" (Carnegie Science Center, 2015). One more example of an outreach program that illustrates gender pairing is Girls in Engineering, Mathematics and Science (GEMS). This is an outreach program for middle school students, and it prides itself on its employment of an all female staff, which provides participants with female role mentors (Dubetz & Wilson, 2013).

Lastly, a university-based female STEM program adopted by many across the country and focused on gender pairing is the Women in Science and Engineering (WISE) program. Government grants and private resources fund WISE. WISE programs emphasize the importance of mentorship and often the pairing is targeted to be female-to-female. It is assumed that young girls need strong established women to provide them with the communal or relationship-oriented guidance and support. However, to-date, the literature does not indicate that mentor gender pairing is a meaningful predictor of academic outcomes. In sum, STEM educators and STEM programs are increasingly focusing on gender-specific mentoring, despite little, if any supportive empirical justification.

Women's Accounts

Women themselves do report a preference for a gendered style of mentoring and gender pairing. Historically, the small population of female Nobel laureates all reported the importance of a parental figure as a role model providing a strong and supportive presence during their younger lives. The same may be seen in a more recent 2006 Carnegie Mellon Study. This study followed successful women in science and engineering fields over the course of four years through a series of focused in-depth interviews. All these women report, in their own biographical summaries, the importance of effective and caring mentors (Ambrose et al., 2006).

In this study, women all referenced parents and teachers that provided them with encouragement and inspiration. Parents and teachers made a crucial difference in their choice of college major where they selected STEM subject matter (Ambrose et al., 2006). This study implies the importance of both task-oriented mentoring and psychosocial support.

However, it is worth noting that both of these studies pose some inferential challenges. The populations in both experiments only include high achieving women; therefore the study may not be applicable to all STEM students. The participants were already above average and successfully navigating the STEM discipline. So, there is a methodological selection problem. A randomized approach would greatly enhance our understanding and for that matter comparative research mixing both genders and crossing all types of matches, would be of enormous value. Additionally, this work studied women's psychosocial experiences and did not report on any measured outcome or scale. So while it is an account of the female experience, there is no quantitative measure or outcome. Also it is post hoc – looking back, recalling or remembering and not longitudinal.

Review of Literature

Could gendered assumptions seen in practice about mentoring be wrong? There is a paucity of research investigating the efficacy of gender-based mentoring. We can however, draw from theory.   Specifically, the research on the identification of a communal versus an agentic orientation allows inferences to be made. Also expectation states theory explains agentic orientation. Additionally, there is leadership theory addressing task and relationship-oriented approaches to management and how women and men use and respond to them differently.

Communal vs. Agentic Orientation

One literature that might inform predictions as to whether male and female protégés desire different types of mentoring is communal versus agentic orientation. Men and women occupy different social roles based upon certain stereotypes and gender prescriptions (Eagly & Karau, 2002). Historically, men are stereotypically agentic in nature while women are more communal. Agency includes behaviors that are assertive and exude confidence and power. Women, on the other hand, are stereotypically communal in nature, displaying behaviors that are pleasant, likable and displaying trust. Agentic behaviors are associated with competence and leadership, thus connecting men to such roles and positions (Duehr & Bono, 2006; Heilman, Block, & Martell, 1995; Schein, 1973; Schein, 1975). According to this stereotype, women are therefore more likeable than their male counterparts but are also viewed as less competent as a result (Lakoff, 1973; Lakoff & McConnell-Ginet, 1975).

The tendency for men and women to act in accordance with this orientation, both through self-stereotyping and biased perceptions, impacts career opportunities and likely career progression. The first is seen through the inequitable amount of leadership positions occupied by women; since women are prescribed as being more communal, they are less likely to be seen as a competent leader (Wiley & Eskilson, 1985). Additionally, if a woman does achieve a position of leadership (and thus employs a level of agency) she is often viewed less favorably (then a male) by others (both male and female) as any indication of agency is incongruous with her prescribed gender stereotype, thus making her less likable. This can compromise career success.

Communality and agency suggest that men and women not only conform their own behaviors to that of their prescribed stereotypes but they use these models as a means of judgment toward other men and women (usually implicitly exhibiting these biases) (Schein, 1973; 1975). Gender roles have implications for STEM mentoring.

For instance, based upon the above gender role stereotyping literature, one may expect that women (protégés and mentors alike) would prefer relationship-oriented mentoring to task-oriented mentoring. Relationship-oriented mentoring is a psychosocial measure that focuses on support, guidance and friendship; this is very much in line with an individual who is more communal by nature. Communality again, being behaviors focused on trust and likeability on a personal level. However, this literature would also imply that men (protégés and mentors) would prefer task-oriented mentoring, as this type of mentoring has more implications for agentic behaviors. Agentic behaviors are focused on the attainment of power and confidence and are more in line with career development and the tangible means by which a protégé achieves a certain career or academic goal.

This implication is especially pertinent within STEM environments. In STEM fields, mentoring is more focused on task-oriented and career development over psychosocial or relationship-oriented mentoring. However, as this literature illustrates, task-oriented mentoring is preferred and more tailored to someone who is agentic in nature, usually a male. In the context of STEM mentoring, this would predict that men prefer task-oriented mentoring, and therefore, they will be more prepared for a STEM career and more likely desire to pursue STEM professionally. However, in accordance with the above theory as well as current interventions and programs, relationship-oriented mentoring continues to be a focus of many STEM programs aimed at retaining women. Since relationship-oriented mentoring is communal in its nature, it may be inferred that women would prefer this type of mentoring. There is incongruity between the relationship-oriented emphasis of STEM mentoring programs and the task-oriented, agentic world of the STEM profession. Therefore, while it may be predicted that women prefer relationship-oriented mentoring, it may also be predicted that this type of mentoring does not increase a female protégé's likelihood of working in STEM upon graduation.

Expectation States Theory

Expectation states theory speaks to the behavioral orientation of males and females. This theory explains how people form and maintain status hierarchies and how these systems regulate inequalities (Berger, 1977; Berger & Zelditch Jr, 1998; Correll & Ridgeway, 2003). Gender is an important status characteristic and is associated with performance expectations; individuals with higher performance expectations are believed to have greater competence and abilities. This competence and ability is a description of an agentic orientation. As a result, it is possible that women who attempt to enact such an assertive role, incongruent with expectations, may be disliked or rejected by others (Reid & Ng, 2006; Ridgeway, 1982; Ridgeway & Berger, 1986; Rudman & Glick, 2001). Gender-based expectations are invoked in contexts in which men and women interact, even when that environment is gender neutral (Dovidio, Heltman, Keating, Brown, & Ellyson, 1988). Women are expected to be likeable and therefore when they are assertive and competent they are resisted and disliked (Reid & Ng, 2006; Ridgeway, 1982; Ridgeway & Berger, 1986; Rudman & Glick, 2001). Expectations states theory explains how gendered expectations can lead to a set of assumptions, not necessarily based on facts.

Task-Oriented and Relationship-Oriented Leadership Theory

Several leadership theories draw the conclusion that men tend toward agency while women tend toward communality (Eagly, 1987; Eagly & Johnson, 1990; Eagly & Karau, 2002; Eagly, Makhijani, & Klonsky, 1992). Task-oriented and relationship-oriented leadership explores this relationship. The theory identifies men as more aggressive and task-oriented; this is often expressed through their goal communication style while women are more relationship-oriented in their approach (Eagly, 1987; Eagly & Johnson, 1990; Eagly & Karau, 2002). Women are known to be more caring in their leadership approach while men are more task-focused (Martell & DeSmet, 2001).

Task-Oriented Leadership. Task-oriented leaders focus on a specific task or a series of tasks or goals (Stogdill & Shartle, 1948). They are less concerned with people's feelings and emotions; to them, the priority exists in the step-by-step solutions needed to accomplish a project or goal. To be a successful task-oriented leader, one must be analytical and take logical steps toward problem solving (Tabernero, Chambel, Curral, & Arana, 2009). Task-oriented leadership depends upon the delegation of activities and time management. When task-oriented leaders are referred to throughout leadership literature they are defined by structure (Hemphill, 1949), production related activities (Blake & Mouton, 1964) and a focus toward goals and achievement (Cartwright & Zander, 1960; Indvik, 1986).

Relationship-Oriented Leadership. Relationship-oriented leaders place greater focus on understanding and meeting the needs of all employees or followers. This involves offering bonuses or mitigating and mediating workplace conflicts. Relationship-oriented leaders prioritize a positive environment where people are motivated; they feel that such an environment will ultimately drive productivity (leading to task completion). The most prominent difference between relationship and task-oriented leaders is that relationship-oriented leaders focus on quality of the interpersonal dynamics they have with their followers, while task-oriented leaders prioritize the goal at hand and steps necessary to achieve it (Bass, 1990). Relationship-oriented leaders are described as considerate (Hemphill, 1949), trusting (Misumi & Peterson, 1985), supporting (Blake & Mouton, 1964) and people-focused (Anderson, 1974).

Leadership Orientation and Mentoring. If we substitute "leader" for "mentor" we can see how this orientation relates to mentoring. Research has found correlations between task-oriented leadership, agency and gender. Similarly, communal orientation and relationship-oriented leadership is associated with being more feminine (Duehr & Bono, 2006). This research is reminiscent of Kram's (1985) two-dimensional model of mentoring functions. It reflects this interpretation of her model in the identification of task and relationship as constructs to describe mentoring behaviors. Leadership theory also supports the approach of a two dimensional mentoring model. It sheds light upon the nature of the mentor's behavior. If task-oriented leadership evokes more masculine behavior and relationship-oriented leadership speaks to more feminine behaviors, it may be hypothesized that male mentors might exhibit more task-oriented mentoring types while females emphasize relationship-oriented mentoring.

The Current Study

Despite the emphasis on increasing women engagement in STEM and despite literature suggesting that women and men have different experiences in STEM fields, it still isn't known whether STEM mentoring for women should be similar to or different than STEM mentoring for men. The current study relates to three phenomenon to enhance our understanding.

1. *Desire* for mentor gender and the gendered mentoring approaches on the part of STEM undergraduates, i.e. what do men and women protégés want or prefer in their mentors' gender?

2. *Assumptions* around mentoring types (by mentors) – what assumptions are made by the mentor about protégé preferences for their gender and their mentoring style?

3. *Effects* - Do mentoring types affect STEM persistence for men and women differently?

This study was not designed to address difference among ethnicities; it was designed to address adequate samples of women. That said, it is of course important to look at the intersection of gender and ethnicity and therefore, when addressing future directions of this research, exploratory analyses will be shared.

A review of the literature allows us to make predictions about the following questions:

Question: 1.

Do male and female protégés desire different types of mentoring?

Hypotheses:

1a. Female protégés desire more relationship-oriented mentoring than task-oriented mentoring.

1b. Male protégés desire more task-oriented mentoring than relationship-oriented mentoring.

Question 2.

Do male and female protégés have a preference for mentor gender?

Hypotheses:

2a. Female protégés will prefer female mentors.

2b. Male protégés will prefer male mentors.

Question 3:

How will the type of mentoring received influence a protégé's likelihood of working in a STEM field?

Hypotheses:

3a. Relationship-oriented mentoring will not be associated with a protégé's likelihood of working in a STEM field for male or female protégés.

3b. Task-oriented mentoring will be associated with a protégés likelihood of working in a STEM field for male and female protégés.

Question 4.

Do male and female mentors have different assumptions about which mentoring type is effective for STEM protégés?

Hypotheses:

4a. Female mentors will emphasize relationship-oriented mentoring.

4b. Male mentors will emphasize task-oriented mentoring.

Methodology

The current dissertation encompasses two studies (Study 1 and Study 2). Study 1 sampled a population of undergraduate STEM students Study 2 sampled a population of STEM faculty mentors. Study 1 addresses research questions 1-3 and Study 2 addresses question 4.

Study 1

Research Design

Study 1 surveyed STEM departments in a large public research university in the fall semester of 2014. The study began with a list of academic disciplines. The National Science Foundation identifies a number of fields of study as STEM, they include: chemistry, computer and information science and engineering, engineering, geosciences, life sciences, materials research, mathematical sciences, physics and astronomy, psychology, and social sciences (nsf.gov). Although NSF identifies psychology and social sciences as STEM disciplines, this study does not include them in the analysis[3]. This study incorporates only the hard sciences. Please see Table 1 in the Appendix for a list of departments included in this research.

Participants

A total of 745 undergraduates participated in Study 1 for an overall response rate of 82 percent. Within the College of Engineering and Applied Sciences, the response rate was 85 percent and within the College of Arts and Sciences the response rate was 79 percent. For a complete list of department-based response rates and enrollments based upon gender, please see Tables 1-3 in the Appendix.

[3] There is continued debate in the field as to whether Psychology and Social Sciences should be considered a STEM discipline and thus whether their data should be aggregated to represent STEM more generally.

Instrumentation

There is little standardization of research questionnaires used for student mentoring relationships (Johnson et al., 2007). Many studies define their own construct and use their own measures.

The Mentoring Functions Questionnaire (MFQ) is an instrument designed to capture distinct functions within a mentoring relationship (Fowler & O'Gorman, 2005). It was employed in this study because it is a broad scale that has been replicated. The original full scale contains 39 items and measures 8 unique types of mentoring, they are: personal and emotional guidance, coaching, advocacy, career development facilitation, role modeling, strategies and systems advice, learning facilitation, and friendship.

In order to gain the cooperation of the departments and the faculty with a survey that could be completed in less than 15 minutes, this study employed a shortened version of the MFQ. In the creation of the original scale, of the 39 questions, 3 items failed to load on any of the 8 types of mentoring (Fowler & O'Gorman, 2005), therefore for our purposes those questions were eliminated. In addition, the function of learning facilitation was omitted as a mentoring type due to its high correlation with coaching in the original creation of the scale (Fowler & O'Gorman, 2005). Friendship had two items and both were included in the final scale; all other mentoring types (6 of them) were represented by three of the original items each. This resulted in a grand total of 20 items representing seven mentoring types. However, in the final analysis two of the seven mentoring types were eliminated based upon student feedback from student focus groups. Strategies and systems advice and advocacy were both eliminated. Students reported confusion about these constructs and had difficulty differentiating them from the other mentoring types. The final mentoring types included for analysis were: role model, friendship, personal and emotional growth, career development and coaching.

Research Procedures

Upon identification of departments and consent by deans and department chairs, classes were identified in order to administer the survey. This research is concerned with successful undergraduate experiences in STEM that lead to a continued persistence to pursue STEM professionally. Therefore, it was the aim of this study to identify the more advanced students within these fields, the students that survived early leaks in the pipeline of STEM success, and to survey them before they reach yet another point in this leaky pipe and enter the workforce. The classes surveyed were identified by department chairs and deans based on the following criteria:

1. The class could not serve as an elective (this would ensure that students in the class were STEM majors)

2. The class had multiple prerequisites (this would indicate advanced standing in the discipline)

3. The class was a “junior” or “senior” level class (i.e. upper level classes, this would mean graduation was imminent)

In order to bolster response rates, surveys were distributed in person. The researcher was a female graduate student that distributed the surveys and then collected upon completion. The researcher visited each class identified for inclusion in the study and with permission granted by the professor, she disseminated surveys at the beginning of each class. There was no time limit to survey completion. On average it took approximately 15 minutes to complete. Those students that chose not to participate simply declined the survey. Upon survey completion, the researcher collected responses and left.

Data Analysis

Factor Analysis. This research focused on the identification of two types of mentoring 1) task-oriented and 2) relationship-oriented. To identify these types a survey was conducted. This survey incorporated items that were expected to represent each of the two mentoring constructs (from the Mentor Functions Questionnaire). These items were embedded in the context of a larger survey that included additional items about undergraduate experiences.

In order to confirm the presence of these two types of mentoring a principal components factor analysis was performed for protégés' identification of the ideal type of mentoring they wish to receive. An additional factor analysis was performed to confirm the presence of these two factors for the types of mentoring protégés are currently receiving from their mentors.

Paired Samples t-test. A paired samples t-test was performed to address Question 1, "Do male and female protégés desire different types of mentoring?" The analysis compared task and relationship-oriented mentoring desired in the male and female conditions.

Chi-square Analysis. A chi-square analysis was performed to address Question 2, "Do male and female protégés have a preference for mentor gender?" Chi-square analyses compared preferences of male and female mentors for male and female participants.

Multiple Regression Analysis. A multiple regression analysis was run to address Question 3, "How does mentoring type received influence a protégé's likelihood of working in a STEM field?" Multiple regression was run to identify which type of mentoring, task or relationship-oriented mentoring, was significantly associated with intention to pursue STEM professionally upon graduation. The regression model was only speaking to the data and the relative impact of the variables included in the model. It was not used to predict the behavior in the real world among all the possible predictor variables; rather its goal was to tease out the relative contributions of two potential variables, to understand theoretically what was meaningful.

Two additional multiple regressions were performed to analyze the same relationship confined first to the female sample and then to the male sample.

Study 1 Results

Factor Analysis for Mentoring Type *Desired* by Protégés

In order to detect the presence of two types of mentoring (among the MFQ items) a principal components factor analysis was performed on 14 items representing 5 types of mentoring from the Mentor Functioning Questionnaire. These items represented the types of mentoring desired by STEM protégés (in an ideal situation). Please see Table 4 in the Appendix, for means, standard deviations and correlations for mentoring type desired individual items. Factor analysis was deemed appropriate because the correlation matrix included several moderate to high values. Therefore an exploratory factor analysis (using principal components analysis) for fourteen items was conducted.

Two factors were extracted based on both the inspection of the scree plot and on only two factors having eigenvalues greater than 1. (The first four Eigenvalues were 6.12, 1.19, .83 and .70). As a result two types of mentoring were confirmed: task-oriented mentoring and relationship-oriented mentoring. The first two unrotated factors accounted for 57 percent of the total variance of the fourteen variables. Varimax-rotated factor loadings are shown in Table 5 (in

Appendix). The first rotated factor had high loadings (>.50) on functions representing task-oriented mentoring and the second rotated factor had high loadings (>.50) on relationship-oriented factors. The identification of two types of mentoring styles is not surprising, but in fact is to be expected. Research analyzing interpersonal styles vis-à-vis impact on others, reveals that two types or ways of relating to others appears consistently. This finding is consistent with Kram's (1985) two-dimensional model (reviewed earlier) and is in alignment with leadership research that identified task and relationship interpersonal styles. As a result two types of mentoring variables were named: task-oriented mentoring and relationship-oriented mentoring. Task-oriented mentoring desired consisted of 9 items (α =. 89) and relationship-oriented mentoring desired consisted of 5 items (α=. 82).

Factor Analysis for Mentoring Type *Received* by Protégés

An additional factor analysis was performed to confirm the presence of these two types of mentoring as it relates to the actual mentoring received (as compared to desired) by STEM protégés (from their current mentors). Please see Table 6 (in Appendix) for means, standard deviations and correlations of individual items. Factor analysis seemed appropriate because again the correlation matrix included several moderate to high values. Therefore an exploratory factor analysis (using principal components analysis) was performed for fourteen items.

Again, two factors were extracted based on both the inspection of the scree plot and on only two factors having eigenvalues greater than 1. (The first four Eigenvalues were 8.38, 1.47, .83 and .46). The first two unrotated factors accounted for 70% of the total variance of the fourteen variables. Varimax-rotated factor loadings are shown in Table 7 (see Appendix). The first rotated factor had high loadings (>.50) on functions representing task-oriented mentoring.

The second rotated factor has high loadings (>.50) on relationship-oriented factors. As expected, this is consistent with Kram's (1985) two-dimensional model. As a result two types of mentoring were created: task-oriented mentoring and relationship-oriented mentoring. Task-oriented mentoring received consisted of 9 items (α =. 94) and relationship-oriented mentoring received consisted of 5 items (α=. 91). Please see Table 8 in the Appendix for means, standard deviations and correlations for task and relationship-oriented mentoring received and task and relationship-oriented mentoring desired.

Paired Samples T-Test

A paired samples t-test was performed to address the first research question of whether male and female protégés desire different types of mentoring.

A paired samples t-test was conducted to compare male protégés' in task-oriented mentoring and relationship-oriented mentoring. There was a significant difference in task-oriented mentoring (M= 5.96, SD= .82) and relationship-oriented mentoring (M 4.82=, SD = 1.15) among male protégés; $t\ (446) = 22.94$, $p <. 001$. There was also a significant difference in task-oriented mentoring (M=6.26, SD = .72) and relationship-oriented mentoring (M=5.35, SD = 1.15) among female protégés; $t\ (275)= 15.24$, $p < .001$. See full Table 9, in Appendix.

Hypotheses 1a and 1b

Hypotheses 1a and 1b were **not** confirmed. Male and female protégés do not desire different types of mentoring.

1a. Female protégés desire more task-oriented mentoring, compared to relationship-oriented mentoring.

1b. Male protégés desire more task-oriented mentoring, compared to relationship-oriented mentoring.

Chi-square Analysis

A chi-square test of independence was performed to examine the relationship between gender of protégé and gender preference of mentor. The relation between these variables was significant, X^2 (2, N = 330) = 143.56, p <. 001. Male protégés preferred male mentors and female protégés preferred female mentors. See Table 10 in Appendix for cross tabulation.

Hypotheses 2a and 2b

Hypotheses 2a and 2b were all confirmed. Male and female protégés have preferences for mentor gender.

2a. Female protégés prefer female mentors.

2b. Male protégés prefer male mentors.

Predictors of Intention to Pursue STEM

For all students, a multiple regression was run to predict intention to work in a STEM field immediately following graduation. Multiple regression analysis was used to test the relationship between two types of mentoring: task-oriented mentoring received and relationship-oriented mentoring received, with intent to work in STEM upon graduation. Intent to work in STEM profession upon graduation was the criterion variable and task and relationship-oriented mentoring were the predictor variables. The analysis was found to be statistically significantly F(2,580) = 7.03, p<. 001, R^2 =. 02, indicating that mentoring types have some effect of intent to work in STEM. These two types of mentoring accounted for 2% of variability in intent to pursue STEM professional. The only variable, however, to add statistical significance was task-oriented mentoring received ($p < .01$). Task-oriented mentoring, as indicated by is β value of .18 was shown to have the strongest relationship to intention to pursue STEM after graduation.

Task-oriented mentoring, for both the males and female condition was statistically significant ($p < .05$). Among male protégés, task-oriented mentoring, as indicated by is β value of .15 was shown to have the strongest relationship to intent to pursue STEM after graduation. Among female protégés, the model also statistically significantly predicted a protégé's desire to work in STEM F (2,230) = 3.70, $p < .05$, $R^2 = .03$. However, among females, the only variable to add significance was task-oriented mentoring ($p < .05$). Task-oriented mentoring, as indicated by is β value of .20 was shown to have the strongest relationship to intention to pursue STEM after graduation. See Table 11 in Appendix.

Hypotheses 3a and 3b

Hypotheses 3a and 3b were confirmed.

3a. Relationship-oriented mentoring does not increase a protégé's likelihood of working in a STEM field for male or female protégés.

3b. Task-oriented mentoring does increase a protégés likelihood of working in a STEM field for both male and female protégés.

Study 2

Research Design

Study 2 surveyed faculty in a large public research university in the fall semester of 2014, data collection occurred simultaneously with Study 1, Study 2 began with the same set of STEM academic disciplines. The same departments included in Study 1 were included in Study 2 (see Table 1 in the Appendix).

Participants

A total of 135 faculty members participated in Study 2, representing a response rate of 45 percent of relevant faculty in the College of Engineering and Applied Science and the College of Arts and Sciences. Faculty from both the College of Engineering and Applied Science and the College of Arts and Sciences were predominantly male (CEAS comprised of 75 percent male and 25 percent female and CAS comprised of 79 percent male and 21 percent female). Please see Table 12 in Appendix for details.

Instrumentation

Please see "Study 1, Instrumentation."

Research Procedures

Upon identification of departments and consent by department chairs, the survey was distributed. The surveys were distributed in two ways. The survey was available electronically via an internal secure link and it was also circulated to all potential faculty participants via campus mailboxes for those that preferred to fill out the survey physically. The faculty survey was shorter than the student survey and on average took between 10 and 15 minutes to complete. No measurable differences were revealed when electronic vs. physical paper surveys were compared. Modality of response did not affect pattern of results observed.

Data Analysis

Independent Samples T-Test. An independent samples t-test was performed to address research Question 4, "Do male and female mentors prioritize different types of mentoring?" The analysis compared task and relationship-oriented mentoring in the male and female conditions.

Study 2 Results

Independent Samples t-test

An independent samples t-test was conducted to compare task and relationship-oriented mentoring in the male and female mentor conditions. In Study 2, task-oriented mentoring consisted of the same 9 items as in Study 1, (α =. 81) and relationship-oriented mentoring consisted of the same 5 items (α =. 80). Sample items include: "A STEM mentor provides professional or technical advice" and "A STEM mentor encourages his or her protégé to discuss personal issues, insecurities and aspirations."

The analysis found no significant difference in task-oriented mentoring for male ($M=5.83$, $SD=.66$) and female ($M=6.02$, $SD = .59$) mentors; $t(117) = -1.38$, $p = .17$. The same conclusion was reached for relationship-oriented mentoring. No significant difference was found between the male ($M=4.61$, $SD = .96$) and female ($M=4.79$, $SD = 1.03$) mentor conditions; $t(117) = -.84$, $p = .40$). See Table 13 in Appendix.

Hypotheses 4a and 4b

Hypotheses 4a and 4b were not confirmed. Male and female mentors do not have different assumptions about which mentoring type is most important for STEM protégés.

4a. Female mentors do not emphasize relationship-oriented mentoring over task-oriented mentoring.

4b. Male mentors do not emphasize task-oriented mentoring over relationship-oriented mentoring.

Discussion

Mentoring is widely acknowledged as key to increasing STEM perseverance, a consensus for which there is solid evidence (Ambrose et al., 2006; Chesler & Chesler, 2002; Downing et al., 2005; Ghosh-Dastidar & Liou-Mark, 2014; Kendricks et al., 2013). STEM programs often emphasize relationship-oriented mentoring when women are in the program; though these programs do not neglect task-oriented mentoring. Relationship-oriented programs purport to appeal to women by emphasizing social connections enabled by STEM work. Relationship-oriented programs tend to focus on social impact or the social benefits of working in STEM fields as part of the program, with an aim toward appealing to women.

This research challenges the conventional wisdom that women need a different style of mentoring. There is a growing emphasis on finding ways to increase the number of women pursuing (and persevering in) STEM fields. STEM programs include mentoring as standard practice in higher education. The goal is to attract and retain women in STEM study. Although the literature suggests that women and men have different experiences in STEM fields, it is not known whether mentoring approaches for women should be similar to or different from mentoring for men. This study explored the critical question of whether, from the perspective of protégés, mentoring should be designed differently to yield optimal impact by gender. The following section considers implications for 1) deployment of mentoring type by preference, 2) practice (i.e. the design of STEM programs as an inclusion program targeting women) and 3) the strategic use of mentor gender by preference. Collectively, the findings are advisory to the design of STEM programs to optimize efficacy for both men and women.

Desire for Mentoring Type

This study found that male and female protégés do not desire different types of mentoring. In fact, they are both in agreement with the type of mentoring that they prefer; both male and female protégés desire more task-oriented mentoring when compared to relationship-oriented mentoring. Regardless of the gender of the protégé, task-oriented mentoring is preferred. This is a curious conclusion, considering the attention given and the literature's focus on attracting females based on a desire to be nurtured and cared for though emotional and psychosocial support. Breaking the gender-role stereotype, this research demonstrates that male and female protégés are not that different from one another in terms of the type of mentoring relationship they desire. However, another interesting finding is that female protégés and female mentors want more mentoring than men.

Implications for Practice: STEM Program Design for Women

The outcomes of this research have practical implications for STEM program design in university settings. Gender-focused STEM programs are aimed at the attraction and retention of female students. To this end, STEM design is focused on the importance of relationships and the social support necessary to guide female students. This research suggests that programs that emphasize relational and personal support as the foundation for effective mentoring may be missing the mark. This research indicates that women in STEM disciplines are not expressing a preference for relationship-oriented mentoring type over task-oriented mentoring. Protégés report that both task and relationship-oriented types are valued, but that task-oriented type mentoring is more important for impact on perseverance. Consequently, institutional leaders should consider designing STEM mentoring programs in a full-spectrum manner, meaning that protégés should be exposed to all types of mentoring rather than based on stereotypical assumptions by gender.

In fact, if programs continue to address women in STEM by employing relationship-oriented types of mentoring, they may be missing the type of mentoring that female protégés themselves prefer, this preference being task-oriented. This research found that gender did not exhibit differences for mentoring type preferred. Male and female protégés agreed on preference for task-oriented mentoring, however, women desired more mentoring overall. If male and female protégés are in agreement with their preference for task-oriented mentoring, then programs aimed specifically at female inclusion may not need to be altered to emphasized one mentor type over another.

Mentor Gender Preference

Male and female students desire the same type of mentoring (i.e., task-oriented mentoring), female protégés prefer to be mentored by female mentors and male protégés prefer to be mentored by male mentors. While it seems STEM students don't differ with regard to the type of mentoring they wish to receive, they do differ in terms of the mentor gender that they prefer. This gender pairing preference is an interesting finding in light of the fact that the types of mentoring these students desire do not differ from one another.

One may only infer as to the cause of this distinction. This may be the result of a feeling of comfort among the same gender. Or perhaps, the students see themselves in their mentors, evoking “similar to me bias” and therefore prefer the same gender as themselves (Baskett, 1973; Griffit & Jackson, 1970; Lin, Dobbins, & Farh, 1992; Peters & Terborg, 1975; Rand & Wexley, 1975). Or this preference may be a reflection of the current emphasis of many STEM programs (in both K-12 and post secondary environments) to employ female gender pairing. The female-to-female mentoring model is so engrained that it may be influencing students’ preferences. There is no way this study can discern the causality of this preference but the distinction is curious given the lack of differentiation of mentoring style.

Pursuing a STEM Career

Results of the study indicate that when compared to the amount of relationship-oriented mentoring received, task-oriented mentoring is significantly correlated to the protégés’ intent to pursue STEM careers. The type of mentoring reported received (not simply desired) was related to protégés’ decision to pursue a STEM career upon graduation. When comparing the types of mentoring that students receive (task-oriented versus relationship-oriented), task-oriented mentoring was significantly correlated to intention to work in a STEM field upon graduation while relationship-oriented mentoring was not. This supports the first finding of this study. Not only are students reporting that they prefer a more task-oriented focus in their mentoring relationships, but those that report receiving this preferred type of mentoring are more likely to report pursuing STEM careers upon graduation. This supports the previous finding that students not only prefer task-oriented mentoring, but when they receive more of it they are more likely to report planning to pursue a STEM career upon graduation.

Mentoring Type Based on Mentor Gender

Should women be mentored differently than men? Both women and men report a preference for task-oriented type mentoring, not to the exclusion of relationship-oriented but rather as a complement to such an approach. So, both men and women bring a practical predilection to yield outcomes from mentoring that will enable them to take a step in the right direction toward a career in STEM.

Do women prefer women mentors? Yes, they do. However, this must be taken in context. Both male and female protégés prefer task-oriented type mentoring relationships. Gender does not dictate approach to mentoring. Programs may want to consider gender preference, for the sake of acquiescence to personal choice, but STEM programs are best delivered by task-orientation type mentoring for both male and female mentors.

Do men want to be mentored by men? Yes, they do. But again, this too must be taken in stride. Male protégés prefer task-oriented type mentoring. So, once again, while STEM programs may select to engage in same-gender-pairing to satisfy a personal choice, this research cannot justify the need to do so on empirical grounds. This research does however indicate the benefits of task-oriented mentoring type regardless of gender pairing.

Do mentors report a preference for one type of mentoring over another? This research found no significant difference between male and female mentors vis-à-vis preferred approach to mentoring. It seems mentors are willing to offer both task-oriented and relationship-oriented styles. This implicates training of mentors given our finding that task-oriented is preferred by both genders. STEM program designers are advised, based on this research to enhance task-oriented mentoring skills and to emphasize them when working with protégés, regardless of gender.

Limitations of the Current Study

The study is founded on self-report. The data reflect recollections of mentors and protégés of the nature of their mentoring relationships. These recollections were based on the year prior to data collection, so memory should be fresh. That said, the research did not engage in direct behavioral observation of mentors.

The research demonstrated that both male and female protégés preferred task-orientations in the mentoring they received. It is worth noting that future research would add value by attempting to measure what constitutes amount of mentoring type preferred. That is, it is difficult to compare thresholds between respondents making it challenging to interpret how much task-orientation (or relationship-orientation) is received. Future research is advised to quantify relationship context so that thresholds between respondents can be better understood.

Generalization to other universities, colleges and educational settings requires analysis. This study was conducted at a public research university. The extent to which it can be generalized to other higher education (and perhaps secondary) settings is a concern. The extent to which the study's findings generalize to other settings, such as liberal arts colleges, private universities or perhaps private business settings, requires research. The same questions exist with respect to the applicability of these results in a K-12 mentoring setting. Again, future research testing gender-oriented mentoring programs in various educational settings is advised.

It should also be noted that this study explored gender as a single, broad, encompassing category. Within each gender exist many ethnicities and each subgroup may have different experiences. This study reports on gender and not student ethnicity or other characteristics, student ethnicity will be explored in directions for future work. Furthermore, gender identity was categorized as male, female or other. Gender identity taxonomy outside the male and female dichotomy was not explored in this research. Participants had the option to choose “other” as a gender identity but no such identification was chosen by any of the respondents.

Response rates in this study require consideration as well. Specifically, there was a difference between the faculty and the student response rate. The faculty response rate was 45 percent and the student response rate was 82 percent. Are students more interested in refining mentoring programs than the faculty? The faculty data therefore may reflect self-selection. It is worth noting however that the faculty response rate is average relative to other studies in the field (Baruch & Holtom, 2008).

Finally, special populations would be an interesting line of research to pursue. For instance, it should be acknowledged that this research does not differentiate extremely gifted and dedicated women from women in general. Future research might consider the exploration of highly gifted or high achieving women as a distinct population. It would be interesting to understand if patterns are different for this population relative to women in general, and comparatively male achievers and the general population of men.

Directions for Future Work

As the current study explained, this research focused on gender identity and its impact on mentoring. However, the exploration of ethnicity is an important next step and avenue for future work. This research grouped ethnicity into two broad categories: underrepresented groups and overrepresented groups. See Table 14 in Appendix for complete breakdown. Overrepresented groups included Caucasian and Asian populations[4] and the underrepresented groups included African Americans and Latinos. 13.5 percent consisted of underrepresented groups and 86.5 percent included overrepresented groups[5].

An independent samples t-test was performed to explain whether underrepresented groups preferred or received different types of mentoring. An independent samples t-test was conducted to compare desired task-oriented mentoring in overrepresented and underrepresented conditions. There was no significant difference in task-oriented mentoring for the overrepresented (M= 6.05, SD= .80) and underrepresented (M 6.14=, SD = .85) conditions; t (636) = .91, p >.05. There was also no significant difference in relationship-oriented mentoring desired for overrepresented (M=5.01, SD = 1.16) and underrepresented (M=5.24, SD = 1.15) conditions; t (636) = 1.68, p > .05.

In addition when analyzing the type of mentoring protégés are receiving, these groups also had no significant difference in the amount of task-oriented mentoring reported received for overrepresented (M=5.05, SD =1.35) and underrepresented (M=4.90, SD = 1.54) conditions; t(500) =-.84, p>.05. The same results were found for the amount of relationship-oriented mentoring received. There was no significant difference in overrepresented (M=4.19, SD=1.64) and underrepresented (M=4.24, SD=1.74) conditions; t(500) = .24, p>.05. Please see Tables 15 and 16 in Appendix.

[4] In this educational environment there was a large Asian population and therefore they were included in the overrepresented group

[5] Please note 107 people are missing from this data. These people either chose not to respond or indicated "other" as a response to their ethnicity.

Beyond further analysis of the intersection of gender and ethnicity, there are four primary avenues for future work. The first is a replication and extension of the current study, paying particular attention to improving faculty response rates and utilizing a behavioral measure of mentoring type. In addition, our dependent variables or outcome measures will benefit from additional measurements, especially those that are behavioral in nature.

The next two avenues of research are both longitudinal in nature, the first from the perspective of the mentor experience and the second from the protégé experience. A deeper exploration into mentoring type dynamics by mentors is necessary. This dissertation does not explore the extent to which a mentor's mentoring type adapts over time and if so, whether that effect varies by gender of mentor and/or protégé. It would be interesting to study the mentoring relationship and its development over time. Does it change? Does gender play a role? For instance, do mentoring relationships change over time and if so, is this adaptation at all linked to genders of the protégés and/or the mentors?

A third avenue for future research would be to explore the protégés' experiences throughout a mentoring experience, on a long-term basis. Studying students in mentoring programs continually, rather than at one point in time would be fascinating to explore as it may reveal the dynamics of the mentoring relationships. It's reasonable to ask the same questions about protégé expectations through mentoring type over time. Does a protégé change their preference for mentoring type during the developmental process? A longitudinal research design measuring mentoring at time one and intent to work in STEM at time two would advance our understanding from a directional perspective. Does the task-oriented mentoring type influence intent to work in STEM?

Finally, this study was interested in exploring mentoring relationships within post-secondary institutions and the implications they have on a student's first job. An important extension of this research is investigation of protégés as they embark upon their careers. Most certainly, whether the protégé in fact acquired a STEM position as a first job. However, it is also essential to understand if these individuals stay within STEM fields or leave them over their careers. If in fact they choose to leave the field, it would be important to understand why. Will they pursue alternative industries? Are they leaving to pursue additional schooling? Or perhaps leave the workforce in general? These questions must be answered over time and within the context of the type of mentoring they receive. A longitudinal study will allow for the understanding of how mentoring affects professionals and especially whether mentoring remains a force in STEM occupational achievement. More than that, it would be advantageous to understand the impact of mentoring over the course of his or her career, as they may continue to be mentored outside the higher education setting.

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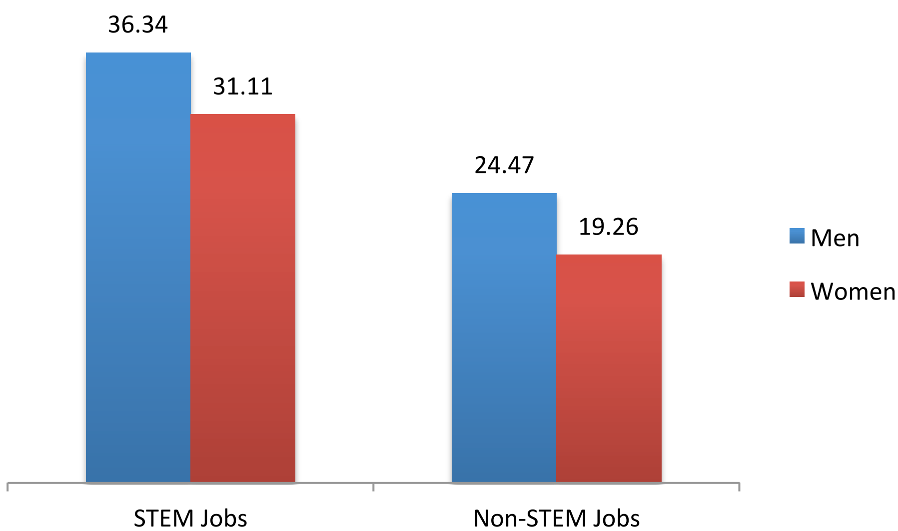
Appendix

Figure 1. Average Hourly Earnings by Gender and Occupation[6]



(Beede, D. et al, 2011, pg. 4)

[6] ESA calculations from American Community Survey public-Us microdata. Estimates are for full-time year-round private wage and salary workers age 16 and over.

Table 1. *List of Departments Included in Studies 1 and 2*
College of Engineering and Applied Sciences
Applied Mathematics & Statistics
Electrical & Computer Engineering
Chemical & Molecular Engineering
Civil Engineering
Mechanical Engineering
Technology & Society
Women in Science and Engineering
College of Arts and Sciences
Biochemistry and Cell Biology
Chemistry
Ecology and Evolution
Pharmacology
Mathematics
Physics and Astronomy
Neurobiology and Behavior

Table 2. *Student Response Rates by Department*

	Response Rate	(N)
Applied Mathematics & Statistics	66%	33
Electrical and Computer Engineering	81%	77
Chemical and Molecular Engineering	96%	24
Mechanical Engineering	78%	117
Technology & Society	90%	18
Civil Engineering	89%	16
Women in Science and Engineering	94%	75
TOTAL CEAS	**85%**	**360**
Biochemistry and Cellular Biology	64%	109
Chemistry	84%	21
Ecology and Evolution	79%	71
Pharmacology	84%	32
Mathematics	80%	32
Physics and Astronomy	72%	54
Neurobiology and Behavior	88%	66
TOTAL CAS	**79%**	**385**
Average Total Response Rate	**82%**	**745**

Table 3. *Male to Female ratio per department based upon Fall 2014 enrollment*

Department	**Male**	**Female**	**Total**
Applied Mathematics & Statistics	66%	34%	463
Electrical & Computer Engineering	91%	9%	233
Chemical & Molecular Engineering	69%	31%	107
Mechanical Engineering	89%	11%	396
Technology & Society	80%	20%	103
Civil Engineering	70%	30%	83
Total CEAS	**81%**	**19%**	**3434**
Biochemistry & Cellular Biology	54%	46%	556
Chemistry	63%	37%	282
Pharmacology	47%	53%	64
Mathematics	73%	27%	402
Physics & Astronomy	86%	14%	311
Total CAS Depts. (Included in study)	**65%**	**35%**	**1615**

Table 4. *Mentoring Type Desired by Protégés*

Individual Items Correlations and Descriptive Statistics (N=745)

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. RM 1	--													
2. FRD 1	.28**	--												
3. PEG 1	.28**	.44**	--											
4. CDF 1	.41**	.17**	.31**	--										
5. COA 1	.46**	.15**	.25**	.54**	--									
6. RM 2	.52**	.16**	.23**	.48**	.57**	--								
7. FRD 2	.31**	.54**	.49**	.30**	.31**	.33**	--							
8. PEG2	.31**	.37**	.51**	.37**	.40**	.32**	.47**	--						
9. CDF 2	.41**	.17**	.27**	.53**	.54**	.54**	.33**	.47**	--					
10. COA2	.46**	.15**	.20**	.56**	.58**	.57**	.29**	.38**	.61**	--				
11. RM 3	.51**	.25**	.30**	.37**	.36**	.39**	.38**	.39**	.37**	.45**	--			
12. CDF 3	.45**	.20**	.22**	.47**	.49**	.49**	.31**	.37**	.57**	.55**	.40**	--		
13. COA 3	.45**	.20**	.20**	.48**	.53**	.50**	.28**	.39**	.61**	.58**	.43**	.56**	--	
14. PEG 3	.29**	.40**	.56**	.26**	.23**	.22**	.50**	.53**	.28**	.22**	.36**	.28**	.30**	--
Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
M	6.04	4.98	4.70	6.07	6.05	6.27	5.26	5.25	6.07	6.13	5.60	6.08	6.13	4.84
SD	1.20	1.53	1.65	1.08	1.06	1.03	1.42	1.47	1.12	1.06	1.31	1.17	1.04	1.65
Range	1-7	1-7	1-7	1-7	1-7	1-7	1-7	1-7	1-7	1-7	1-7	1-7	1-7	1-7

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

Table 5. *Factor Loadings for Principal Factors Extraction and Varimax Rotation – Mentoring Desired*

Item	Factor 1 (Task-Oriented)	Factor 2 (Relationship-Oriented)
Role Model 1	.62	.27
Career Development 1	.69	.21
Coaching 1	.76	.15
Role Model 2	.75	.13
Career Development 2	.77	.20
Coaching 2	.81	.10
Role Model 3	.52	.38
Career Development 3	.73	.18
Coaching 3	.76	.16
Friendship 1	.05	.73
Personal Emotional 1	.13	.79
Friendship 2	.26	.74
Personal Emotional 2	.39	.64
Personal Emotional 3	.18	.77

Table 6. *Mentoring Type Received by Protégés*

Individual Items Correlations and Descriptive Statistics (N=745)

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. RM 1	--													
2. FRD 1	.33**	--												
3. PEG 1	.43**	.67**	--											
4. CDF 1	.52**	.43**	.53**	--										
5. COA 1	.57**	.38**	.44**	.63**	--									
6. RM 2	.69**	.33**	.40**	.57**	.64**	--								
7. FRD 2	.44**	.72**	.68**	.49**	.49**	.49**	--							
8. PEG2	.47**	.57**	.71**	.63**	.56**	.46**	.64**	--						
9. CDF 2	.53**	.39**	.50**	.75**	.62**	.56**	.48**	.65**	--					
10. COA2	.54**	.33**	.44**	.66**	.68**	.61**	.46**	.56**	.72**	--				
11. RM 3	.67**	.40**	.47**	.57**	.60**	.76**	.55**	.55**	.59**	.69**	--			
12. CDF 3	.47**	.46**	.52**	.64**	.56**	.53**	.53**	.60**	.70**	.65**	.57**	--		
13. COA 3	.52**	.40**	.48**	.69**	.67**	.62**	.52**	.61**	.71**	.74**	.66**	.70**	--	
14. PEG 3	.41**	.58**	.74**	.53**	.50**	.43**	.71**	.68**	.52**	.49**	.54**	.55**	.57**	--
Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
M	5.36	3.89	4.07	4.96	5.13	5.41	4.40	4.42	4.79	5.05	5.06	4.50	4.94	4.26
SD	1.54	2.10	1.95	1.66	1.64	1.61	1.90	1.85	1.85	1.72	1.67	1.87	1.75	1.95
Range	1-7	1-7	1-7	1-7	1-7	1-7	1-7	1-7	1-7	1-7	1-7	1-7	1-7	1-7

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

Table 7. *Factor Loadings for Principal Factors Extraction and Varimax Rotation – Mentoring Received*

Item	Factor 1 (Task-Oriented)	Factor 2 (Relationship-Oriented)
Role Model 1	.72	.22
Career Development 1	.72	.30
Coaching 1	.76	.15
Role Model 2	.81	.18
Career Development 2	.76	.35
Coaching 2	.82	.25
Role Model 3	.78	.30
Career Development 3	.66	.44
Coaching 3	.79	.34
Friendship 1	.16	.84
Personal Emotional 1	.29	.84
Friendship 2	.34	.81
Personal Emotional 2	.48	.69
Personal Emotional 3	.36	.78

Table 8. *Correlations and Descriptives for Mentoring types Desired and Received*

Variables	1	2	3	4
Task –oriented mentoring desired	--			
Relationship-oriented mentoring desired	.49**	--		
Task-oriented mentoring received	.29**	.17**	--	
Relationship-oriented mentoring received	.06	.35**	.69**	--
M	6.05	5.00	5.02	4.21
SD	.83	1.18	1.39	1.67
Range	1-7	1-7	1-7	1-7
*$p < .05$. ** $p <.01$. *** $p < .001$.				

Table 9. *Results of paired samples t-test and Descriptives for Desired Mentoring Type by Gender*

	Mentoring Type						95% CI For Mean Difference		
	Task-Oriented			Relationship-Oriented					
	M	SD	N	M	SD	N		t	df
Male Protégés	5.96	.82	447	4.82	1.15	447	1.04, 1.23	22.94***	446
Female Protégés	6.26	.72	276	5.35	1.15	276	.79,1.02	15.24***	275

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

Table 10. *Results of Chi-square Test and Descriptive Statistics for Gender Preference by Protégé Gender*

	Protégé Gender	
Gender Preference	Male	Female
Male	225 (68%)	46 (20%)
Female	48 (15%)	130 (56%)
No preference	57 (17%)	57 (24%)

Note. X^2 = 143.35, df = 2. Numbers in parenthesis indicate column percentages

***p<.001

Table 11. *Summary of Simple Regression for Variables Predicting Intention to Pursue STEM professionally*

	All Protégés			Male Protégés			Female Protégés		
Variable	*B*	*SE B*	β	*B*	*SE B*	β	*B*	*SE B*	β
Task-Oriented Mentoring Received	.14	.04	.18	.12	.06	.15	.15	.07	.20
Relationship-Oriented Mentoring Received	-.03	.04	-.04	-.03	.05	-.04	-.02	.06	-.04
R^2		.02			.02			.03	
F		7.03**			2.78			3.70*	

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

Table 12. *Faculty Response Rates*

College	Male	Female	Response Rate	N
CEAS	75%	25%	65%	88
CAS	79%	21%	32%	43
Missing			3%	4
Total Response Rate			45%	135

Table 13. *Results of t-test and Descriptives for Preferred mentoring Type by Mentor Gender*

	Mentor Gender						95% CI For Mean Difference		
	Male			Female					
	M	SD	N	M	SD	N		t	df
Task-oriented mentoring	5.83	.66	91	6.02	.59	28	-.47, .08	-1.38	117
Relationship-oriented mentoring	4.61	.96	91	4.79	1.03	28	-.59, .24	-.84	117

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

Table 14. *Represented and Underrepresented Populations*

	Percentage	N
Represented	86.5	552
Underrepresented	13.5	86
Total	100	638

Table 15. *Results of t-test and Descriptives for Desired Mentoring Type by Underrepresented and Represented Groups*

	Groups						95% CI For Mean Difference		
	Underrepresented			Represented					
	M	SD	N	M	SD	N		t	df
Task-oriented mentoring	6.14	.85	86	6.05	.80	552	-.10, .27	.91	636
Relationship-oriented mentoring	5.24	1.15	86	5.01	1.16	552	-.04,.49	1.68	636

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

Table 16. *Results of t-test and Descriptives for Mentoring Type Received by Underrepresented and Represented Groups*

	Groups						95% CI For Mean Difference		
	Underrepresented			Represented					
	M	SD	N	M	SD	N		t	df
Task-oriented mentoring	4.90	1.53	70	5.05	1.35	432	-.50, .20	-.84	500
Relationship-oriented mentoring	4.24	1.74	70	4.19	1.64	432	-.37,.47	.24	500

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